Supporting information

Scalable Electrochemical Oxidant- and Metal-Free Dehydrogenative Coupling of S-H/N-H

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General Information

All materials were purchased from general merchants. The instrument for electrolysis is dual display potentiostat (RXN-1503D) (China). Cyclic voltammograms were obtained on a CHI 660 potentiostat. ^{1}H NMR and ^{13}C NMR were recorded at a Bruker Avance Ⅲ HD spectrometer (Bremen, Germany) at 400 MHz for ^{1}H NMR and 100 MHz for ^{13}C NMR with $CDCl_3$ and DMSO-d_6 as the solvent and TMS as the internal standard. High resolution mass spectra (HRMS) were measured on an Agilent 1290-6540 mass spectrometer (Santa Clara, USA). Low resolution mass spectra (LRMS) were recorded under an electron ionization (EI) conditions by using a Shimadzu GCMS-QP2010 Plus mass spectrometer (Kyoto, Japan). The melting points of the products were determined by an X-4 micro-melting point apparatus (Beijing, China). Electron paramagnetic resonance (EPR) spectra were recorded on a Bruker A300-10/12 EPR spectrometer.

General procedure for small scale electrolysis

With no precautions to exclude air or moisture, a 25 mL sealed glass tube was charged with a stir bar, *tetra*-butylammonium tetrafluoroborate ($Bu_4N\bullet BF_4$) (0.50 mmol, 164.5 mg), thiols (0.3mmol, 1.0 equiv.), amine (3.0 mmol, 10 equiv.) and MeCN (5 mL). The Ni foam anode (area: 2 cm^2) and Ni foam cathode (area: 2 cm^2) were inserted to this solution, and the reaction mixture was electrolyzed at a constant current of 5 mA under room temperature for 6 h. The reaction was monitored by TLC. When the reaction was finished, the reaction mixture was transferred to a 25 mL flask and the solvent was removed in vacuo. The residue was subjected to flash column chromatography on silica gel to afford products **3a-3t**.

Procedure for gram scale electrolysis

To a 3 L glass tank were added 2-mercaptobenzothiazole (0.24 mol, 40.08 g, 1 equiv.), $Bu_4N\bullet BF_4$ (0.4 mol, 131.60 g), tert-Butylamine (2.4 mol, 177.60 g, 258 mL, 10 equiv.) and MeCN (4 L). Ni foam anode (area: 280 cm^2) and Ni foam cathode (area: 280 cm^2) were inserted to this solution and electrolysis was conducted at a constant current (250 mA). The electrolysis was stopped after 22 h. The reaction mixture was analyzed by HPLC and the product was obtained in 95% yield. The solution was transferred to a round bottom flask and concentrated in vacuo. The solvent MeCN was recycled by rotovap for future use. The resulting residue was passed through a short silicagel plug (hexanes : EtOAc = 3:1) to remove the electrolyte; the filtrate was concentrated in vacuo. The crude material was purified by flash column chromatography (hexanes : EtOAc = 10 : 1) to afford the desired product **3a** in 94% yield.

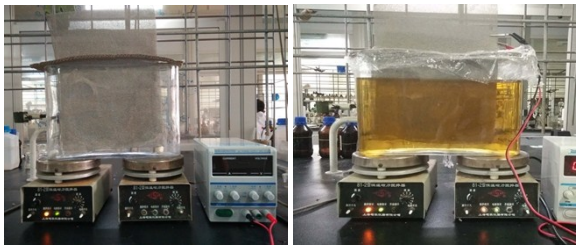


Figure S1. A 50-gram synthesis of **3a**.

General procedure for cyclic voltammetry (CV)

Cyclic voltammographs of 0.012 M **1a, 2m** in CH_3CN with 0.1 M $Bu_4N\bullet BF_4$, glassy carbon working electrode, platinum counter electrode, and an Ag/AgCl reference electrode under nitrogen at room temperature. The scan rate is 100 mV/s, ranging from 0 V to 1.8 V.

Free radical trapping experiments

1. Free radical trapping of **1a** with DMPO

A reaction tube equipped with a stir bar was loaded with **1a** (0.30 mmol), $Bu_4N\bullet BF_4$ (0.5 mmol) and DMPO (68 μL) in 5.0 mL CH_3CN. The Ni foam anode (area: 2 cm^2) and Ni foam cathode (area: 2 cm^2) were inserted to this solution, and the reaction mixture was electrolyzed at a constant current of 5 mA under room temperature for 2 h. After electrolysis, the reaction mixture sample was analyzed by HMRS. After electrolysis, the reaction mixture sample was analyzed by HMRS. An adduct of thiyl radical from **1a** with DMPO was detected by HRMS analysis (Figure S2). HRMS (ESI): m/z calcd for $C_{13}H_{15}N_2OS_2$ $[M]^+$, 279.0620; found, 279.0617. The HRMS result suggested that a thiyl radical might be involved in this electrochemical transformation.

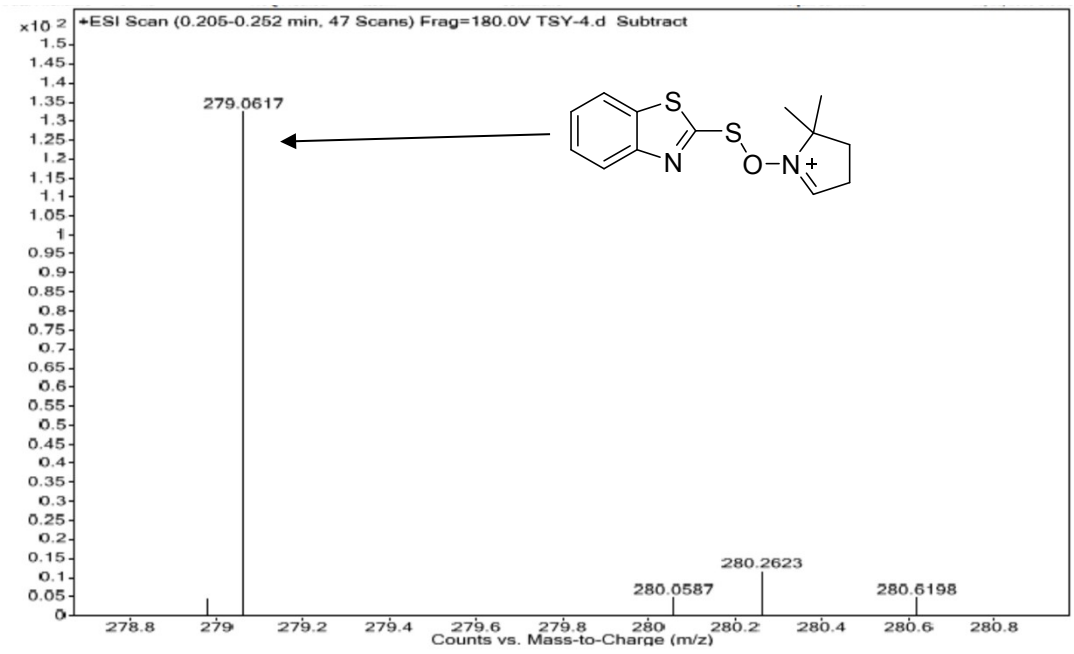


Figure S2. HRMS analysis of the adduct of thiol radical from **1a** with DMPO

2. Free radical trapping of **2m** with DMPO

A reaction tube equipped with a stir bar was loaded with **2m** (3 mmol), $Bu_4N\bullet BF_4$ (0.5 mmol) and DMPO (68 μL) in 5.0 mL CH_3CN. The Ni foam anode (area: 2 cm^2) and Ni foam cathode (area: 2 cm^2) were inserted to this solution, and the reaction mixture was electrolyzed at a constant current of 5 mA under room temperature for 2 h. After electrolysis, the reaction mixture sample was analyzed by HMRS. After electrolysis, the reaction mixture sample was analyzed. An adduct of nitrogen radical from **2m** with DMPO was detected by HRMS analysis (Figure S3). HRMS (ESI): m/z

calcd for $C_{13}H_{19}N_2O$ $[M]^+$, 219.1492; found, 219.1494. The HRMS result suggested that a nitrogen radical might be involved in this electrochemical transformation.

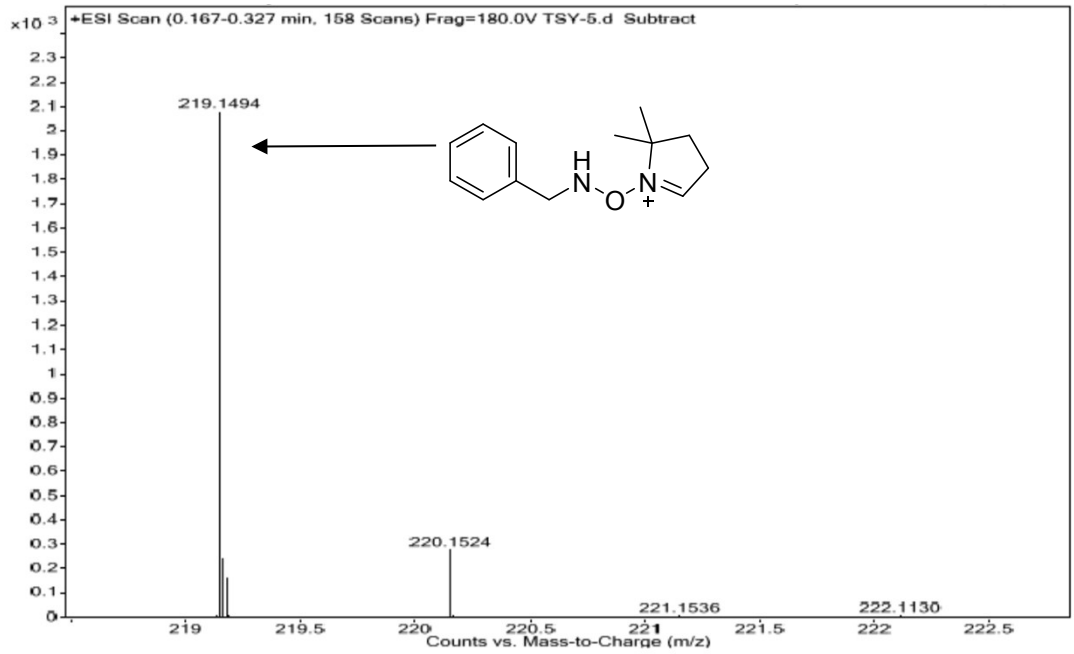
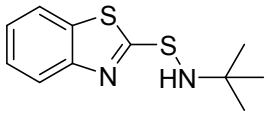
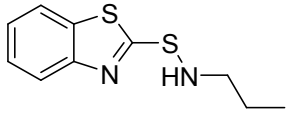


Figure S3. HRMS analysis of the adduct of nitrogen radical from **2m** with DMPO.

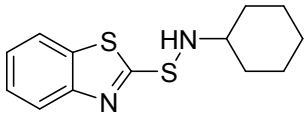
Characterization Data of all products



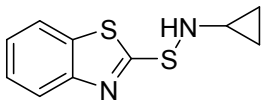
N-tert-Butyl-2-benzothiazolesulfenamide (3a)[1]**.** White solid (67.9 mg, 95% yield) (hexane : EtOAc = 10 : 1 as eluent). 105-106 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.82-7.74 (m, 2H), 7.41-7.35 (m, 1H), 7.28-7.22 (m, 1H), 3.42 (s, 1H), 1.28 (s, 9H).^{13}C NMR (100 MHz, $CDCl_3$), δ = 181.14, 155.14, 134.94, 125.78, 123.45, 121.48, 120.93, 55.55, 29.04. LRMS (EI): m/z calcd for $C_{11}H_{14}N_2S_2$ $[M]^+$, 238; found, 238.



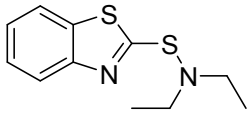
***N*-propyl-2-benzothiazolesulfenamide (3b)**[1]**.** Light yellow oil (63.9 mg, 95% yield) (hexane: EtOAc = 10:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.77-7.69 (m, 2H), 7.35-7.29 (m, 1H), 7.21-7.16 (m, 1H), 3.23 (t, *J* = 5.4 Hz, 1H), 3.07-2.97 (m, 2H), 1.63-1.52 (m, 2H), 0.90 (t, *J* = 7.4 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ = 178.69, 154.96, 135.02, 125.88, 123.63, 121.57, 121.07, 54.87, 23.80, 11.28. LRMS (EI): m/z calcd for $C_{10}H_{12}N_2S_2$ $[M]^+$, 224; found, 224.



