Supporting Information

for

Microwave-assisted synthesis of 2-substituted 4,5,6,7-tetrahydro-1,3-thiazepines from 4-aminobutanol

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Experimental procedures and characterization of new compounds
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1. General Information

Chromatography was carried out using Merck Kieselgel 60 (230–400 mesh). Thin layer chromatography was performed on Silica gel and was visualized by UV. Melting points were determined with a Büchi capillary apparatus and are uncorrected. $^1$H and $^{13}$C NMR spectra were recorded on a Bruker Bio Spin Avance III 600 MHz spectrometer or a Bruker Avance II 500 MHz spectrometer, using deuteriochloroform as the solvent. In $^1$H NMR spectra, chemical shifts (ppm) are referenced to residual CHCl$_3$ (7.27 ppm in CDCl$_3$). In $^{13}$C NMR spectra, chemical shifts (ppm) were referenced to the deuterated solvent (77.0 ppm in CDCl$_3$). D$_2$O was employed to confirm exchangeable protons (ex). Splitting multiplicities are reported as singlet (s), broad signal (bs), doublet (d), double doublet (dd), triplet (t), quartet (q), heptet (h) and multiplet (m). HRMS (ESI) were performed with a Bruker MicroTOF-Q II spectrometer. Reagents, solvents and starting materials were purchased from standard sources and purified according to literature procedures.

2. Representative procedures for synthesis

a. General procedure for the synthesis of $N,O$-diacyl-1,4-aminobutanols (1)

A solution of the acyl chloride or anhydride (5 mmol) in anhydrous dichloromethane (5 mL) was added dropwise to a mixture of 1,4-aminobutanol (2.5 mmol), DMAP (0.10 mmol) and 0.7 mL of triethylamine. The reaction mixture was stirred at room temperature until the disappearance of the acid chloride by TLC was observed. For compounds 1l,m the reaction was carried out at reflux for 48 h. After the reaction was completed, dichloromethane was evaporated in vacuo. The crude product was purified by column chromatography (silicagel, hexane/ethyl acetate 3: 2$\rightarrow$1:1).

b. General procedure for the synthesis of $N$-thioacyl-$O$-acyl-1,4-aminobutanols (2)

To a solution of amidoester 1 (2 mmol) in toluene (20 mL) was added LR (0.75 mmol). The mixture was heated at reflux for 30 min. After the reaction is complete, the toluene is evaporated in vacuo. The resulting residue is purified by column chromatography (silicagel, dichloromethane).

c. General procedure for the synthesis of $N$-(4-hydroxybutyl)thioamides (3)

Thioamidoester 2 (1.5 mmol) was placed in a round-bottomed flask and a solution of K$_2$CO$_3$ in water/methanol 1: 1 was added. The mixture was stirred at 70 °C for 30 minutes. After completion of the reaction, as indicated by TLC, the solvent is evaporated in vacuo. For compounds 3l,m the reaction was carried out using 10% NaOH:methanol at reflux for 4h. The mixture obtained is diluted with water (15 mL) and extracted with dichloromethane (3 $\times$ 30 mL). The combined organic phases were washed with water, dried over anhydrous Na$_2$SO$_4$, filtered and concentrated in vacuo. The crude product was purified by column chromatography (silicagel, hexane: ethyl acetate 1: 1$\rightarrow$2: 3)
d. General procedure for the synthesis of 4,5,6,7-tetrahydro-1,3-thiazepines (4)

A mixture of the corresponding compound 3 (1 mmol) and neat PPSE (6 g) was reacted in the microwave reactor (Monowave 300, Anton Paar) at the indicated temperature and time. After reaching room temperature, the resulting oil was treated with ethyl acetate (25 mL) and 10% aqueous NaOH (10 mL). The aqueous phase was extracted with ethyl acetate (2 × 25 mL). The organic phases were pooled, washed with water (5 mL), filtered, dried over Na$_2$SO$_4$ and filtered. The solvent was removed in vacuo. The crude products were purified by column chromatography (silicagel, hexane/ethyl acetate 3:2).
3. Characterization data for compounds 1–6

Compounds 1a, 1b, 1i, 3a, 3j, 4a, 4f were described in the literature.

4-Benzamidobutyl benzoate (1a)

Prepared according to the general procedure, 706.25 mg, 95%. White solid, mp (hexane/CHCl₃): 42-44°C.

**¹H NMR** (600 MHz, CDCl₃) δ 1.71-1.74 (m, 2H), 1.79-1.84 (m, 2H), 3.47-3.50 (m, 2H), 4.31 (t, J=6.5 Hz, 2H), 6.86 (bs ex, 1H), 7.35-7.45 (m, 5H), 7.53 (t, J=7.5 Hz, 1H), 7.77 (d, J=7.2 Hz, 2H), 8.00 (d, J=7.2 Hz, 2H).

**¹³C NMR** (151 MHz, CDCl₃) δ 26.1, 26.15, 39.7, 64.4, 126.8, 128.2, 128.3, 129.4, 130.0, 131.2, 132.8, 134.5, 166.5, 167.6.

**HRMS (ESI):** m/z Calcd. for C₁₈H₂₀NO₃⁺ [M+H⁺]: 298.1438; found: [M+H⁺]: 298.1424.

4-(4-Chlorobenzamido)butyl 4-chlorobenzoate (1b)

Prepared according to the general procedure, 824.0 mg, 90%. White solid, mp (ethyl acetate): 147-148°C.

**¹H NMR** (500 MHz, CDCl₃) δ 1.74-1.80 (m, 2H), 1.84-1.89 (m, 2H), 3.51-3.55 (m, 2H), 4.36 (t, J=6.4 Hz, 2H), 6.26 (bs ex, 1H), 7.39-7.42 (m, 4H), 7.70 (ddd, J=8.7, 2.3, 2.0 Hz, 2H), 7.96 (ddd, J=8.7, 2.3, 2.0 Hz, 2H).

**¹³C NMR** (125 MHz, CDCl₃) δ 26.1, 26.15, 39.7, 64.4, 128.3, 128.6, 128.7, 129.8, 130.9, 132.9, 137.7, 139.4, 165.8, 166.5.

**HRMS (ESI):** m/z Calcd. for C₁₈H₁₈Cl₂NO₃⁺ [M+H⁺]: 366.0658; found: [M+H⁺]: 366.0662.

4-(4-Methylbenzamido)butyl 4-methylbenzoate (1c)

Prepared according to the general procedure, 756.0 mg, 93%. White solid, mp (hexane/CHCl₃): 103-105°C.

**¹H NMR** (500 MHz, CDCl₃) δ 1.75-1.81 (m, 2H), 1.84-1.90 (m, 2H), 2.39 (s, 3H), 2.41 (s, 3H), 3.51-3.55 (m, 2H), 4.35 (t, J=6.4 Hz, 2H), 6.28 (bs ex, 1H), 7.21-7.24 (m, 4H), 7.67 (d, J=8.0 Hz, 2H), 7.91 (d, J=8.0 Hz, 2H).

**¹³C NMR** (125 MHz, CDCl₃) δ 21.4, 21.6, 26.3, 26.4, 39.6, 64.3, 126.8, 127.5, 129.1, 129.2, 129.5, 131.7, 141.7, 143.6, 166.7, 167.5

**HRMS (ESI):** m/z calcd. for C₂₀H₂₂NO₃⁺ [M+H⁺]: 326.1751; found: [M+H⁺]: 326.1756.
4-(4-Methoxybenzamido)butyl 4-methoxybenzoate (1d)

\[
\begin{align*}
\text{H}_3\text{CO} & \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{N} \\
\end{align*}
\]

Prepared according to the general procedure, 849.0 mg, 95%. White solid, mp (isopropanol): 132-134°C.