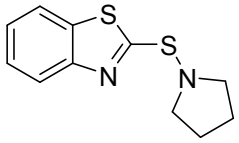
***N*-cyclohexyl-2-benzothiazolesulfenamide (3c)**[1]**.** White solid (57.8 mg, 73% yield) (hexane: EtOAc = 10 : 1 as eluent). 98-100 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.75-7.66 (m, 2H), 7.32-7.26 (m, 1H), 7.19-7.13 (m, 1H), 3.19 (d, *J* = 5.5 Hz, 1H), 2.86-2.72 (m, 1H), 2.03-1.92 (m, 2H), 1.73-1.59 (m, 2H), 1.56-1.47 (m, 1H), 1.21-1.07 (m, 5H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 180.06, 155.11, 134.99, 125.82, 123.53, 121.51, 121.00, 60.29, 33.73, 25.64, 24.90. LRMS (EI): m/z calcd for $C_{13}H_{16}N_2S_2$ $[M]^+$, 264; found, 264.



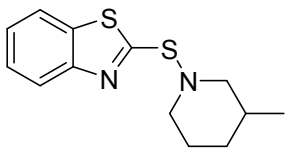
N-cyclopropyl-2-benzothiazolesulfenamide (3d). Colorless oil (40.0 mg, 51% yield) (hexane : EtOAc = 10 : 1 as eluent). ^{1}H NMR (400 MHz, DMSO) δ = 8.00 (d, *J* = 7.9 Hz, 1H), 7.77 (d, *J* = 8.1 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 1H), 7.32 (t, *J* = 7.6 Hz, 1H), 6.09 (s, 1H), 2.79-2.70 (m, 1H), 0.66-0.52 (m, 4H). ^{13}C NMR (100 MHz, DMSO) δ = 179.90, 155.04, 134.76, 126.55, 124.15, 122.15, 121.49, 33.55, 8.36. HRMS (ESI) m/z calcd for $C_{10}H_{10}N_2S_2$ $[M+H]^+$: 223.0358, found 223.0357.



***N*,*N*-diethyl-2-Benzothiazolesulfenamide (3e)**[1]**.** Light yellow oil (60.0 mg, 84% yield) (hexane: EtOAc = 10:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.83-7.73 (m, 2H), 7.40-7.34 (m, 1H), 7.27-7.21 (m, 1H), 3.15 (q, *J* = 7.1 Hz, 4H), 1.25 (t, *J* = 7.1 Hz, 6H).^{13}C NMR (100 MHz, $CDCl_3$) δ = 179.21, 155.21, 135.03, 125.79, 123.50, 121.50, 120.93, 52.50, 13.51. LRMS (EI) m/z calcd for $C_{11}H_{14}N_2S_2[M]^+$: 238, found 238.

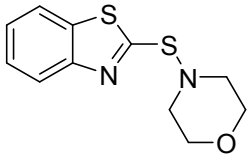


2-(1-pyrrolidinylthio)-Benzothiazole (3f). Colorless oil (61.6 mg, 87% yield) (hexane: EtOAc = 10:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.76-7.68 (m, 2H), 7.33-7.28 (m, 1H), 7.21-7.15 (m, 1H), 3.26 (t, *J* = 6.5 Hz, 4H), 1.94-1.82 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.14, 154.12, 134.00, 124.74, 122.52, 120.54, 119.96, 54.67, 25.17. HRMS (ESI) m/z calcd for $C_{11}H_{12}N_2S_2[M+H]^+$: 237.0515, found 237.0516.

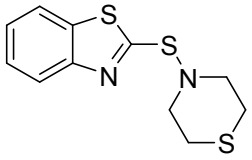


2-[(3-methyl-1-piperidinyl)thio]-Benzothiazole (3g)[1]**.** Light yellow oil (55.5 mg, 70% yield) (hexane: EtOAc = 10:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.84-

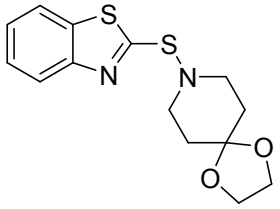
7.77 (m, 2H), 7.41-7.36 (m, 1H), 7.29-7.23 (m, 1H), 3.33-3.21 (m, 2H), 3.12-3.00 (m, 1H), 2.76 (t, *J* = 11.0 Hz, 1H), 1.92-1.82 (m, 1H), 1.81-1.70 (m, 3H), 1.05-0.93 (m, 1H), 0.91 (d, *J* = 6.7 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.39, 155.21, 135.12, 125.68, 123.46, 121.56, 120.89, 64.81, 57.37, 32.58, 31.56, 26.60, 19.14. LRMS (EI) m/z calcd for $C_{13}H_{16}N_2S_2[M]^+$: 264, found 264.



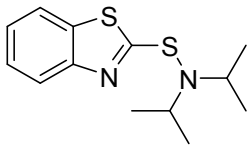
2-(4-morpholinylthio)-Benzothiazole (3h)[1]**.** White solid (65.0 mg, 86% yield) (hexane: EtOAc = 10:1 as eluent). 80-82 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.80-7.71 (m, 2H), 7.37-7.31 (m, 1H), 7.25-7.19 (m, 1H), 3.76(t, *J* = 4.7 Hz, 4H), 3.22 (t, *J* = 4.7 Hz, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.86, 155.05, 135.02, 126.01, 123.95, 121.89, 121.05, 67.90, 56.59. LRMS (EI) m/z calcd for $C_{11}H_{12}N_2OS_2[M]^+$: 252, found 252.



2-(4-thiomorpholinylthio)-Benzothiazole (3i)[1]**.** White solid (74.8 mg, 93% yield) (hexane : EtOAc = 10 : 1 as eluent). 63-65 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.86-7.77 (m, 2H), 7.44-7.37 (m, 1H), 7.31-7.25 (m, 1H), 3.55 (t, *J* = 4.9 Hz, 4H), 2.79 (t, *J* = 5.0 Hz, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 175.75, 155.18, 135.02, 126.00, 123.90, 121.87, 121.06, 58.65, 28.58. LRMS (EI) m/z calcd. for $C_{11}H_{12}N_2S_3$ $[M]^+$: 268, found 268.

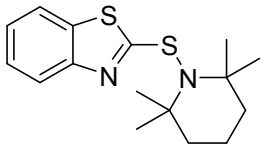


8-(2-benzothiazolylthio)-1,4-Dioxa-8-azaspiro[4.5]decane (3j)[1]**.** White solid (134.0 mg, 69% yield) (hexane: EtOAc = 10:1 as eluent). 109-111 °C.^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.85-7.76 (m, 2H), 7.50-7.32 (m, 1H), 7.33-7.19 (m, 1H), 3.97 (s, 4H), 3.38 (t, *J* = 5.6 Hz, 4H), 1.89 (t, *J* = 5.6 Hz, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.83, 155.29, 135.20, 125.86, 123.68, 121.75, 121.04, 105.82, 64.42, 55.22, 36.13. LRMS (EI) m/z calcd for $C_{14}H_{16}N_2O_2S_2$ $[M]^+$: 308, found 308.

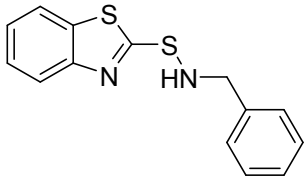


***N*,*N*-bis(1-methylethyl)-2-Benzothiazolesulfenamide (3k)**[1]**.** White solid (16.0 mg, 20% yield) (hexane: EtOAc = 10:1 as eluent). 56-58 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.81-7.72 (m, 2H), 7.40-7.33 (m, 1H), 7.28-7.20 (m, 1H), 3.51-3.41(m, 2H), 1.26

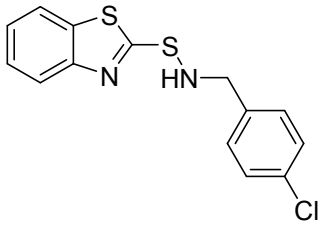
(d, J = 6.5 Hz, 12H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.28, 155.11, 134.77, 125.75, 123.39, 121.38, 120.85, 55.71, 22.50, 21.69. LRMS (EI) m/z calcd for $C_{13}H_{18}N_2S_2[M]^+$: 266, found 266.



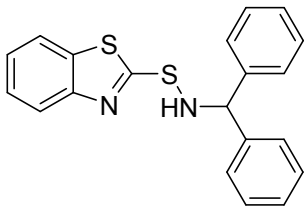
2-[(2,2,6,6-tetramethyl-1-piperidinyl)thio]-Benzothiazole (3l)[1]**.** White solid (18.0 mg, 20% yield) (hexane: EtOAc = 10:1 as eluent). 135-137 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.74-7.64 (m, 2H), 7.34-7.27 (m, 1H), 7.20-7.14 (m, 1H), 1.77-1.60 (m, 5H), 1.54-1.43 (m, 1H), 1.34 (s, 6H), 1.20 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.21, 154.56, 134.63, 125.74, 123.36, 121.37, 120.76, 61.09, 40.76, 32.52, 24.90, 17.30. LRMS (EI) m/z calcd for $C_{16}H_{22}N_2S_2[M]^+$: 306, found 306.



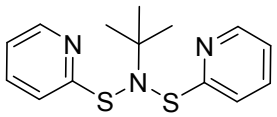
***N*-(phenylmethyl)-2-Benzothiazolesulfenamide (3m)** [1]**.** White solid (74.3 mg, 91% yield) (hexane: EtOAc = 10:1 as eluent).117-119 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.80-7.72 (m, 2H), 7.38-7.27 (m, 5H), 7.28-7.19 (m, 2H), 4.20 (d, J = 6.0 Hz, 2H), 3.49 (t, J = 5.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.39, 154.83, 138.49, 135.04, 128.76, 128.48, 128.03, 125.98, 123.81, 121.67, 121.16, 57.08. LRMS (EI) m/z calcd for $C_{14}H_{12}N_2S_2[M]^+$: 272, found 272.



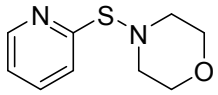
***N*-[(4-chlorophenyl)methyl]-2-Benzothiazolesulfenamide(3n).** White solid (38.6 mg, 42% yield) (hexane: EtOAc = 10:1 as eluent). 116-117 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.87-7.79 (m, 2H), 7.45-7.39 (m, 1H), 7.35 (s, 4H), 7.32-7.27 (m, 1H), 4.25 (d, J = 5.8 Hz, 2H), 3.60 (t, J = 5.7 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.47, 154.67, 136.86, 135.01, 133.85, 129.87, 128.88, 126.04, 123.92, 121.71, 121.17, 56.18. HRMS (ESI) m/z calcd for $C_{14}H_{11}ClN_2S_2$ $[M+H]^+$: 307.0125, found 307.0126.



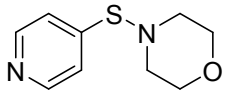
***N*-[bis(phenyl)-methyl]-2-Benzothiazolesulfenamide (3o).** White solid (46.0 mg, 44% yield) (hexane: EtOAc = 10:1 as eluent). 138-140 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.80-7.72 (m, 2H), 7.38-7.27 (m, 8H), 7.25-7.16 (m, 4H), 5.35 (d, *J* = 5.6 Hz, 1H), 4.00 (d, *J* = 5.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.20, 154.57, 141.80, 135.12, 128.74, 127.88, 127.75, 126.00, 123.88, 121.71, 121.18, 69.11. HRMS (ESI) m/z calcd for $C_{20}H_{17}N_2S_2$ $[M+H]^+$: 349.0828, found 349.0829.



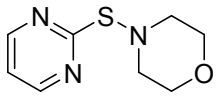
***N*-(1,1-dimethylethyl)-*N*-(2-pyridinylthio)-2-Pyridinesulfenamide (3p).** White solid (48.9 mg, 56% yield) (hexane: EtOAc = 10:1 as eluent). 110-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.48-8.40 (m, 2H), 7.67-7.59 (m, 2H), 7.45 (d, *J* = 8.1 Hz, 2H), 7.02-6.94(m, 2H), 1.42 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 164.80, 149.30, 136.45, 119.64, 118.10, 67.07, 29.62. HRMS (ESI) m/z calcd for $C_{14}H_{17}N_3S_2$[M+H]$^+$: 292.0937, found 292.0939.



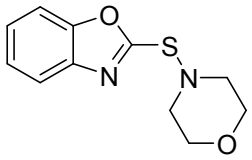
4-(2-pyridinylthio)-Morpholine (3q). Light yellow oil (36.5 mg, 62% yield) (hexane: EtOAc = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.40-8.29 (m, 1H), 7.57-7.51 (m, 1H), 7.38 (d, *J* = 8.1 Hz, 1H), 6.96-6.86 (m, 1H), 3.70 (t, *J* = 4.8 Hz, 4H), 3.18(t, *J* = 4.8 Hz, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 164.21, 149.45, 136.56, 119.57, 118.11, 67.95, 56.17. HRMS (ESI) m/z calcd for $C_9H_{12}N_2OS$ $[M+H]^+$:197.0743, found 197.0744.