\(^1\text{H} \text{NMR}\) (500 MHz, CDCl\(_3\)) \(\delta\) 1.74-1.80 (m, 2H), 1.83-1.88 (m, 2H), 3.51-3.54 (m, 2H), 3.84 (s, 3H), 3.86 (s, 3H), 4.32-4.35 (m, 2H), 6.29 (bs ex, 1H), 6.90-6.92 (m, 4H), 7.74 (dd, \(J=8.9, 2.8, 2.1\) Hz, 2H), 8.00 (dd, \(J=8.9, 2.8, 2.1\) Hz, 2H).

\(^{13}\text{C} \text{NMR}\) (125 MHz, CDCl\(_3\)) \(\delta\) 26.38, 26.43, 39.6, 55.36, 55.40, 64.2, 113.6, 113.7, 122.6, 126.8, 128.6, 131.5, 162.1, 163.3, 166.4, 167.1.

HRMS (ESI): m/z calcd. for C\(_{36}\)H\(_{26}\)NO\(_5\)\([M+H]^+\): 358.1649; found: [M+H]\(^+\): 358.1655.

4-(4-Nitrobenzamido)butyl 4-nitrobenzoate (1e)

\[
\begin{align*}
\text{O} & \quad \text{N} \\
& \quad \text{O} \\
\end{align*}
\]

Prepared according to the general procedure, 871.5 mg, 90%. Yellow solid, mp (isopropanol): 130-131°C.

\(^1\text{H} \text{NMR}\) (500 MHz, CDCl\(_3\)) \(\delta\) 1.80-1.86 (m, 2H), 1.90-1.96 (m, 2H), 3.58-3.62 (m, 2H), 4.46 (t, \(J=6.4\) Hz, 2H), 6.33 (bs ex, 1H), 7.94 (d, \(J=8.7\) Hz, 2H), 8.22 (d, \(J=8.9\) Hz, 2H), 8.29-8.31 (m, 4H).

\(^{13}\text{C} \text{NMR}\) (125 MHz, CDCl\(_3\)) \(\delta\) 26.1, 26.1, 39.9, 65.2, 123.5, 123.8, 128.1, 130.7, 135.5, 140.1, 149.5, 150.5, 164.7, 165.6.

HRMS (ESI): m/z Calcd. for C\(_{36}\)H\(_{26}\)N\(_3\)O\(_7\)\([M+H]^+\): 388.1139; found: [M+H]\(^+\): 388.1134.

4-(2,4-Dichlorobenzamido)butyl 2,4-dichlorobenzoate (1f)

\[
\begin{align*}
\text{Cl} & \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{N} \\
\end{align*}
\]

Prepared according to the general procedure, 1022.6 mg, 94%. White solid, mp (ethyl acetate): 100-102°C.

\(^1\text{H} \text{NMR}\) (500 MHz, CDCl\(_3\)) \(\delta\) 1.77-1.82 (m, 2H), 1.86-1.91 (m, 2H), 3.51-3.55 (m, 2H), 4.38 (t, \(J=6.5\) Hz, 2H), 6.36 (bs ex, 1H), 7.27-7.31 (m, 2H), 7.41 (d, \(J=2.0\) Hz, 1H), 7.47 (d, \(J=2.0\) Hz, 1H), 7.61 (d, \(J=8.0\) Hz, 1H), 7.79 (d, \(J=8.0\) Hz, 1H).

\(^{13}\text{C} \text{NMR}\) (125 MHz, CDCl\(_3\)) \(\delta\) 26.1, 26.2, 39.7, 65.2, 127.0, 127.5, 128.4, 130.0, 131.0, 131.2, 131.3, 132.5, 133.4, 134.8, 136.7, 138.3, 164.8, 165.5.

HRMS (ESI): m/z calcd. for C\(_{36}\)H\(_{26}\)Cl\(_2\)N\(_3\)O\(_7\)\([M+H]^+\): 433.9879; found: [M+H]\(^+\): 433.9885.

4-(2-Fluorobenzamido)butyl 2-fluorobenzoate (1g)

\[
\begin{align*}
\text{F} & \quad \text{O} \\
& \quad \text{O} \\
& \quad \text{N} \\
\end{align*}
\]
Prepared according to the general procedure, 800 mg, 96%. White solid, mp (ethyl acetate): 60-62°C

$^1$H NMR (500 MHz, CDCl$_3$) $\delta$: 1.79-1.84 (m, 2H), 1.85-1.92 (m, 2H), 3.56-3.60 (m, 2H), 4.39-4.41 (m, 2H), 6.82 (bs ex, 1H), 7.10-7.16 (m, 2H), 7.20-7.23 (m, 1H), 7.25-7.28 (m, 1H), 7.45-7.49 (m, 1H), 7.50-7.55 (m, 1H), 7.94 (td, $J=7.5$, 1.8 Hz, 1H), 8.10 (td, $J=8.0$, 1.8 Hz, 1H).

$^{13}$C NMR (125 MHz, CDCl$_3$) $\delta$: 26.1, 26.3, 39.6, 64.9, 115.9 (d, $J=25.4$ Hz), 117.0 (d, $J=22.7$ Hz), 118.7 (d, $J=9.1$ Hz), 121.0 (d, $J=10.9$ Hz), 123.9 (d, $J=3.6$ Hz), 124.8 (d, $J=2.7$ Hz), 132.0 (d, $J=3.6$ Hz), 132.1 (d, $J=2.7$ Hz), 133.2 (d, $J=9.1$ Hz), 134.4 (d, $J=9.1$ Hz), 160.5 (d, $J=247.1$ Hz), 162.2 (d, $J=259.8$ Hz), 163.3 (d, $J=2.7$ Hz), 164.5 (d, $J=3.6$ Hz).

HRMS (ESI): m/z Calcd. for C$_{13}$H$_{13}$F$_{3}$NO$_3^+ [M+H]$^+$: 334.1249; found: [M+H]$^+$: 334.1253.

4-(2-Methylbenzamido)butyl 2-methylbenzoate (1h)

Prepared according to the general procedure, 732.2 mg, 90%. White solid, mp (hexane/CHCl$_3$): 100-102°C.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$: 1.76-1.81 (m, 2H), 1.86-1.90 (m, 2H), 2.44 (s, 3H), 2.60 (s, 3H), 3.50-3.54 (m, 2H), 4.35 (t, $J=6.4$ Hz, 2H), 5.89 (bs ex, 1H), 7.18-7.25 (m, 4H), 7.31 (t, $J=7.5$ Hz, 1H), 7.34 (d, $J=7.5$ Hz, 1H), 7.40 (d, $J=7.5$ Hz, 1H), 7.90 (d, $J=8.0$ Hz, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$: 19.7, 21.7, 26.3, 26.5, 39.4, 64.2, 125.7, 126.5, 129.6, 129.8, 130.5, 131.0, 131.7, 132.0, 135.9, 136.5, 140.1, 167.6, 170.2.

HRMS (ESI): m/z calcd. for C$_{26}$H$_{28}$NO$_5^+ [M+H]$^+$: 326.1751; found: [M+H]$^+$: 326.1745.