4-(4-pyridinylthio)-Morpholine (3r). Colorless oil (35.9 mg, 61% yield) (hexane: EtOAc = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.45-8.40 (m, 2H), 7.23-7.20 (m, 2H), 3.82-3.75 (m, 4H), 3.12-3.06 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.27, 149.32, 117.03, 77.36, 77.04, 76.72, 67.75, 56.19. HRMS (ESI) m/z calcd for $C_9H_{12}N_2OS$ $[M+H]^+$:197.0743, found 197.0744.



4-(2-pyrimidinylthio)-Morpholine (3s). White solid(49.0 mg, 83% yield) (hexane: EtOAc = 3:1 as eluent). 57-58 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.46 (d, *J* = 4.8 Hz, 2H), 6.88 (t, *J* = 4.9 Hz, 1H), 3.75 (s, 4H), 2.65 (s, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.81, 157.04, 116.77, 57.06, 29.08. HRMS (ESI) m/z calcd for $C_8H_{11}N_3OS$ $[M+H]^+$:198.0696, found 198.0697.



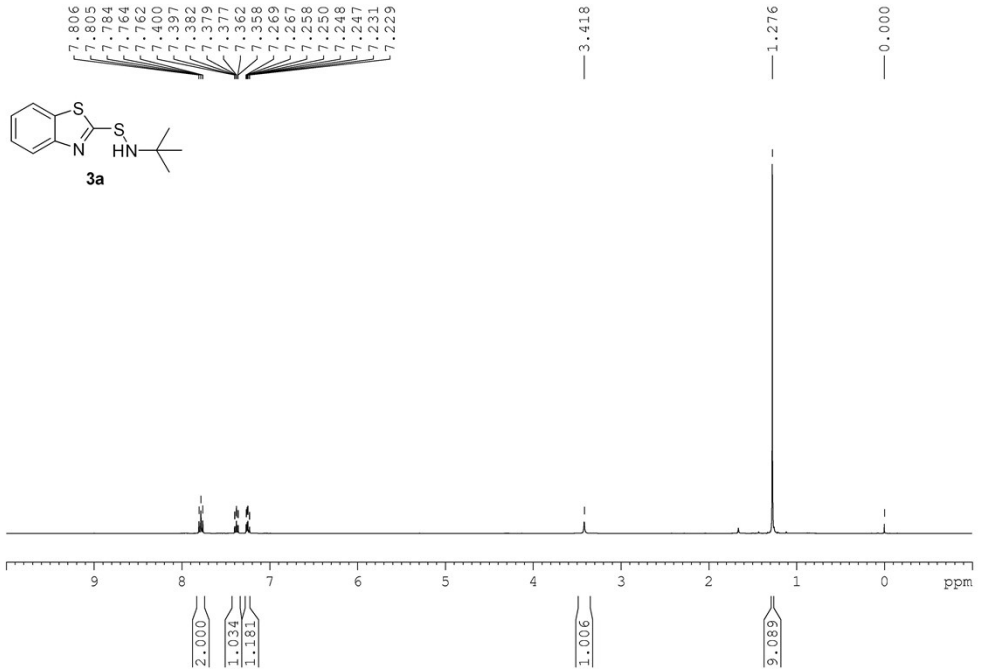
2-(4-morpholinylthio)-Benzoxazole (3t). White solid(53.9 mg, 76% yield) (hexane: EtOAc = 10:1 as eluent). 36-38 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.61-7.56 (m, 1H), 7.44-7.39 (m, 1H), 7.27-7.18 (m, 2H), 3.69 (t, *J* = 4.7 Hz, 4H), 3.37 (t, *J* = 4.8 Hz, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 165.18, 151.37, 141.66, 124.45, 124.35, 119.19, 110.19, 67.75, 55.79. HRMS (ESI) m/z calcd for $C_{11}H_{12}N_2O_2S$ $[M+H]^+$:237.0692, found 237.0692.

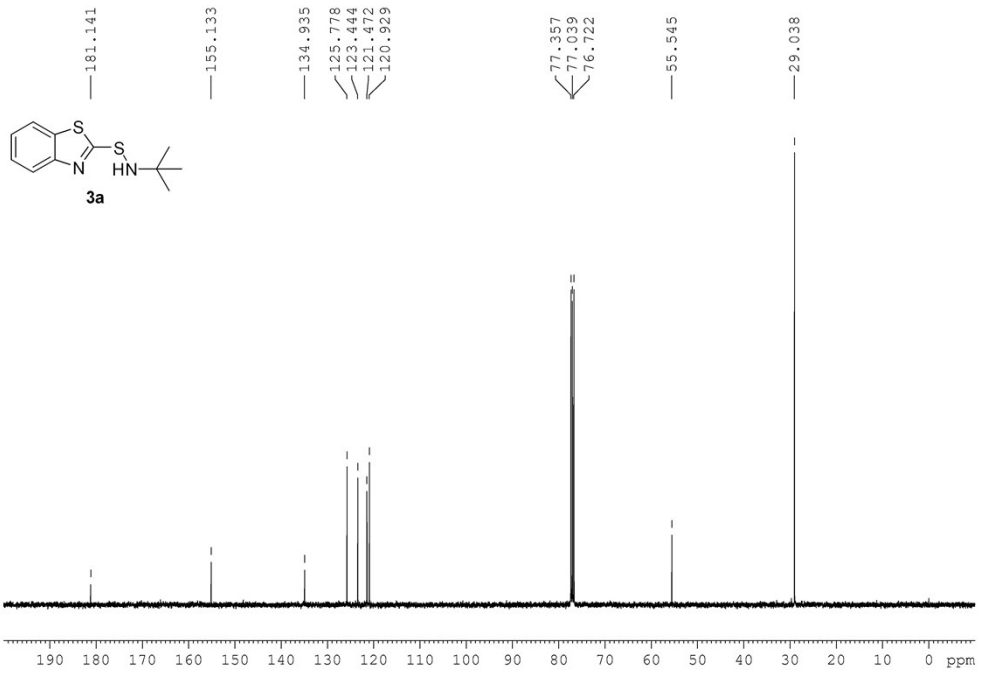
References

[1]Y. Dou, X. Huang, H. Wang, L. Yang, H. Li, B. Yuan, G. Yang, *Green Chem.* **2017**, *19*, 2491-2495.

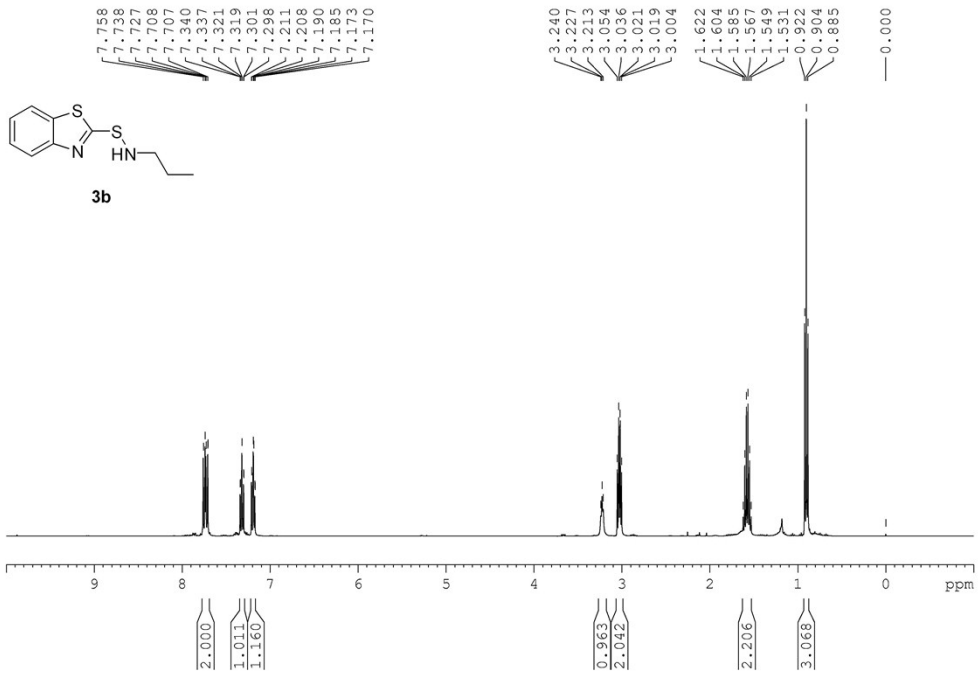
The NMR Spectra of all products

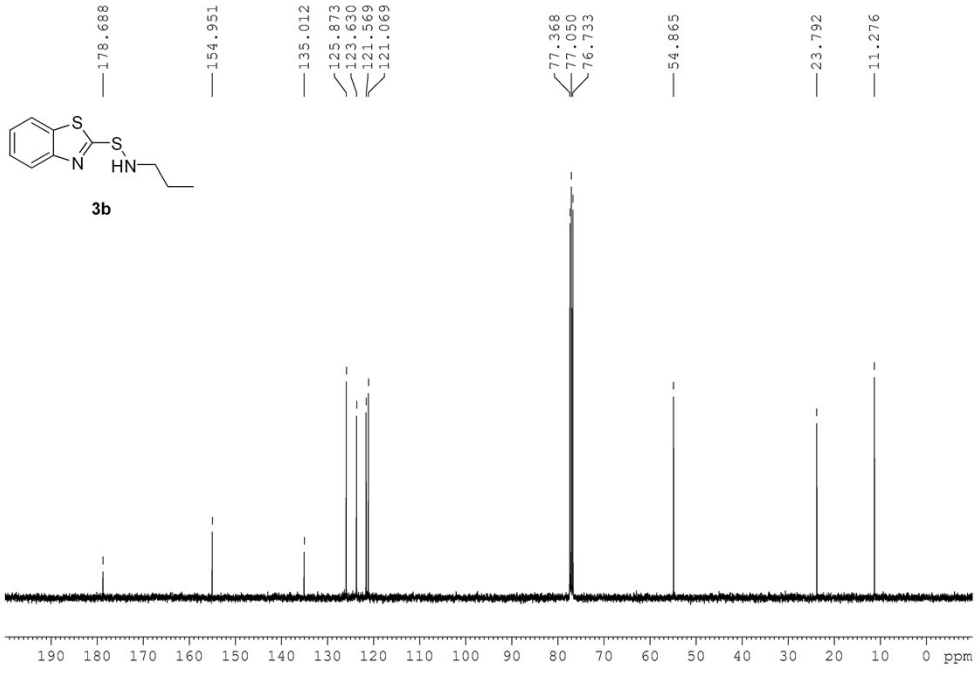
N-tert-Butyl-2-benzothiazolesulfenamide (3a):



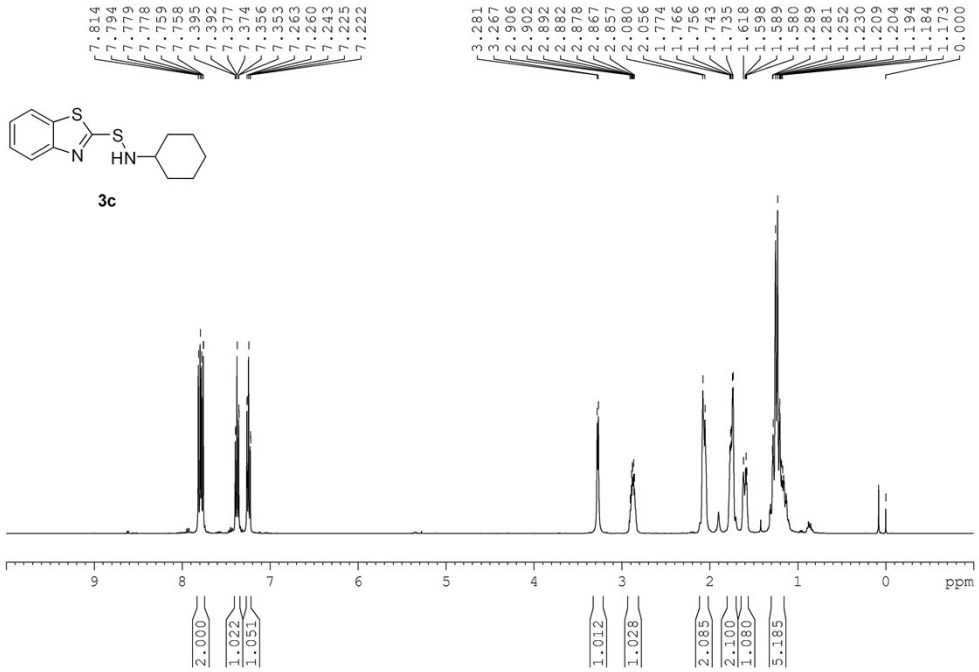


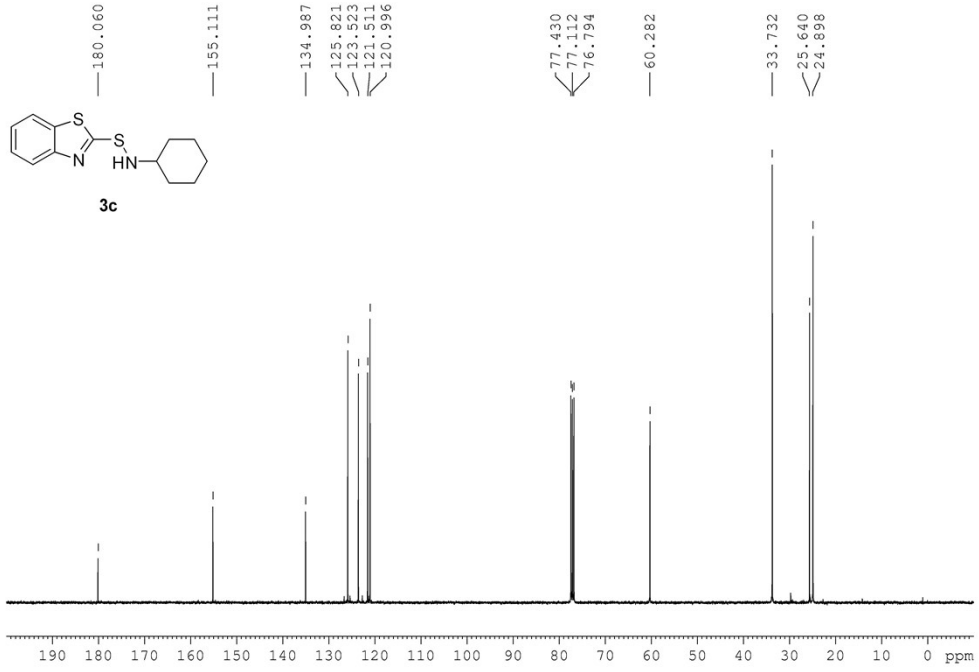
N-propyl-2-benzothiazolesulfenamide (3b):



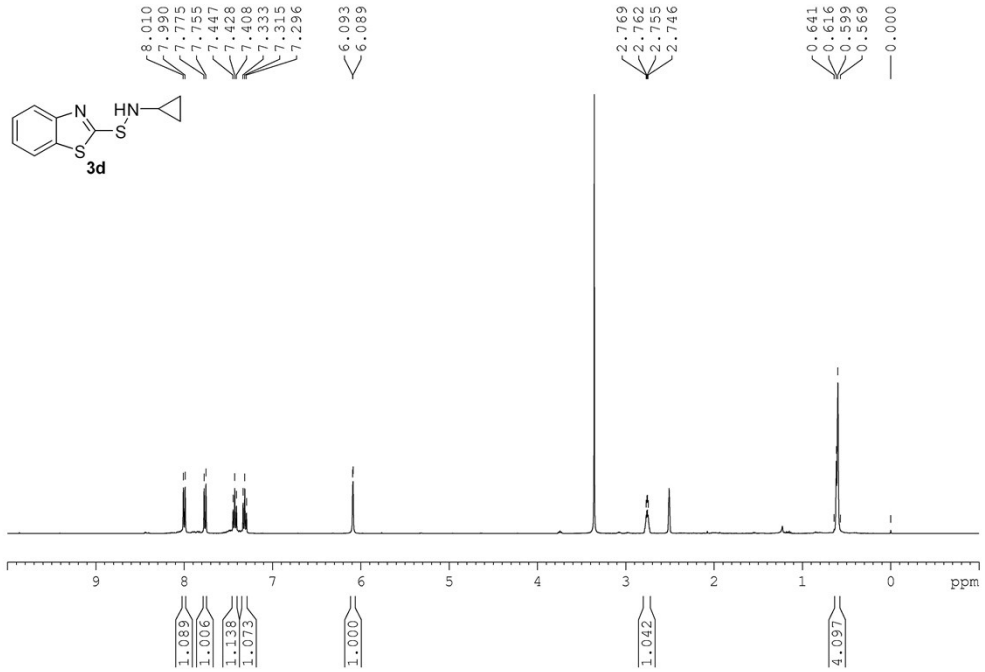


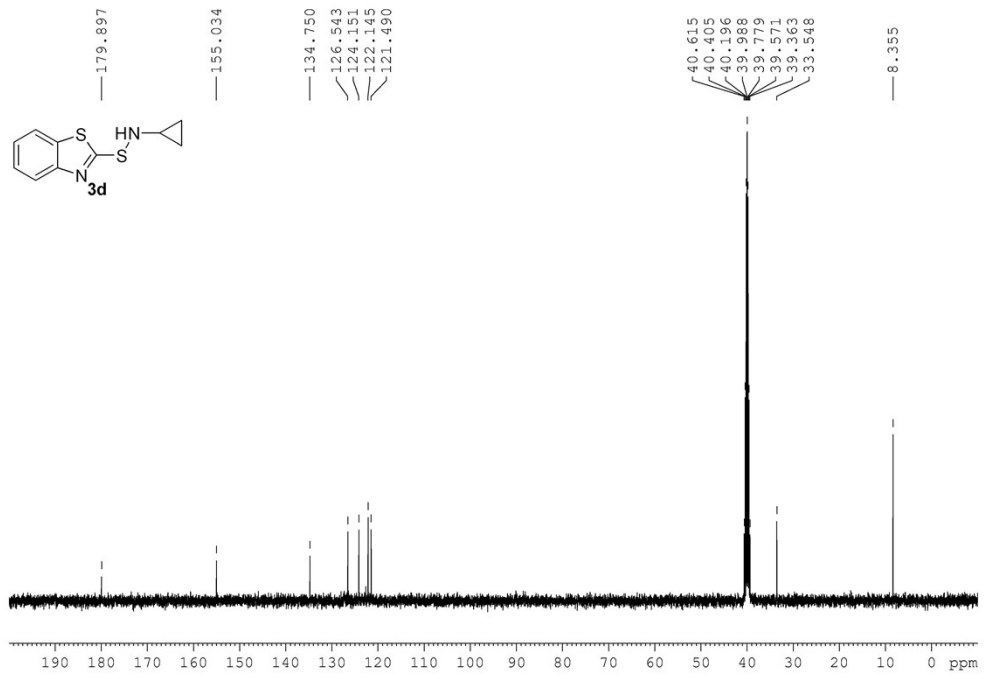
N-cyclohexyl-2-benzothiazolesulfenamide (3c):



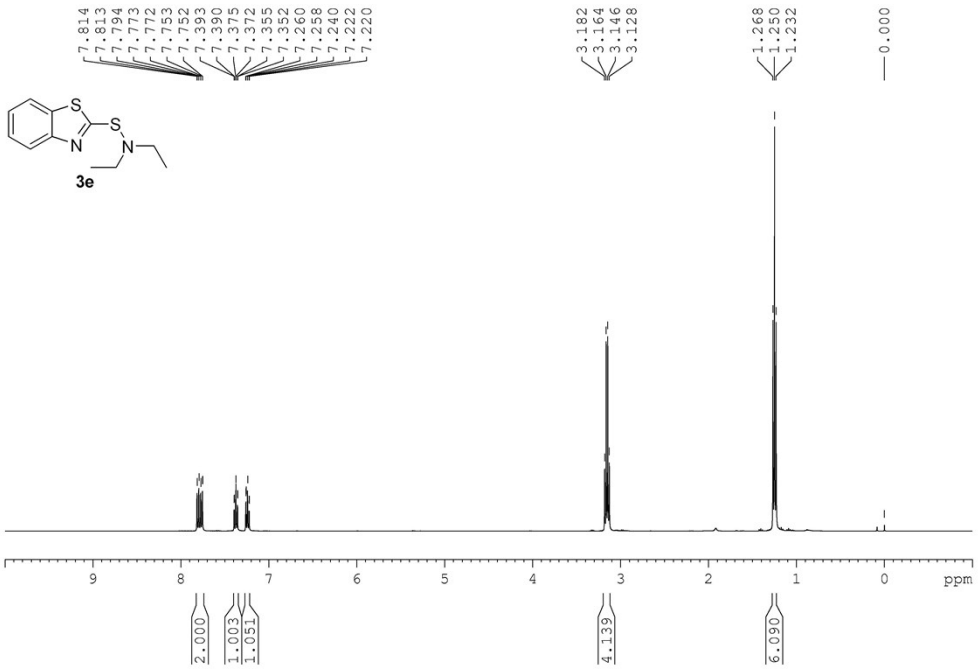


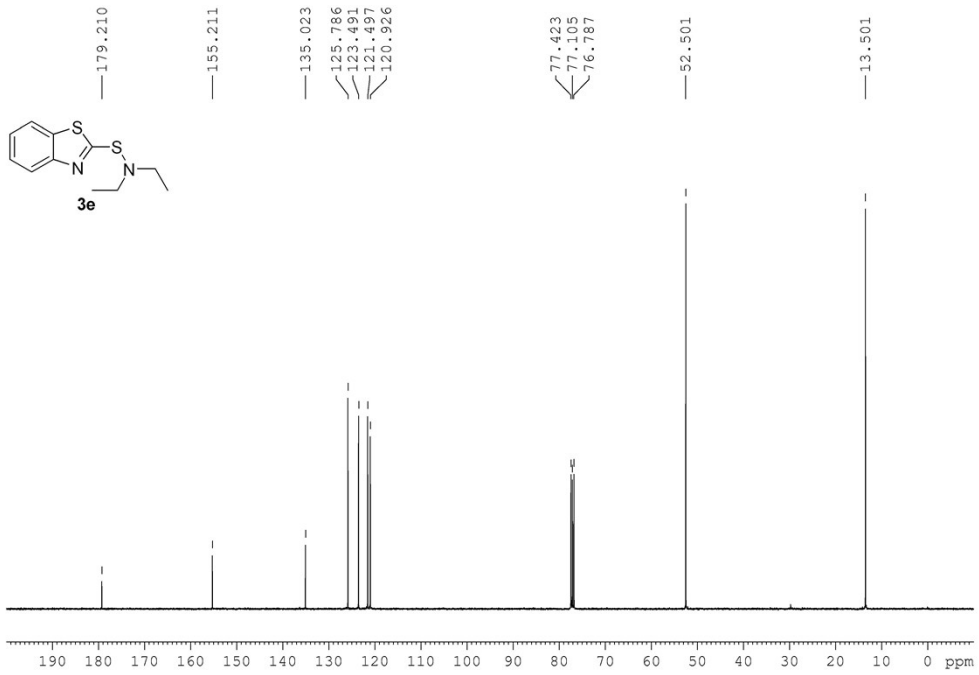
N-cyclopropyl-2-benzothiazolesulfenamide (3d):