4-Cinnamamidobutyl cinnamate (II)$_3$

Prepared according to the general procedure, 830.0 mg, 95%. White solid, mp (hexane/ethyl acetate): 103-106°C.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$: 1.69-1.74 (m, 2H), 1.78-1.83 (m, 2H), 3.45-3.49 (m, 2H), 4.25 (t, $J=6.5$ Hz, 2H), 5.90 (bs ex, 1H), 6.42 (d, $J=15.6$ Hz, 1H), 6.44 (d, $J=16$ Hz, 1H), 7.34-7.36 (m, 3H), 7.37-7.40 (m, 3H), 7.48-7.50 (m, 2H), 7.50-7.54 (m, 2H), 7.64 (d, $J=15.6$ Hz, 1H), 7.70 (d, $J=16$ Hz, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$: 26.3, 26.3, 39.3, 64.1, 118.0, 120.6, 127.7, 128.1, 128.8, 128.9, 129.6, 130.3, 134.3, 134.8, 141.0, 144.9, 165.9, 167.0.

HRMS (ESI): m/z calcd. for C$_{22}$H$_{26}$NO$_5^+ [M+H]$^+$: 350.1751; found: [M+H]$^+$: 350.1755.

4-(2-Phenylacetamido)butyl 2-phenylacetate (1j)

Prepared according to the general procedure, 700.0 mg, 86%. White solid, mp (hexane/ethyl acetate): 47-49°C.
1H NMR (600 MHz, CDCl₃) δ 1.43–1.48 (m, 2H), 1.55-1.60 (m, 2H), 3.21 (c, J = 7.0 Hz, 2H), 3.58 (s, 2H), 3.61 (s, 2H), 4.07 (t, J = 6.5 Hz, 2H), 5.40 (bs ex, 1H), 7.26-7.28 (m, 5H), 7.31-7.34 (m, 3H), 7.37–7.39 (m, 2H).

13C NMR (151 MHz, CDCl₃) δ 25.9, 26.0, 39.1, 41.4, 43.8, 64.3, 127.1, 127.4, 128.5, 129.0, 129.2, 129.4, 134.0, 134.9, 170.9, 171.5.


4-Hexanamidobutyl hexanoate (1k)

Prepared according to the general procedure, 499.5 mg, 70%. Colorless oil.

1H NMR (600 MHz, CDCl₃) δ 0.85–0.88 (m, 6H), 1.25-1.33 (m, 8H), 1.52-1.66 (m, 8H), 2.14 (t, J = 7.7 Hz, 2H), 2.25 (t, J = 7.6 Hz, 2H), 3.24-3.27 (m, 2H), 4.05 (t, J = 6.5 Hz, 2H), 5.78 (bs ex, 1H).


4-Isobutyramidobutyl isobutyrate (1l)

Prepared according to the general procedure, 533 mg, 93%. Yellow oil.

1H NMR (600 MHz, CDCl₃) δ 1.14-1.16 (m, 12H), 1.54-1.59 (m, 2H), 1.63-1.68 (m, 2H), 2.33 (s, J = 6.5 Hz, 1H), 2.36 (m, J = 6.5 Hz, 1H), 3.26-3.29 (m, 2H), 4.07 (t, J = 6.5 Hz, 2H), 5.62 (bs ex, 1H).

13C NMR (151 MHz, CDCl₃) δ 18.9, 19.6, 26.1, 26.2, 34.0, 35.6, 38.9, 63.8, 177.0, 177.2.


4-Pivalamidobutyl pivalate (1m)

Prepared according to the general procedure, 533 mg, 77%. Yellow solid, mp (ethyl acetate): 38–40°C.

1H NMR (600 MHz, CDCl₃) δ 1.19 (s, 18 H), 1.54-1.59 (m, 2H), 1.63-1.68 (m, 2H), 2.36-3.29 (m, 2H), 4.07 (t, J = 6.5 Hz, 2H), 5.70 (bs ex, 1H).

13C NMR (151 MHz, CDCl₃) δ 26.1, 26.3, 27.2, 27.6, 38.6, 38.7, 39.1, 63.9, 178.4, 178.6.

HRMS (ESI): m/z calcd. for C₁₆H₂₄NO₃⁺ [M+H]⁺: 258.2064; found: [M+H]⁺: 258.2081.

4-Phenythioamidobutyl benzoate (2a)

Prepared according to the general procedure, 595.4 mg, 95%. Yellow oil.
**1^H NMR** (600 MHz, CDCl₃) δ 1.90-1.97 (m, 4H), 3.92-3.95 (m, 2H), 4.40 (t, J=5.9 Hz, 2H), 7.36-7.39 (m, 2H), 7.43-7.46 (m, 3H), 7.57 (t, J=7.4 Hz, 1H), 7.73-7.74 (m, 3H), 8.05 (d, J=7.3 Hz, 2H).

**13C NMR** (151 MHz, CDCl₃) δ 24.8, 26.4, 26.4, 64.3, 126.6, 128.4, 128.5, 129.5, 130.1, 131.0, 133.0, 141.9, 166.6, 199.5.

**HRMS (ESI):** m/z Calcd. for C₁₉H₂₀NO₃S⁺ [M+H]⁺: 314.1209; found: [M+H]⁺: 314.1215.

**4-(4-Chlorophenylthioamido)butyl 4-chlorobenzoate (2b)**

![Structure](image)

Prepared according to the general procedure, 711.0 mg, 93%. White solid, mp (ethyl acetate): 141-143°C.

**1^H NMR** (500 MHz, CDCl₃) δ 1.90-1.95 (m, 4H), 3.91-3.95 (m, 2H), 4.40 (t, J=6.0 Hz, 2H), 7.36 (ddd, J=8.6, 2.6, 2.0 Hz, 2H), 7.42 (ddd, J=8.6, 2.3, 2.0 Hz, 2H), 7.66 (bs ex, 1H), 7.69 (ddd, J=8.6, 2.6, 2.0 Hz, 2H), 7.98 (ddd, J=8.6, 2.3, 2.0 Hz, 2H).

**13C NMR** (125 MHz, CDCl₃) δ 24.8, 26.4, 26.4, 64.5, 127.9, 128.5, 128.7, 128.8, 131.0, 137.3, 139.6, 140.1, 165.8, 198.0.

**HRMS (ESI):** m/z Calcd. for C₁₉H₁₆Cl₂NO₃S⁺ [M+H]⁺: 382.0430; found: [M+H]⁺: 382.0425.

**4-(4-Methylphenylthioamido)butyl 4-methylbenzoate (2c)**

![Structure](image)

Prepared according to the general procedure, 648.8 mg, 95%. Yellow solid (Hexane/CHCl₃), mp 108-110°C.

**1^H NMR** (500 MHz, CDCl₃) δ 1.88-1.97 (m, 4H), 2.37 (s, 3H), 2.42 (s, 3H), 3.91-3.95 (m, 2H), 4.38 (t, J=6.0 Hz, 2H), 7.17-7.18 (m, 2H), 7.23-7.25 (m, 2H), 7.66 (d, J=8.2 Hz, 2H), 7.70 (bs ex, 1H), 7.93 (d, J=8.2, 2H).

**13C NMR** (125 MHz, CDCl₃) δ 21.3, 21.7, 24.4, 26.5, 46.3, 46.4, 126.6, 127.4, 129.11, 129.12, 129.6, 139.1, 141.6, 143.7, 166.7, 199.2.

**HRMS (ESI):** m/z Calcd. for C₂₀H₂₂NO₃S⁺ [M+H]⁺: 342.1522; found: [M+H]⁺: 342.1530.

**4-(4-Methoxyphenylthioamido)butyl 4-methoxybenzoate (2d)**

![Structure](image)

Prepared according to the general procedure, 694.7 mg, 93%. Yellow solid (ethyl acetate), mp 119-121°C.