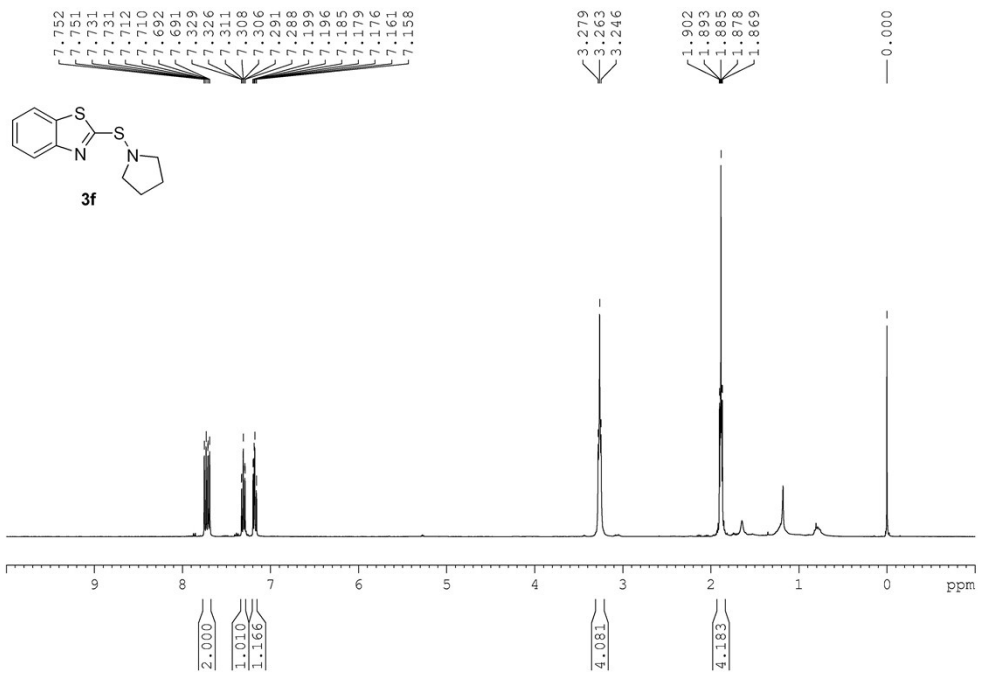


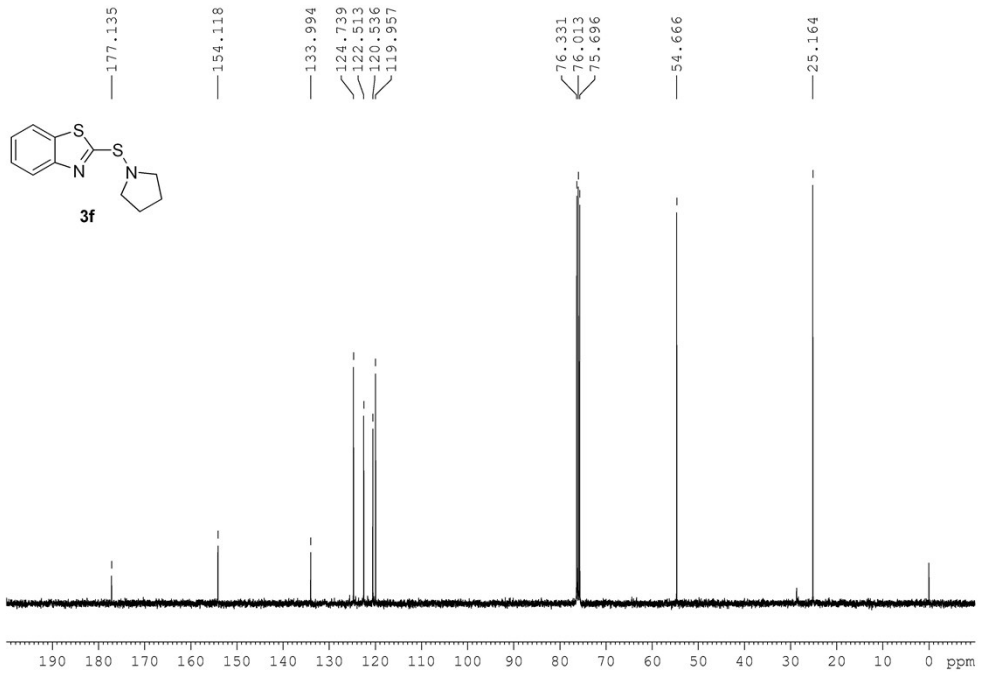
N,*N*-diethyl-2-Benzothiazolesulfenamide (3e):



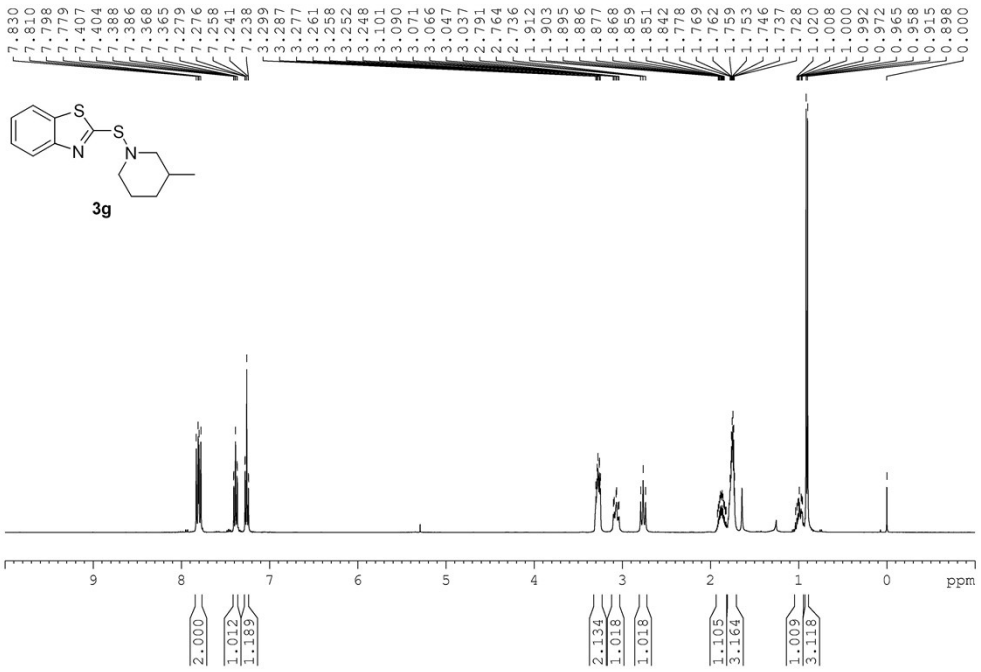


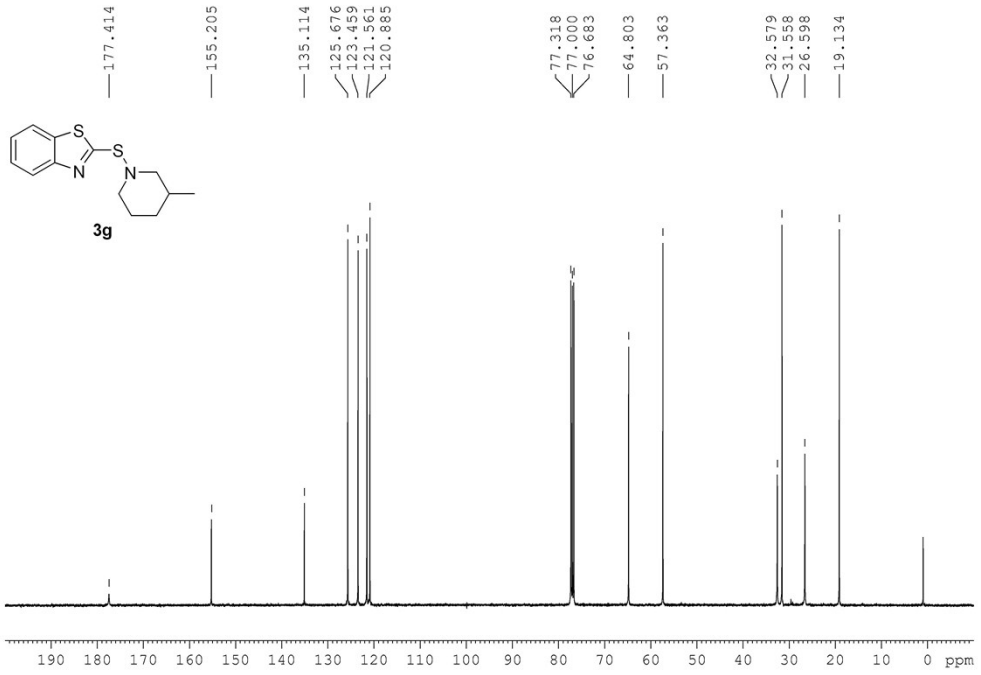
2-(1-pyrrolidinylthio)-Benzothiazole (3f):



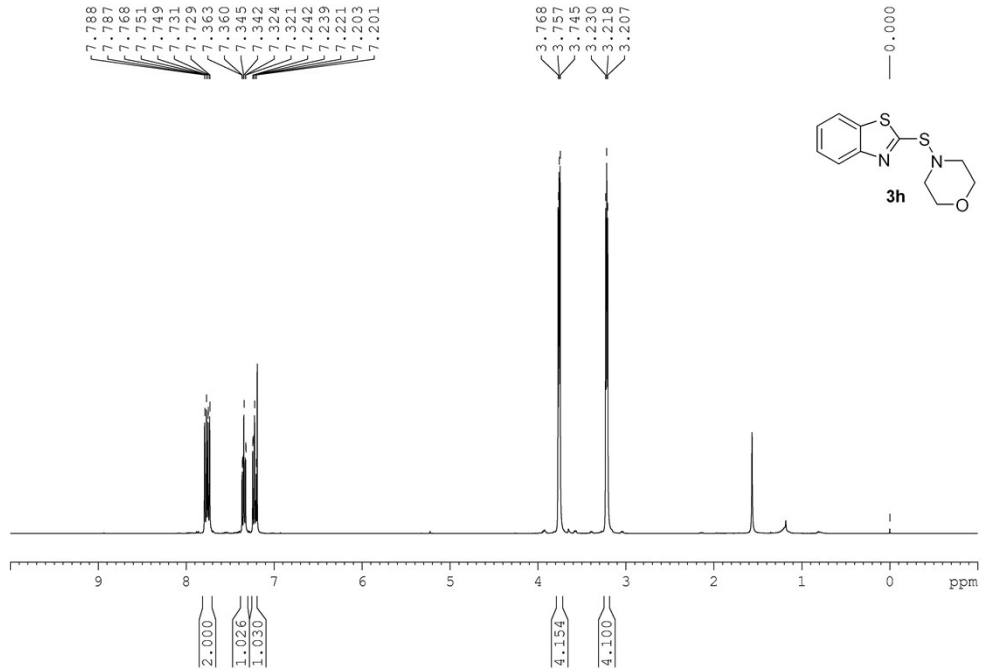


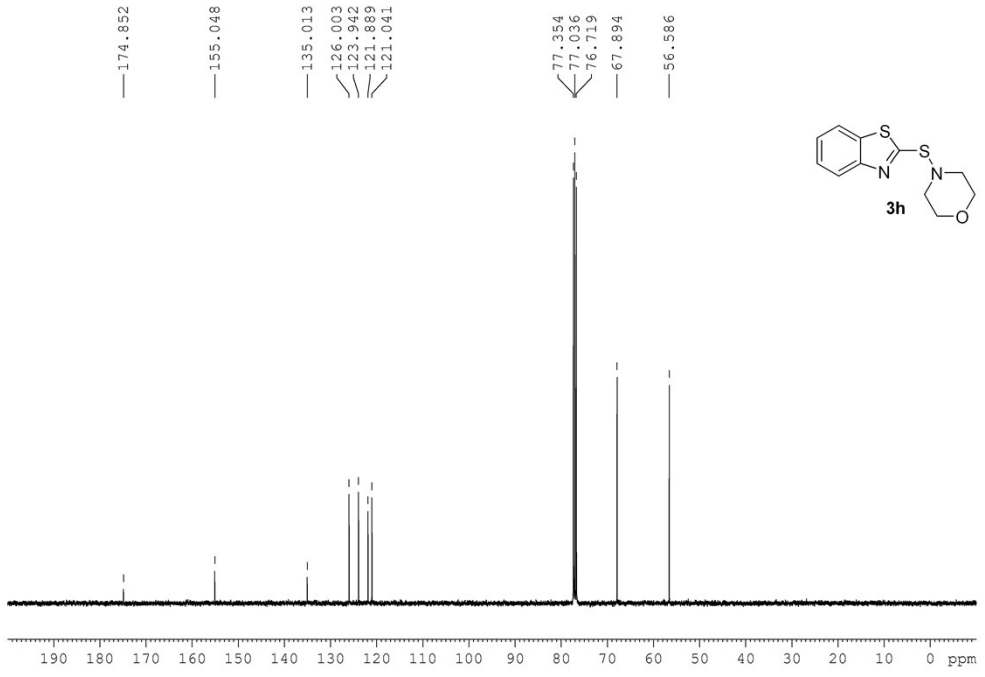
2-[(3-methyl-1-piperidinyl)thio]-Benzothiazole (3g):



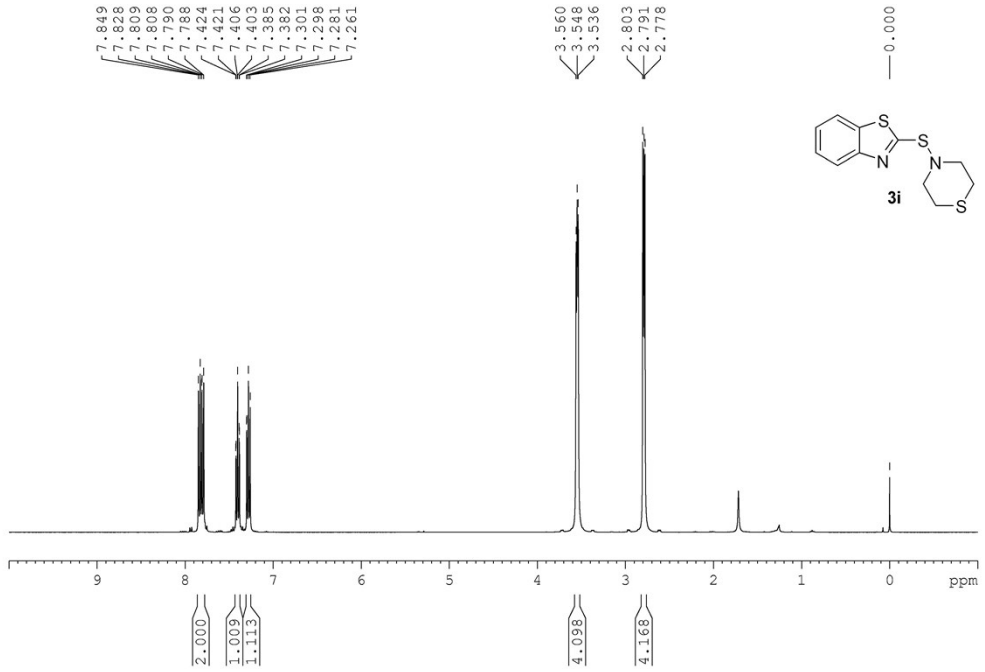


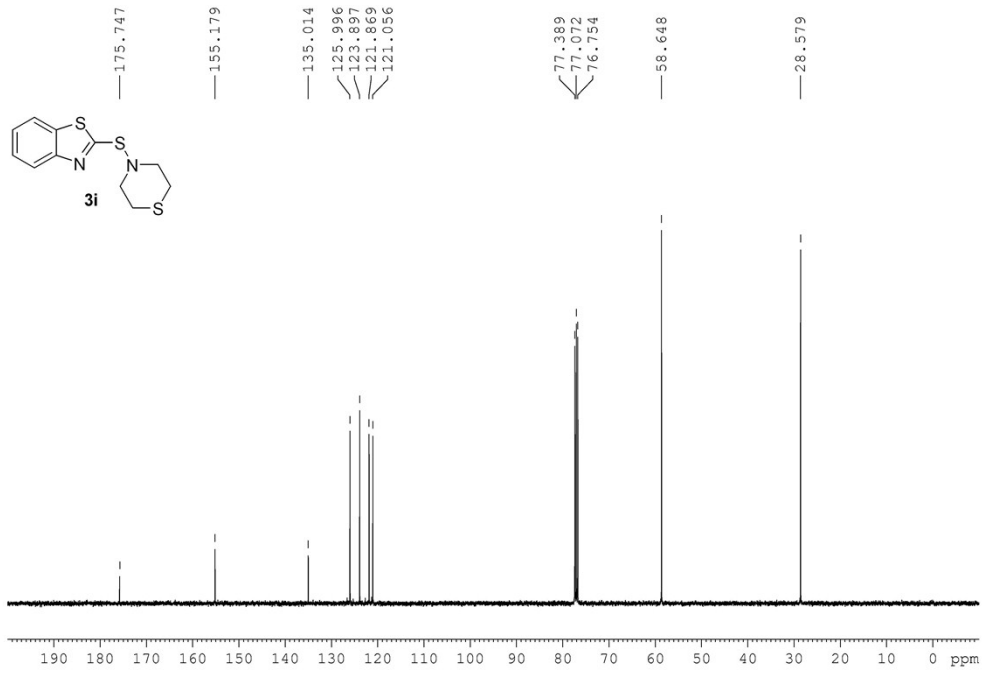
2-(4-morpholinylthio)-Benzothiazole (3h):



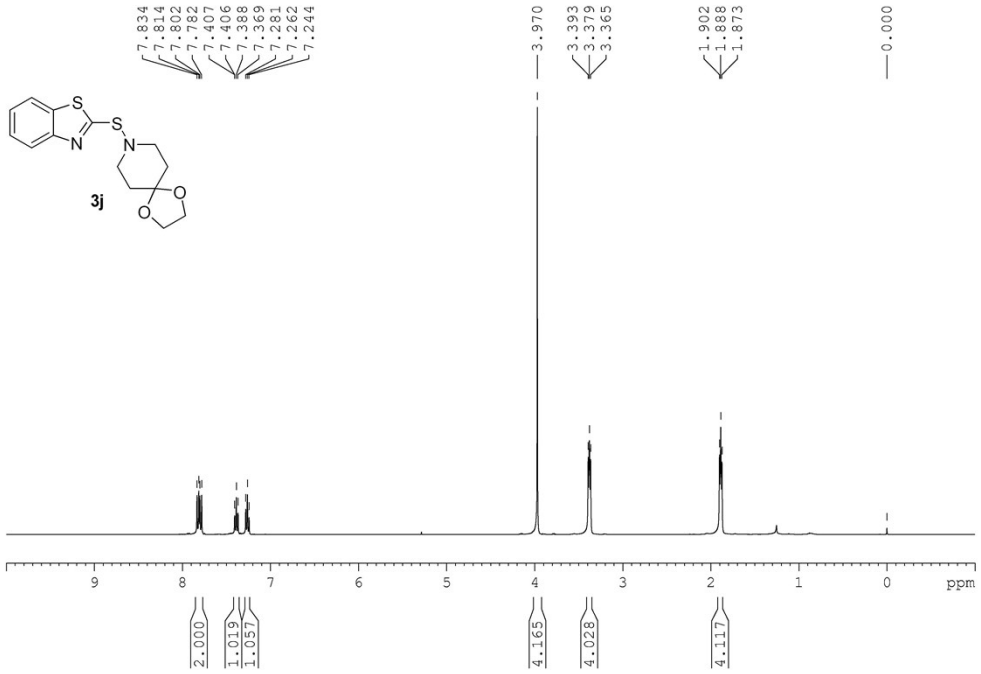


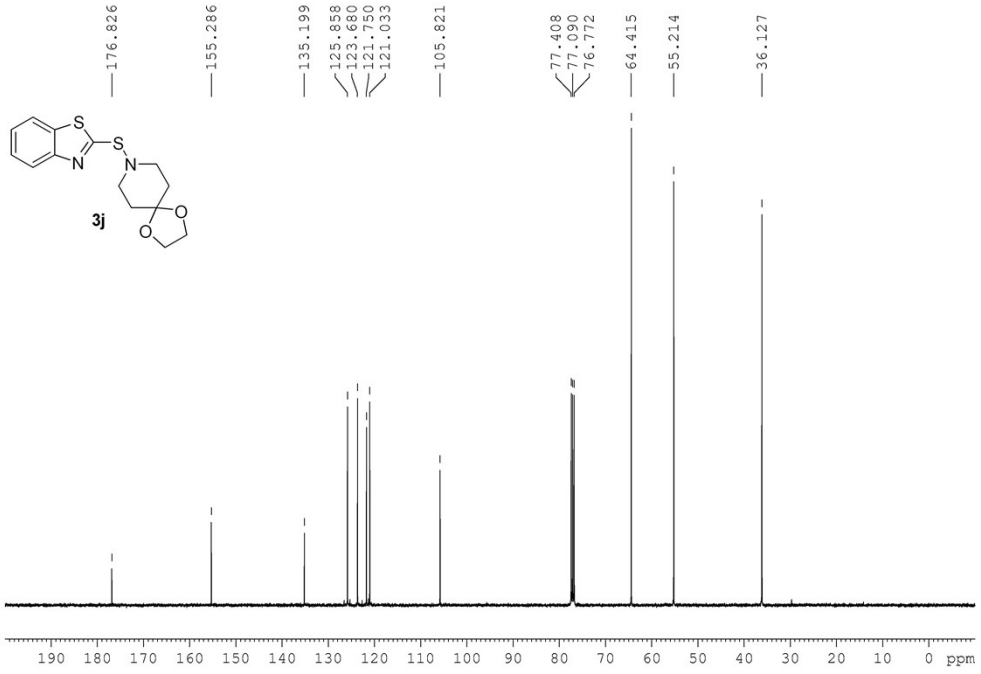
2-(4-thiomorpholinylthio)-Benzothiazole (3i):



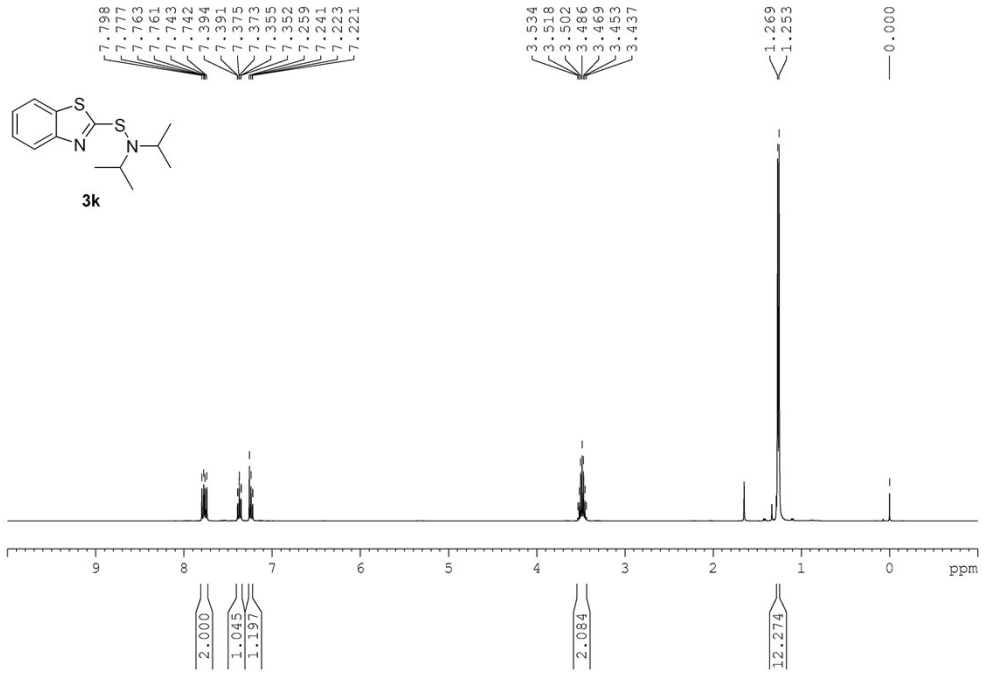


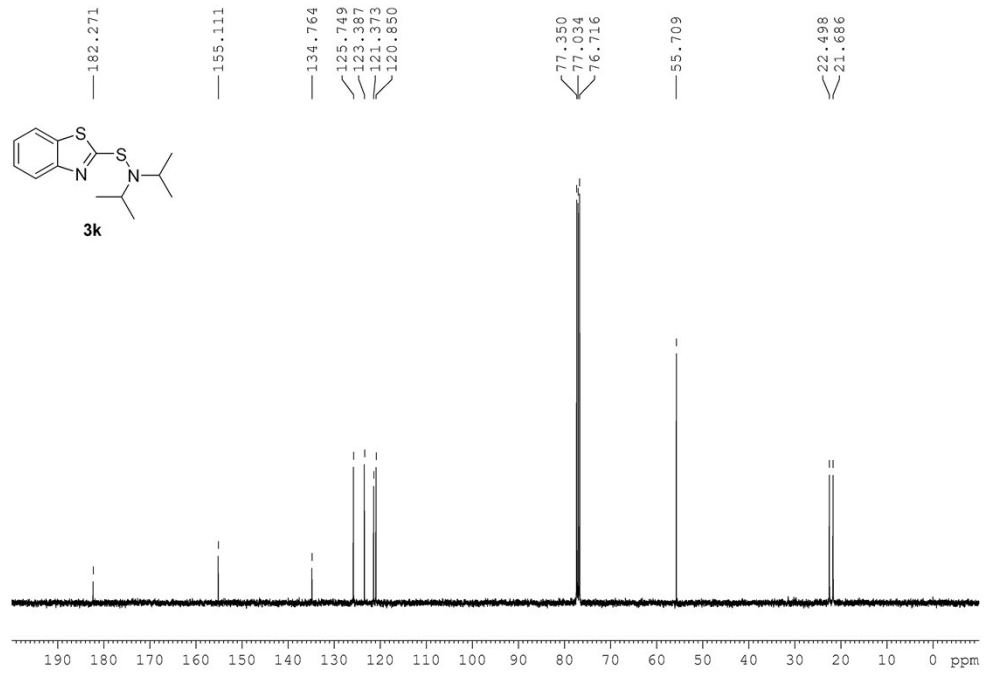
8-(2-benzothiazolylthio)-1,4-Dioxa-8-azaspiro[4.5]decane (3j):