**1^H NMR** (500 MHz, CDCl₃) δ 1.87-1.96 (m, 4H), 3.84 (s, 3H), 3.86 (s, 3H), 3.91-3.95 (m, 2H), 4.36 (t, J=6.1 Hz, 2H), 6.87 (d, J=8.9 Hz, 2H), 6.92 (d, J=8.9 Hz, 2H), 7.67 (bs ex, 1H), 7.76 (d, J=8.9 Hz, 2H), 7.99 (d, J=8.9, 2H).

**13C NMR** (125 MHz, CDCl₃) δ 24.9, 26.5, 46.3, 55.42, 55.45, 64.0, 113.6, 113.6, 122.5, 128.4, 131.6, 134.1, 162.1, 163.4, 166.4, 198.2.

**HRMS (ESI):** m/z Calcd. for C₂₀H₂₄NO₄S⁺ [M+H]⁺: 374.1421; found: [M+H]⁺: 374.1425.
4-(4-Nitrophenylthioamido)butyl 4-nitrobenzoate (2e)

Prepared according to the general procedure, 807.0 mg, 100%. Yellow solid, mp (isopropanol): 133-135°C

$^1$H NMR (600 MHz, CDCl$_3$) δ 1.97-2.01 (m, 4H), 3.95-3.97 (m, 2H), 4.47 (t, J=6.0 Hz, 2H), 7.83 (bs ex, 1H), 7.86 (d, J=8.6 Hz, 2H), 8.21-8.23 (m, 4H), 8.29 (d, J=8.7 Hz, 2H).

$^{13}$C NMR (151 MHz, CDCl$_3$) δ 24.6, 26.2, 46.4, 65.1, 123.6, 123.7, 127.6, 130.7, 135.4, 146.9, 148.9, 150.6, 164.7, 197.0.

HRMS (ESI): m/z Calcd. for C$_{18}$H$_{15}$NO$_3$S$^+$ [M+H$^+$]: 404.0911; found: [M+H$^+$]: 404.0905.

4-(2,4-Dichlorophenylthioamido)butyl 2,4-dichlorobenzoate (2f)

Prepared according to the general procedure, 785.0 mg, 87%. Yellow solid, mp (ethyl acetate): 134-136°C

$^1$H NMR (600 MHz, CDCl$_3$) δ 1.90-1.98 (m, 4H), 3.89-3.92 (m, 2H), 4.41 (t, J=5.7 Hz, 2H), 7.26 (dd, J=8.4, 2.0 Hz, 1H), 7.31 (dd, J=8.4, 2.0 Hz, 1H), 7.37 (d, J=2.0 Hz, 1H), 7.47 (d, J=2.0 Hz, 1H), 7.51 (d, J=8.4 Hz, 1H), 7.58 (bs ex, 1H), 7.80 (d, J=8.4 Hz, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) δ 24.6, 26.2, 45.9, 65.1, 127.1, 127.4, 128.3, 129.1, 129.6, 131.0, 131.1, 132.5, 134.7, 135.7, 138.4, 140.3, 164.9, 196.1

HRMS (ESI): m/z Calcd. for C$_{18}$H$_{15}$Cl$_2$NO$_3$S$^+$ [M+H$^+$]: 449.9656; found: [M+H$^+$]: 449.9656.

4-(2-Fluorophenylthioamido)butyl 2-fluorobenzoate (2g)

Prepared according to the general procedure, 629.0 mg, 90%. Yellow oil.

$^1$H NMR (500 MHz, CDCl$_3$) δ 1.91-1.98 (m, 4H), 3.94-3.97 (m, 2H), 4.41 (d, J= 6 Hz, 2H), 7.03-7.08 (m, 1H), 7.18-7.23 (m, 1H), 7.37-7.40 (m, 1H), 7.50-7.5m (m, 1H), 7.94 (td, J=7.5, 1.8 Hz, 1H), 7.96 (bs ex, 1H), 8.10 (td, J=8.0, 1.9 Hz, 1H).

$^{13}$C NMR (125 MHz, CDCl$_3$) δ 24.7, 26.1, 46.4, 64.7, 115.8 (d, J= 23.6 Hz), 116.9 (d, J= 22.5 Hz), 118.7 (d, J= 10.0 Hz), 124.0 (d, J= 3.6 Hz), 124.5 (d, J= 3.6 Hz), 128.1 (d, J= 10.7 Hz), 132.1, 132.2 (d, J= 9.0 Hz), 133.3 (d, J= 1.6 Hz), 134.5 (d, J= 9.0 Hz), 157.6 (d, J= 248.4 Hz), 161.9 (d, J= 259.6 Hz), 164.5 (d, J= 3.6 Hz), 193.6 (d, J= 1.7 Hz).

HRMS (ESI): m/z Calcd. for C$_{18}$H$_{15}$F$_2$NO$_3$S$^+$ [M+H$^+$]: 350.1021; found: [M+H$^+$]: 350.1014.
4-(2-Methylphenylthioamido)butyl 2-methylbenzoate (2h)

\[
\text{\begin{center}
\includegraphics[scale=0.5]{image1}
\end{center}}
\]

Prepared according to the general procedure, 628.0 mg, 92%. White solid (Hexane/CHCl₃), mp 91-93°C.

\( ^1\text{H NMR} \) (500 MHz, CDCl₃) \( \delta \) 1.90–1.93 (m, 4H), 2.37 (s, 3H), 2.59 (s, 3H), 3.88–3.92 (m, 2H), 4.35–4.37 (m, 2H), 7.17–7.20 (m, 2H), 7.23–7.27 (m, 4H), 7.41 (td, \( J = 7.4, 1.2 \) Hz, 2H), 7.46 (bs ex, 1H), 7.90 (d, \( J = 7.4, 2H \)).

\( ^{13}\text{C NMR} \) (125 MHz, CDCl₃) \( \delta \) 19.3, 21.7, 24.9, 26.4, 45.4, 64.0, 125.7, 125.9, 126.5, 128.9, 129.5, 130.5, 130.7, 131.7, 132.0, 132.8, 143.9, 167.5, 201.9.

HRMS (ESI): \( m/z \) Calcd. for C₂₀H₂₂NO₂S⁺ [M+H]⁺: 342.1522; found: [M+H]⁺: 342.1525.

4-((E)-3-Phenylprop-2-enethioamido)butyl cinnamate (2i)

\[
\text{\begin{center}
\includegraphics[scale=0.5]{image2}
\end{center}}
\]

Prepared according to the general procedure, 694.4 mg, 95%. White solid, mp (hexane/ethyl acetate): 122-125°C. This compound was obtained as inseparable mixture of E/Z diastereoisomers. Only the major isomer is reported.

\( ^1\text{H NMR} \) (600 MHz, CDCl₃) \( \delta \) 1.81–1.90 (m, 4H), 3.89–3.92 (m, 2H), 4.29 (t, \( J = 6.0 \) Hz, 2H), 6.47 (d, \( J = 16.0 \), 1H), 6.86 (d, \( J = 15.3 \) Hz, 1H), 7.35–7.37 (m, 3H), 7.39–7.41 (m, 3H), 7.52–7.57 (m, 4H), 7.57 (bs ex, 1H), 7.71 (d, \( J = 16 \) Hz, 1H), 7.82 (d, \( J = 15.3 \) Hz, 1H).

\( ^{13}\text{C NMR} \) (151 MHz, CDCl₃) \( \delta \) 24.8, 26.5, 45.6, 63.9, 117.8, 127.6, 128.0, 128.1, 128.85, 128.89, 129.8, 130.4, 134.3, 134.9, 141.6, 145.1, 167.1, 194.9.


4-(2-Phenylethanethioamido)butyl 2-phenylacetate (2j)

\[
\text{\begin{center}
\includegraphics[scale=0.5]{image3}
\end{center}}
\]

Prepared according to the general procedure, 546.0 mg, 80%. Yellow oil.

\( ^1\text{H NMR} \) (600 MHz, CDCl₃) \( \delta \) 1.55–1.57 (m, 4H), 3.60–3.62 (m, 4H)*, 4.06 (t, \( J = 6.0 \) Hz, 2H), 4.13 (s, 2H), 6.99 (bs ex, 1H), 7.25–7.27 (m, 5H), 7.30–7.40 (m, 5H).

\( ^{13}\text{C NMR} \) (151 MHz, CDCl₃) \( \delta \) 24.3, 25.9, 41.4, 45.5, 53.2, 64.1, 127.1, 127.9, 128.6, 129.2, 129.3, 129.5, 134.0, 134.8, 171.5, 202.1.

HRMS (ESI): \( m/z \) Calcd. for C₂₀H₂₂NO₂S⁺ [M+H]⁺: 342.1522; found: [M+H]⁺: 342.1527.

*overlapping signals

4-Hexanethioamidobutyl hexanoate (2k)

\[
\text{\begin{center}
\includegraphics[scale=0.5]{image4}
\end{center}}
\]

S10
Prepared according to the general procedure, 603.0 mg, 100%. Yellow oil.

$1^H$ NMR (600 MHz, CDCl$_3$) δ 0.88–0.91 (m, 6H), 1.27-1.38 (m, 8H), 1.60-1.65 (m, 2H), 1.70-1.79 (m, 6H), 2.30 (t, $J = 7.6$ Hz, 2H), 2.64 (t, $J = 7.7$ Hz, 2H), 3.69-3.73 (m, 2H), 4.11 (t, $J = 6.0$ Hz, 2H), 7.37 (bs ex, 1H).

$1^C$ NMR (151 MHz, CDCl$_3$) δ 13.87, 13.90, 22.3, 22.4, 24.5, 24.6, 26.2, 29.1, 31.1, 31.3, 34.3, 45.5, 47.3, 63.5, 174.0, 205.9.

HRMS (ESI): m/z calcd. for C$_{18}$H$_{22}$NO$_3$S$^+$ [M+H]$^+$: 302.2148; found: [M+H]$^+$: 302.2154.

4-(2-Methylpropanethioamido)butyl isobutyrate (2I)

Prepared according to the general procedure, 417.0 mg, 85%. Yellow oil.

$1^H$ NMR (600 MHz, CDCl$_3$) δ 1.15 (d, $J = 7.0$ Hz, 6H), 1.25 (d, $J = 6.6$ Hz, 6H), 1.70-1.75 (m, 4H), 2.54 (h, $J = 7.0$ Hz, 1H), 2.80 (h, $J = 6.6$ Hz,1H), 3.70-3.73 (m, 2H), 4.09-4.11 (m, 2H), 7.40 (bs ex, 1H).

$1^C$ NMR (151 MHz, CDCl$_3$) δ 18.9, 22.6, 24.5, 26.2, 34.0, 44.5, 45.2, 63.6, 177.2, 211.7.

HRMS (ESI): m/z calcd. for C$_{18}$H$_{22}$NO$_3$S$^+$ [M+H]$^+$: 246.1522; found: [M+H]$^+$: 246.1526.

4-(2,2-Dimethylpropanethioamido)butyl pivalate (2m)

Prepared according to the general procedure, 475 mg, 87%. White solid, mp (Hexane/ CHCl$_3$): 35-47°C.

$1^H$ NMR (600 MHz, CDCl$_3$) δ 1.20 (s, 9 H), 1.35 (s, 9 H), 1.69-1.73 (m, 4H), 3.71-3.74 (m, 2H), 4.10 (t, $J = 6.2$ Hz, 2H), 5.70 (bs ex, 1H).

$1^C$ NMR (151 MHz, CDCl$_3$) δ 24.5, 26.2, 27.2, 30.1, 38.7, 44.5, 45.8, 63.6, 178.6, 213.46.

HRMS (ESI): m/z calcd. for C$_{18}$H$_{22}$NO$_3$S$^+$ [M+H]$^+$: 274.1835; found: [M+H]$^+$: 274.1841.

$N$-(4-Hydroxybutyl)benzothioamide (3a)$^a$

Prepared according to the general procedure, 298.0 mg, 95%. White solid (Hexane/ CHCl$_3$), mp 61-62°C.

$1^H$ NMR (600 MHz, CDCl$_3$) δ 1.70-1.74 (m, 2H), 1.82 (bs ex, 1H), 1.86-1.91 (m, 2H), 3.74 (t, $J = 6.0$ Hz, 2H), 3.83-3.87 (m, 2H), 7.36-7.38 (m, 2H), 7.43-7.46 (m, 1H), 7.75 (d, $J = 7.3$ Hz, 2H) , 8.32 (bs ex, 1H).

4-Chloro-$N$-(4-hydroxybutyl)benzothioamide (3b)

Prepared according to the general procedure, 318.0 mg, 87%. White solid (Hexane/ CHCl$_3$), mp 89-90°C.
**1H NMR** (500 MHz, CDCl₃) δ 1.69-1.74 (m, 2H), 1.86-1.91 (m, 2H), 1.97 (bs ex, 1H), 3.73 (t, J= 6.0 Hz, 2H), 3.79-3.83 (m, 2H), 7.33 (ddd, J=8.6, 2.6, 2.0 Hz, 2H), 7.70 (ddd, J=8.6, 2.6, 2.0 Hz, 2H), 8.50 (bs ex, 1H).

**13C NMR** (125 MHz, CDCl₃) δ 24.7, 29.6, 46.9, 62.2, 128.1, 128.5, 137.1, 139.9, 197.2

**HRMS (ESI):** m/z Calcd. for C₁₃H₁₈ClNOS⁺ [M+H]⁺: 244.0557; found: [M+H]⁺: 244.0561.

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**N-(4-Hydroxybutyl)-4-methylbenzothioamide (3c)**

![Chemical Structure]

Prepared according to the general procedure, 274.0 mg, 82%. Yellow oil.

**1H NMR** (500 MHz, CDCl₃) δ 1.71-1.76 (m, 2H), 1.90-1.93 (m, 2H), 2.38 (s, 3H), 3.76 (t, J= 6.0 Hz, 2H), 3.85-3.88 (m, 2H), 7.18 (d, J=8.1 Hz, 2H), 7.68 (d, J=8.1 Hz, 2H), 8.20 (bs ex, 1H).

**13C NMR** (125 MHz, CDCl₃) δ 21.3, 24.7, 29.7, 46.6, 62.3, 126.7, 129.1, 139.0, 141.5, 198.7

**HRMS (ESI):** m/z Calcd. for C₁₂H₁₅NOS⁺ [M+H]⁺: 224.1104; found: [M+H]⁺: 224.1111.

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**N-(4-Hydroxybutyl)-4-methoxybenzothioamide (3d)**

![Chemical Structure]

Prepared according to the general procedure, 312.0 mg, 87%. Yellow oil.

**1H NMR** (500 MHz, CDCl₃) δ 1.70-1.75 (m, 2H), 1.85 (bs ex, 1H), 1.86-1.92 (m, 2H), 3.75 (m, J=6.0 Hz, 2H), 3.84-3.87 (m, 5H), 6.87 (ddd, J=8.8, 3.1, 2.0 Hz, 2H), 7.78 (ddd, J=8.8, 3.1, 2.0 Hz, 2H), 8.19 (bs ex, 1H).