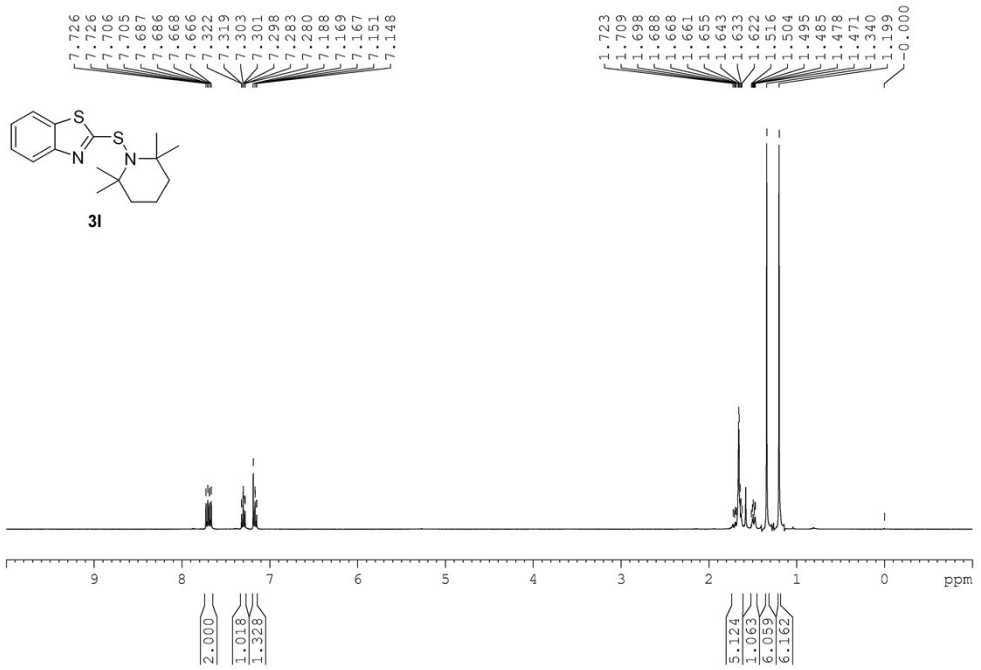


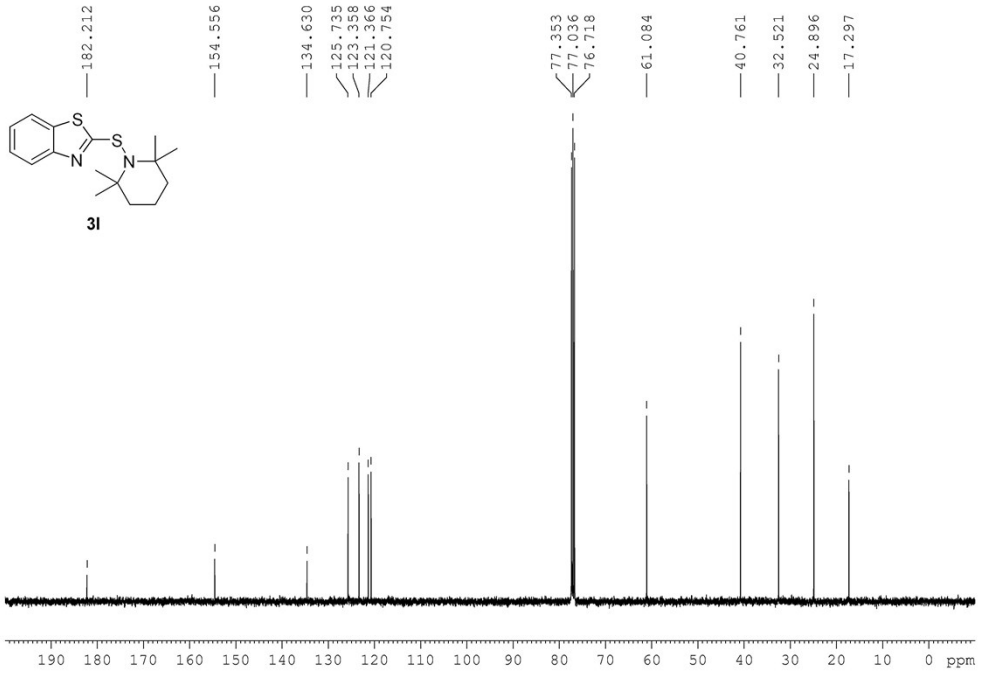
***N*,*N*-bis(1-methylethyl)-2-Benzothiazolesulfenamide (3k):**



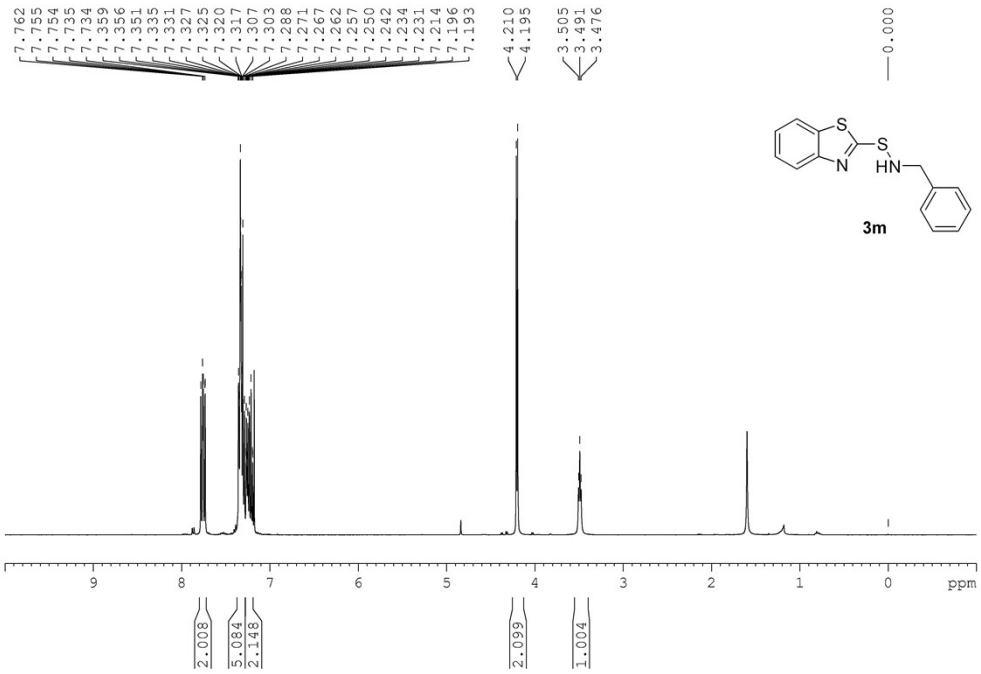


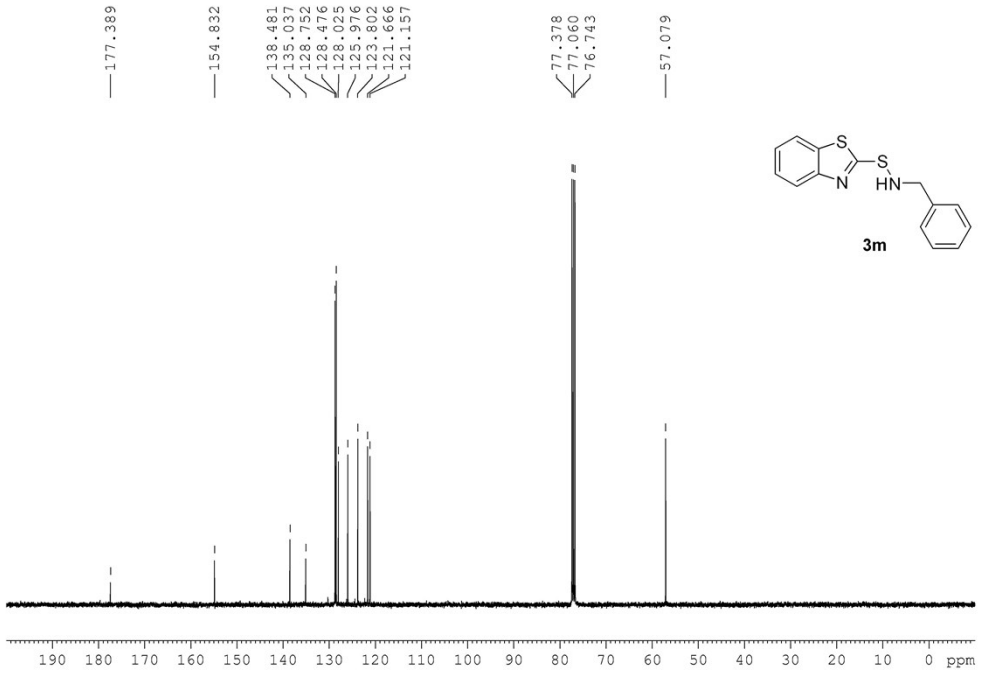
2-[(2,2,6,6-tetramethyl-1-piperidinyl)thio]-Benzothiazole (3l):





N-(phenylmethyl)-2-Benzothiazolesulfenamide (3m):





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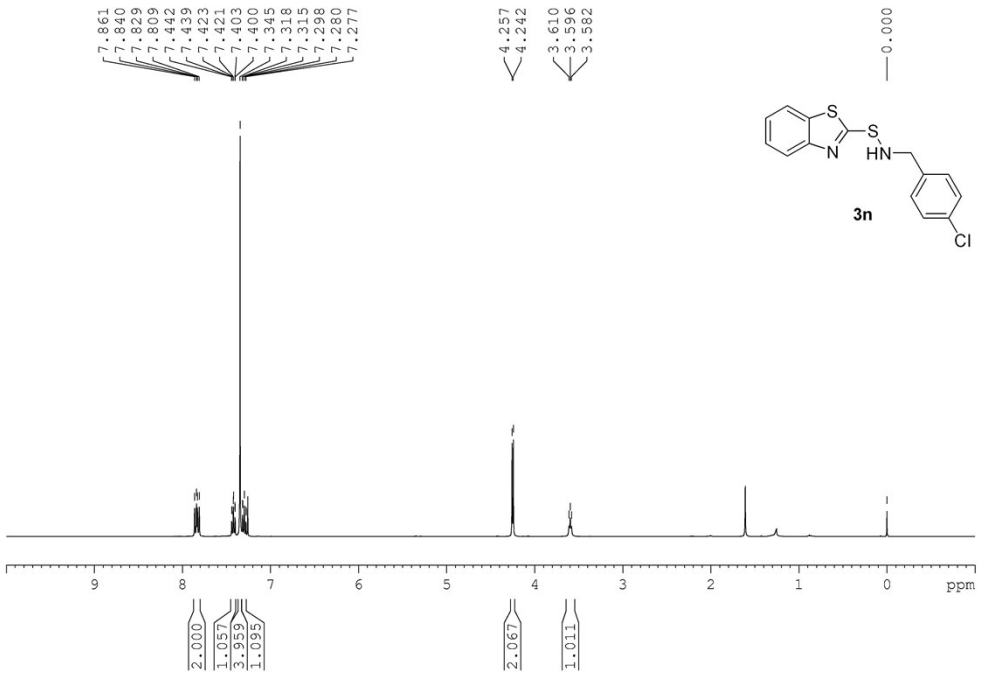
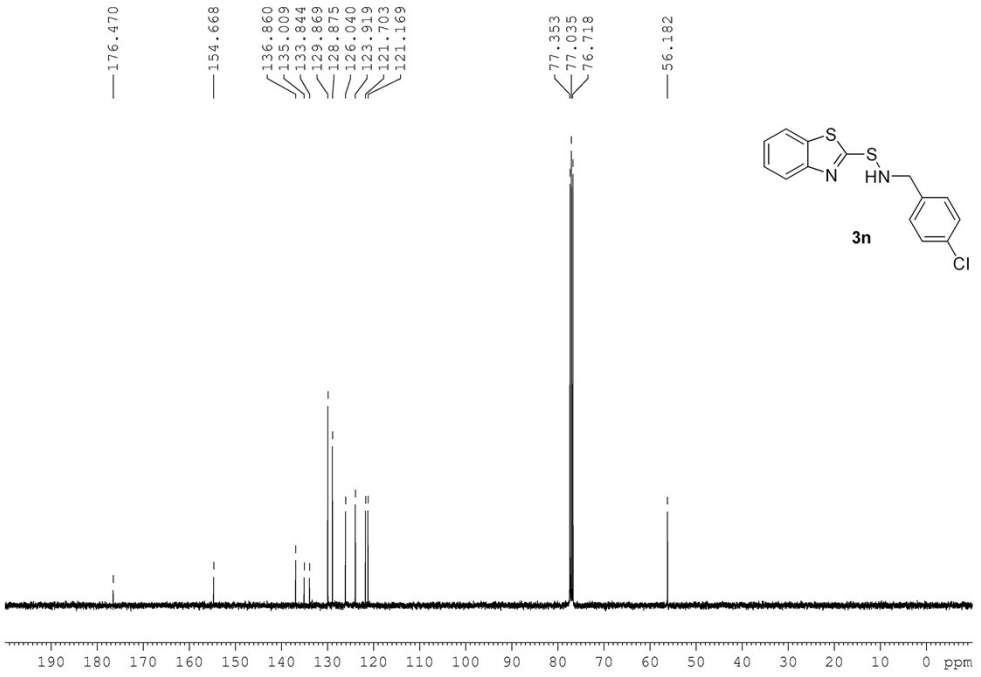
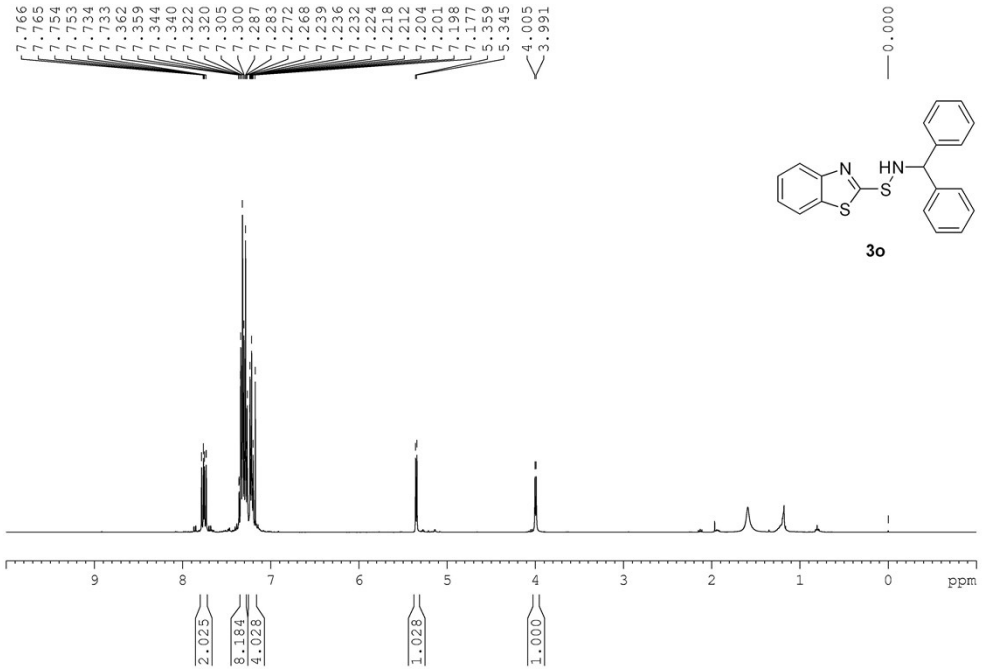
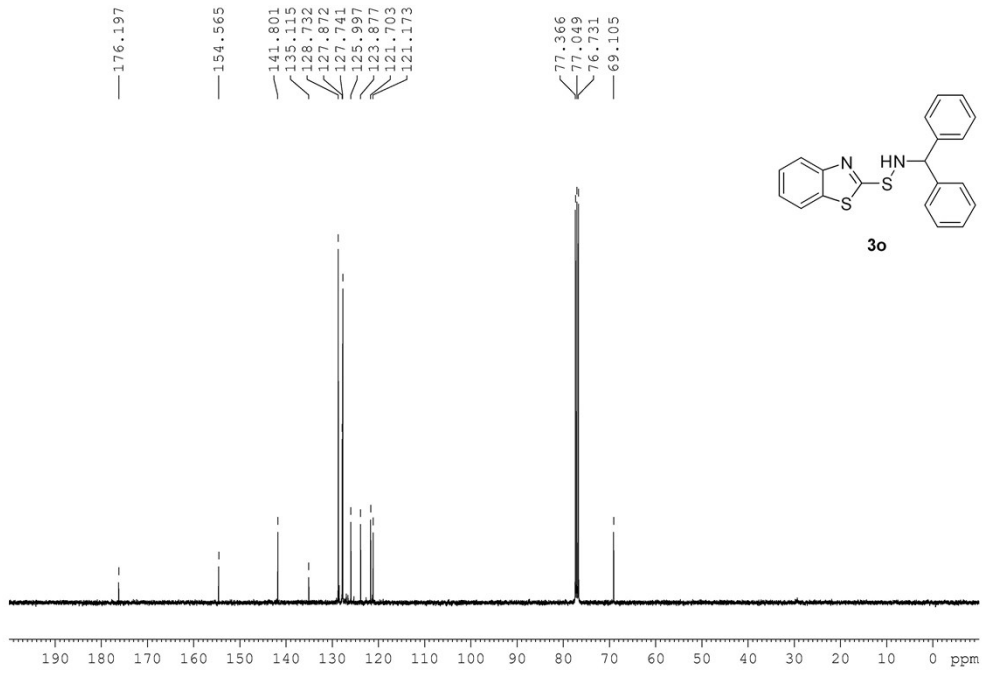