**13C NMR** (125 MHz, CDCl₃) δ 24.7, 29.7, 46.6, 55.4, 62.3, 113.5, 128.5, 134.1, 162.0, 197.7

**HRMS (ESI):** m/z Calcd. for C₁₂H₁₆NO₂S⁺ [M+H]⁺: 244.1053; found: [M+H]⁺: 244.1059.

*Overlapping signals*

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**N-(4-Hydroxybutyl)-4-nitrobenzothioamide (3e)**

![Chemical Structure]

Prepared according to the general procedure, 347.3 mg, 91%. Yellow oil.

**1H NMR** (500 MHz, CDCl₃) δ 1.70 (bs ex, 1H) 1.76-1.81 (m, 2H), 1.93-1.98 (m, 2H), 3.80 (t, J=5.8 Hz, 2H), 3.84-3.87 (m, 2H), 7.91 (ddd, J=8.6, 2.5, 1.9 Hz, 2H), 8.22 (ddd, J=8.6, 2.5, 1.9 Hz, 2H), 8.76 (bs ex, 1H).

**13C NMR** (125 MHz, CDCl₃) δ 24.7, 29.5, 47.2, 62.4, 123.6, 127.8, 146.9, 148.8, 196.0

**HRMS (ESI):** m/z Calcd. for C₁₂H₁₃N₂O₃S⁺ [M+H]⁺: 255.0798; found: [M+H]⁺: 255.0793.

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**2,4-Dichloro-N-(4-hydroxybutyl)benzothioamide (3f)**

![Chemical Structure]

Prepared according to the general procedure, 408.9 mg, 98%. Yellow oil.

**1H NMR** (600 MHz, CDCl₃) δ 1.69-1.74 (m, 3H)*, 1.86-1.90 (m, 2H), 3.72 (t, J=6.0 Hz, 2H), 3.82-3.85 (m, 2H), 7.26 (dd, J=8.3, 2 Hz; 1H), 7.38 (d, J=8.3 Hz, 1H), 7.49 (d, J=2.0 Hz, 1H), 8.11 (bs ex, 1H).

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*S* overlapping signals
**1^H NMR** (500 MHz, CDCl₃) δ 1.69-1.74 (m, 3H)*, 1.86-1.92 (m, 2H), 3.74 (t, J=6.1 Hz, 2H), 3.88-3.91 (m, 2H), 7.05-7.09 (m, 1H), 7.18-7.22 (m, 1H), 7.37-7.42 (m, 1H), 8.08 (td, J=8.0, 1.8 Hz, 1H), 8.33 (bs ex, 1H).

**1^3C NMR** (125 MHz, CDCl₃) δ 19.4, 24.6, 29.7, 45.8, 62.20, 126.0, 126.5, 128.9, 130.7, 132.9, 144.0, 201.5.


*overlapping signals

**2-Fluoro-N-(4-hydroxybutyl)benzothioamide (3g)**

Prepared according to the general procedure, 307 mg, 90%. Pale yellow oil.

**1^H NMR** (500 MHz, CDCl₃) δ 1.69-1.74 (m, 3H)*, 1.86-1.92 (m, 2H), 3.74 (t, J=6.1 Hz, 2H), 3.88-3.91 (m, 2H), 7.05-7.09 (m, 1H), 7.18-7.22 (m, 1H), 7.37-7.42 (m, 1H), 8.08 (td, J=8.0, 1.8 Hz, 1H), 8.33 (bs ex, 1H).

**1^3C NMR** (125 MHz, CDCl₃) δ 24.5, 29.6, 46.7, 62.2, 115.8 (d, J=23.5 Hz), 124.5 (d, J=3.3 Hz), 128.4 (d, J=10.9 Hz), 132.2 (d, J=9 Hz), 133.2 (d, J=1.6 Hz), 156.6 (d, J=248.6 Hz), 193.3.


*overlapping signals

**N-(4-Hydroxybutyl)-2-methylbenzothioamide (3h)**

Prepared according to the general procedure, 278 mg, 83%. Yellow oil.

**1^H NMR** (500 MHz, CDCl₃) δ 1.69-1.74 (m, 2H), 1.84-1.90 (m, 2H), 2.38 (s, 3H), 3.73 (t, J=6.0 Hz, 2H), 3.83-3.87 (m, 2H), 7.18 (d, J=7.5, 2H), 7.23-7.27 (m, 3H), 7.76 (bs ex, 1H).

**1^3C NMR** (125 MHz, CDCl₃) δ 19.4, 24.6, 29.7, 45.8, 62.20, 126.0, 126.5, 128.9, 130.7, 132.9, 144.0, 201.5.


**(E)-N-(4-Hydroxybutyl)-3-phenylprop-2-enethioamide (3i)**

Prepared according to the general procedure, 282 mg, 80%. Yellow solid (Hexane/ CHCl₃), mp 80-83°C

This compound was obtained as inseparable mixture of E/Z diastereoisomers. Only the major isomer is reported.

**1^H NMR** (600 MHz, CDCl₃) δ 1.68-1.72 (m, 2H), 1.83-1.88 (m, 3H)*, 3.74 (t, J=6 Hz, 2H), 3.81-3.84 (m, 2H), 6.84 (d, J=16 Hz, 1H), 7.34-7.37 (m, 4H), 7.52-7.53 (m, 2H), 7.80 (d, J=16 Hz, 1H), 8.09 (bs ex, 1H).

**1^3C NMR** (151 MHz, CDCl₃) δ 24.8, 29.7, 45.8, 62.2, 127.7, 128.0, 128.8, 129.7, 134.9, 141.3, 194.3.


*overlapping signals
N-(4-Hydroxybutyl)-2-phenylethanethioamide (3j)

Prepared according to the general procedure, 268 mg, 80%. Yellow oil.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 1.47 (bs ex, 1H), 1.51-1.55 (m, 2H), 1.65-1.69 (m, 2H), 3.58 (t, $J$ = 6.0 Hz, 2H), 3.64-3.67 (m, 2H), 4.13 (s, 2H), 7.26 (d, $J$ = 7.1 Hz, 2H), 7.32-7.34 (m, 1H), 7.37-7.39 (m, 2H), 7.56 (bs ex, 1H).

N-(4-Hydroxybutyl)hexanethioamide (3k)

Prepared according to the general procedure, 284.0 mg, 93%. Yellow oil.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 0.88 (t, $J$ = 7.1 Hz, 2H), 1.26-1.34 (m, 4H), 1.63-1.67 (m, 2H), 1.73-1.80 (m, 4H), 2.27 (bs ex, 1H) 2.62 (t, $J$ = 7.7 Hz, 2H), 2.78-2.79 (m, 2H), 3.65-3.69 (m, 2H), 3.70 (t, $J$ = 6.0 Hz, 2H), 8.00 (bs ex, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 13.9, 22.3, 24.5, 29.0, 29.5, 31.0, 45.8, 47.1, 62.1, 205.4.

HRMS (ESI): m/z Calcd. for C$_{10}$H$_{22}$NOS$^+$ [M+H]$^+$: 204.1417; found: [M+H]$^+$: 204.1421.

N-(4-Hydroxybutyl)-2-methylpropanethioamide (3l)

Prepared according to the general procedure, 187 mg, 71%. White solid (hexane/CHCl$_3$ crystallized): 44-46°C.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 1.22 (d, $J$ = 6.7 Hz, 6H), 1.62-1.66 (m, 2H), 1.75-1.80 (m, 2H), 2.46 (bs ex, 1H), 2.81 (h, $J$ = 6.7 Hz, 1H), 3.65-3.70 (m, 4H), 8.04 (bs ex, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 22.4, 24.4, 29.5, 44.3, 45.5, 62.0, 211.1.

HRMS (ESI): m/z Calcd. for C$_{8}$H$_{18}$NOS$^+$ [M+H]$^+$: 176.1104; found: [M+H]$^+$: 176.1106.

N-(4-Hydroxybutyl)-2,2-dimethylpropanethioamide (3m)

Prepared according to the general procedure, 252 mg, 89%. Yellow oil.

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 1.34 (s, 9H), 1.63-1.67 (m, 2H), 1.77-1.82 (m, 2H), 2.09 (bs ex, 1H), 3.68-3.72 (m, 4H), 7.88 (bs ex, 1H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 24.3, 29.5, 30.0, 44.4, 46.2, 62.0, 213.1.

HRMS (ESI): m/z Calcd. for C$_{9}$H$_{20}$NOS$^+$ [M+H]$^+$: 190.1260; found: [M+H]$^+$: 190.1251.
2-Phenyl-4,5,6,7-tetrahydro-1,3-thiazepine (4a) 

Prepared according to the general procedure, 139.0 mg, 73%. Colorless oil.

\[ \text{H NMR (600 MHz, CDCl}_3 \text{) } \delta 1.89-1.92 (m, 2H), 2.07-2.11 (m, 2H), 2.91-2.93 (m, 2H), 4.07-4.09 (m, 2H), 7.37-7.39 (m, 2H), 7.43 (t, } J = 7.3 \text{ Hz, 1H), 7.95 (d, } J = 7.8 \text{ Hz, 2H).} \]

\[ \text{C NMR (151 MHz, CDCl}_3 \text{) } \delta 25.6, 28.0, 30.9, 53.8, 128.1, 128.5, 130.5, 139.8, 163.8.} \]

HRMS (ESI): m/z calcd. for C\textsubscript{16}H\textsubscript{16}NS\textsuperscript{+} [M+H\textsuperscript{+}]: 237.0692; found: 237.0700.

2-(4-Chlorophenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4b)

Prepared according to the general procedure, 185 mg, 82%. Yellow oil.

\[ \text{H NMR (500 MHz, CDCl}_3 \text{) } \delta 1.87-1.92 (m, 2H), 2.06-2.11 (m, 2H), 2.91-2.93 (m, 2H), 4.05-4.07 (m, 2H), 7.35 (dd, } J = 8.6, 2.5, 1.8 \text{ Hz, 2H), 7.91 (ddd, } J = 8.6, 2.5, 1.8 \text{ Hz, 2H).} \]

HRMS (ESI): m/z calcd. for C\textsubscript{17}H\textsubscript{17}ClNS\textsuperscript{+} [M+H\textsuperscript{+}]: 275.0692; found: 275.0692.

2-(4-Methylphenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4c)

Prepared according to the general procedure, 147.8 mg, 72%. Yellow oil.

\[ \text{H NMR (300 MHz, CDCl}_3 \text{) } \delta 1.85-1.93 (m, 2H), 2.04-2.11 (m, 2H), 2.38 (s, 3H), 2.88-2.92 (m, 2H), 4.03-4.07 (m, 2H), 7.18 (d, } J = 8.1 \text{ Hz, 2H), 7.85 (ddd, } J = 8.1 \text{ Hz, 2H).} \]

HRMS (ESI): m/z calcd. for C\textsubscript{16}H\textsubscript{15}NS\textsuperscript{+} [M+H\textsuperscript{+}]: 277.0842; found: 277.0845.

2-(4-Methoxyphenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4d)

OCH\textsubscript{3}

Prepared according to the general procedure, 177.1 mg, 80%. Colorless oil.

\[ \text{H NMR (500 MHz, CDCl}_3 \text{) } \delta 1.85-1.89 (m, 2H), 2.03-2.08 (m, 2H), 2.87-2.89 (m, 2H), 3.83 (s, 3H), 4.01-4.03 (m, 2H), 6.88 (ddd, } J = 8.9, 2.9, 2.0 \text{ Hz, 2H), 7.91 (ddd, } J = 8.9, 2.9, 2.0 \text{ Hz, 2H).} \]

HRMS (ESI): m/z calcd. for C\textsubscript{16}H\textsubscript{16}O\textsubscript{2}NS\textsuperscript{+} [M+H\textsuperscript{+}]: 279.0842; found: 279.0845.

2-(4-Nitrophenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4e)

NO\textsubscript{2}

Prepared according to the general procedure, 153.6 mg, 65%. Yellow solid, mp (hexane/CHCl\textsubscript{3} crystallized): 89-91°C.

\[ \text{H NMR (500 MHz, CDCl}_3 \text{) } \delta 1.90-1.96 (m, 2H), 2.09-2.14 (m, 2H), 2.95-2.97 (m, 2H), 4.11-4.14 (m, 2H), 8.12 (ddd, } J = 9.0, 2.3, 2.0 \text{ Hz, 2H), 8.22 (ddd, } J = 9.0, 2.3, 2.0 \text{ Hz, 2H).} \]

HRMS (ESI): m/z calcd. for C\textsubscript{16}H\textsubscript{12}N\textsubscript{2}O\textsubscript{2}S\textsuperscript{+} [M+H\textsuperscript{+}]: 315.0700; found: 315.0700.
2-(2,4-Dichlorophenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4f)

Prepared according to the general procedure, 182.0 mg, 70%. Pale yellow oil.

\[ ^1H \text{ NMR} \] (500 MHz, CDCl$_3$) $\delta$ 1.90-1.94 (m, 2H), 2.16-2.20 (m, 2H), 2.94-2.96 (t, 2H), 4.04-4.06 (m, 2H), 7.23 (dd, $J=8.3$, 1.5 Hz; 1H), 7.26 (d, $J=8.3$ Hz, 1H), 7.39 (d, $J=1.5$ Hz, 1H).

\[ ^13C \text{ NMR} \] (125 MHz, CDCl$_3$) $\delta$ 25.6, 28.3, 31.8, 53.5, 127.0, 129.7, 130.4, 132.8, 135.2, 138.6, 161.5.

HRMS (ESI): m/z calcd. for C$_{11}$H$_7$Cl$_2$NS$^+$ [M+H]$^+$: 260.0062; found: 260.0058.

2-(2-Fluorophenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4g)

Prepared according to the general procedure, 134.0 mg, 64%. Pale yellow oil.

\[ ^1H \text{ NMR} \] (500 MHz, CDCl$_3$) $\delta$ 1.91-1.95 (m, 2H), 2.14-2.18 (m, 2H), 2.95-2.97 (m, 2H), 4.09-4.11 (m, 2H), 7.07-7.10 (m, 1H), 7.13-7.15 (m, 1H), 7.33-7.37 (m, 1H), 7.52 (td, $J=7.5$, 1.7 Hz, 1H).

\[ ^13C \text{ NMR} \] (125 MHz, CDCl$_3$) $\delta$ 25.5, 28.1, 31.4, 53.4, 116.1 (d, $J=22.0$ Hz), 123.8 (d, $J=3.7$ Hz), 129.0 (d, $J=10.5$ Hz), 130.3 (d, $J=2.4$ Hz), 131.1 (d, $J=8.5$ Hz), 159.8 (d, $J=251.6$ Hz), 160.4.


2-(2-Methylphenyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4h)

Prepared according to the general procedure, 133.5 mg, 65%. Colorless oil.

\[ ^1H \text{ NMR} \] (500 MHz, CDCl$_3$) $\delta$ 1.96-2.01 (m, 2H), 2.18-2.22 (m, 2H), 2.44 (s, 3H), 2.99-3.01 (m, 2H), 4.06-4.08 (m, 2H), 7.17-7.20 (m, 2H), 7.23-7.26 (m, 1H), 7.17-7.20 (m, 2H), 7.35-7.37 (m, 1H).

\[ ^13C \text{ NMR} \] (125 MHz, CDCl$_3$) $\delta$ 19.8, 26.2, 28.0, 31.4, 52.7, 125.5, 128.5, 129.0, 130.6, 135.5, 140.5, 164.6.

HRMS (ESI): m/z calcd. for C$_{12}$H$_{16}$NS$^+$ [M+H]$^+$: 206.0998; found: 206.1000.

(E)-2-Styril-4,5,6,7-tetrahydro-1,3-thiazepine (4i)

Prepared according to the general procedure, 141.2 mg, 65%. Colorless oil.

\[ ^1H \text{ NMR} \] (600 MHz, CDCl$_3$) $\delta$ 1.79-1.83 (m, 2H), 2.02-2.06 (m, 2H), 2.79-2.81 (m, 2H), 4.01-4.03 (m, 2H), 6.88 (d, $J=16$ Hz, 1H), 7.30-7.32 (m, 1H), 7.35-7.37 (m, 2H), 7.50 (d, $J=7.5$ Hz, 2H), 7.54 (d, $J=16$ Hz, 1H).

\[ ^13C \text{ NMR} \] (151 MHz, CDCl$_3$) $\delta$ 25.6, 28.5, 30.7, 53.7, 127.5, 128.7, 129.0, 130.5, 135.8, 138.8, 163.5.

HRMS (ESI): m/z calcd. for C$_{12}$H$_{16}$NS$^+$ [M+H]$^+$: 218.0998; found: 218.0991.

2-Benzyl-4,5,6,7-tetrahydro-1,3-thiazepine (4j)

Prepared according to the general procedure, 154 mg, 75%. Colorless oil.

\[ ^1H \text{ NMR} \] (600 MHz, CDCl$_3$) $\delta$ 1.79-1.83 (m, 2H), 1.91-1.95 (m, 2H), 2.68-2.70 (m, 2H), 3.72 (s, 2H), 3.85-3.87 (m, 2H), 7.24-7.33 (5H, m).

\[ ^13C \text{ NMR} \] (151 MHz, CDCl$_3$) $\delta$ 25.8, 28.0, 30.5, 49.7, 52.4, 126.7, 128.4, 129.1, 136.7, 164.8.

HRMS (ESI): m/z calcd. for C$_{13}$H$_{18}$NS$^+$ [M+H]$^+$: 206.0998; found: 206.1003.
2-Pentyl-4,5,6,7-tetrahydro-1,3-thiazepine (4k)
Prepared according to the general procedure, 148.3 mg, 80%. Colorless oil.

^1H NMR (600 MHz, CDCl₃) δ 0.88-0.90 (m, 3H), 1.28-1.35 (m, 4H), 1.60-1.67 (m, 2H), 1.78-1.83 (m, 2H), 1.98-2.02 (m, 2H), 2.38 (t, J=7.7 Hz, 2H), 2.78-2.79 (m, 2H), 3.79-3.81 (m, 2H).

^13C NMR (151 MHz, CDCl₃) δ 14.0, 22.4, 26.0, 27.3, 28.0, 30.3, 31.3, 43.4, 52.2, 166.5.

HRMS (ESI): m/z calcd. for C₂₀H₂₀NS⁺ [M+H]⁺: 186.1311; found: 186.1307.

2-Isopropyl-4,5,6,7-tetrahydro-1,3-thiazepine (4l)
Prepared according to the general procedure, 149.4 mg, 95%. Colorless oil.

^1H NMR (600 MHz, CDCl₃) δ 1.16 (d, J=6.9 Hz, 6H), 1.71-1.75 (m, 2H), 1.95-1.99 (m, 2H), 2.60 (h, J=6.9 Hz, 1H), 2.74-2.76 (m, 2H), 3.81-3.83 (m, 2H).

^13C NMR (151 MHz, CDCl₃) δ 20.5, 25.7, 28.0, 30.2, 41.5, 52.3, 171.6.

HRMS (ESI): m/z calcd. for C₁₆H₁₆NS⁺ [M+H]⁺: 158.0998; found: 158.1051.

2-(tert-Butyl)-4,5,6,7-tetrahydro-1,3-thiazepine (4m)
Prepared according to the general procedure, 68.5 mg, 40%. Colorless oil.

^1H NMR (600 MHz, CDCl₃) δ 1.20 (s, 9H), 1.71-1.75 (m, 2H), 1.91-1.95 (m, 2H), 2.67-2.69 (m, 2H), 3.83-3.85 (m, 2H).

^13C NMR (151 MHz, CDCl₃) δ 25.3, 28.0, 28.2, 30.3, 43.1, 52.8, 173.9.

4. Copies of $^1$H and $^{13}$C NMR spectra of compounds 1–4

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1a

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 1a

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 1b
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 1b
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 1c

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 1c
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 1d

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 1d
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 1e

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 1e
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 1f

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 1f
$^{1}\text{H NMR (500 MHz, CDCl}_3\text{)}$ spectrum of compound $1g$

$^{13}\text{C NMR (125 MHz, CDCl}_3\text{)}$ spectrum of compound $1g$
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1h

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 1h
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1i

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 1i
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1j

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 1j
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1k

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 1k

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 1l
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 11
$\text{H NMR (600 MHz, CDCl}_3\text{) spectrum of compound 1m}$

$\text{13C NMR (151 MHz, CDCl}_3\text{) spectrum of compound 1m}$
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2a

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2a
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 2b

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 2b
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 2c

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 2c
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 2d

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 2d
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2e

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2e
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound $2f$

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound $2f$
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 2g

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 2g
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 2h

$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 2h
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2i

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2i
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2j

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2j
$^{1}$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2k

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2k
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2l

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2l
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 2m

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 2m
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3a

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3b
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 3b

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3c
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 3c

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3d
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 3d

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3e
\(^{13}\)C NMR (125 MHz, CDCl\(_3\)) spectrum of compound 3e

\(^1\)H NMR (600 MHz, CDCl\(_3\)) spectrum of compound 3f
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 3f

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3g
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 3g

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 3h
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 3h

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3i
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 3i

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3j
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3k

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 3k
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3l

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 3l
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 3m

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 3m
$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 4a

$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 4a
NOESY spectrum of compound 4a

HSQC spectrum of compound 4a
HMBC spectrum of compound 4a

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 4b
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 4b

$^{1}$H NMR (300 MHz, CDCl$_3$) spectrum of compound 4c

$^{13}$C NMR (75 MHz, CDCl$_3$) spectrum of compound 4c
$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 4d

Chemical Shift (ppm)
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 4d

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 4e
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 4e

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 4f
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound $4f$

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound $4g$
$^{13}$C NMR (125 MHz, CDCl$_3$) spectrum of compound 4g

$^1$H NMR (500 MHz, CDCl$_3$) spectrum of compound 4h
\(^{13}\)C NMR (125 MHz, CDCl\(_3\)) spectrum of compound 4h

\(^1\)H NMR (600 MHz, CDCl\(_3\)) spectrum of compound 4i
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 4i

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 4j
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound $4j$

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound $4k$
Compound 4k underwent partial decomposition after purification.

$^1$H NMR (600 MHz, CDCl$_3$) spectrum of compound 4l
$^{13}$C NMR (151 MHz, CDCl₃) spectrum of compound 4l

$^1$H NMR (600 MHz, CDCl₃) spectrum of compound 4m
$^{13}$C NMR (151 MHz, CDCl$_3$) spectrum of compound 4m
5. References