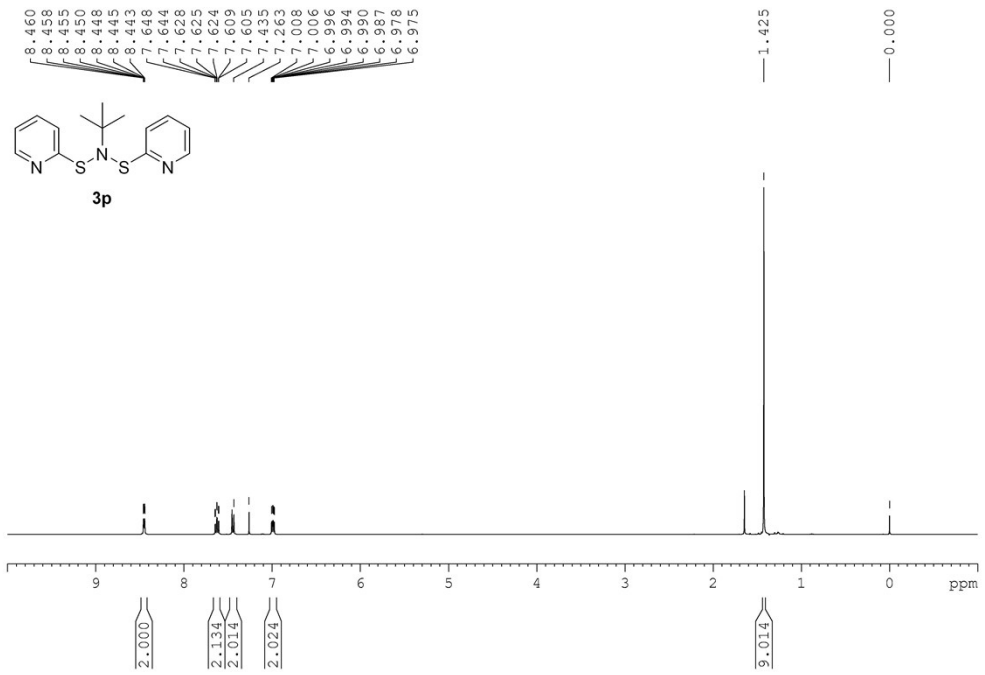


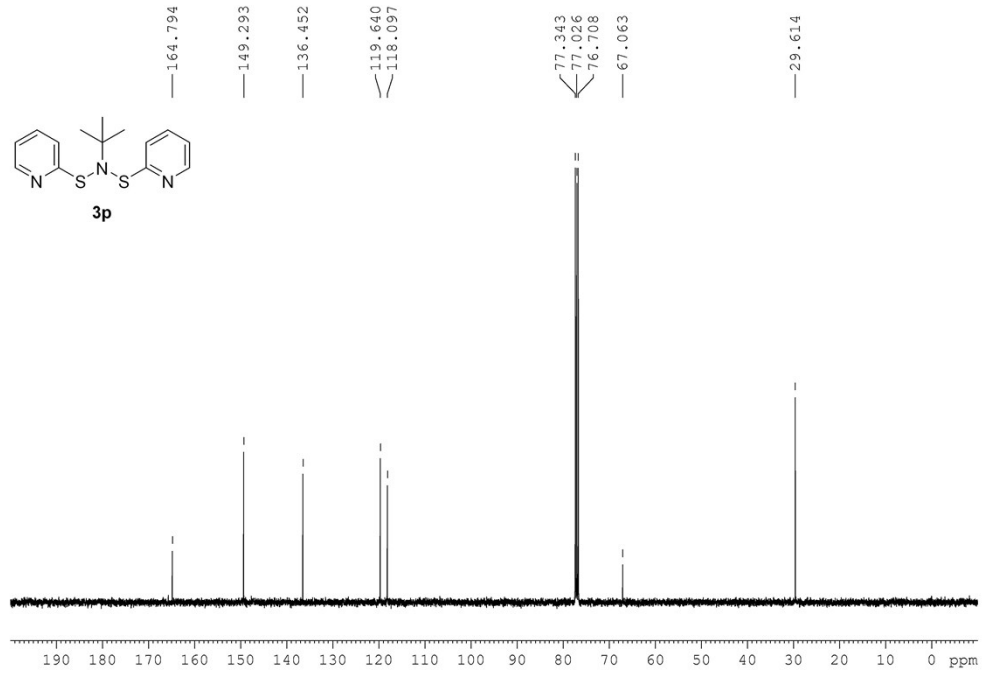
N-[bis(phenyl)-methyl]-2-Benzothiazolesulfenamide (3o):



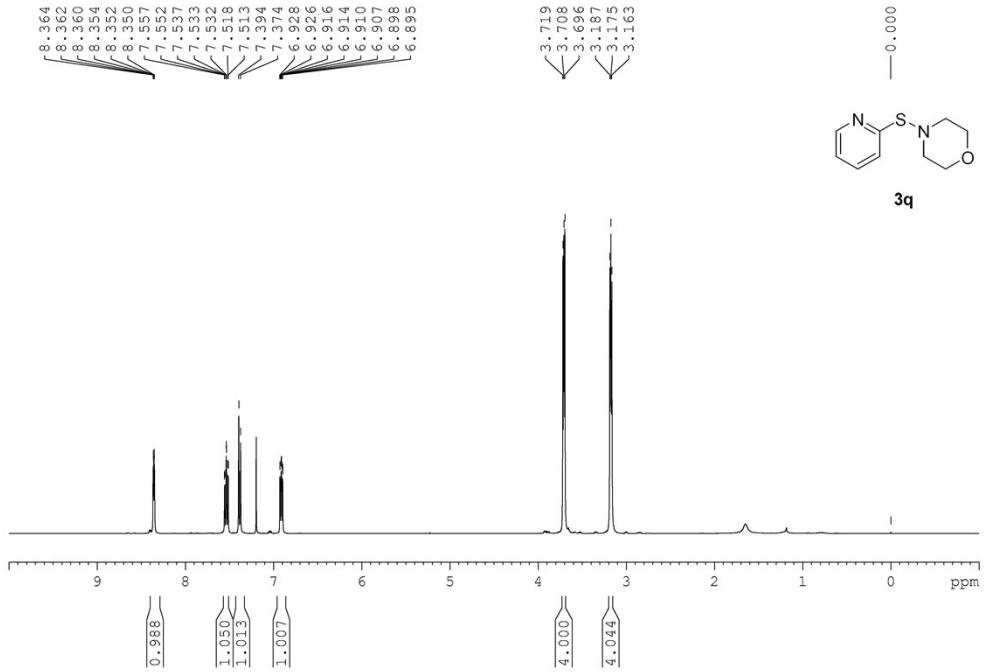


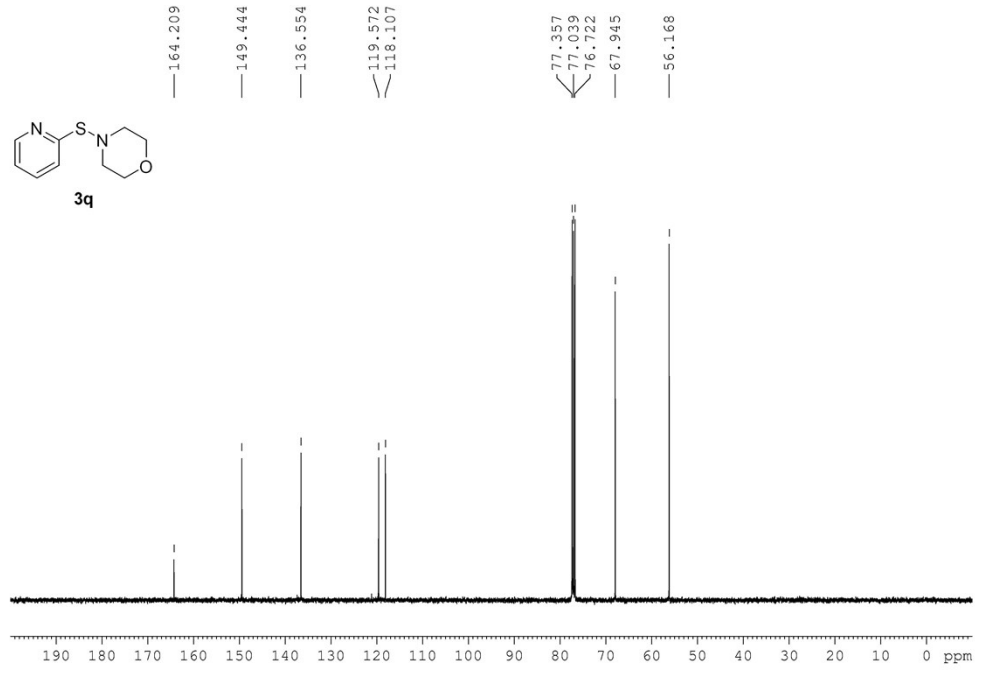
***N*-(1,1-dimethylethyl)-*N*-(2-pyridinylthio)-2-Pyridinesulfenamide (3p):**



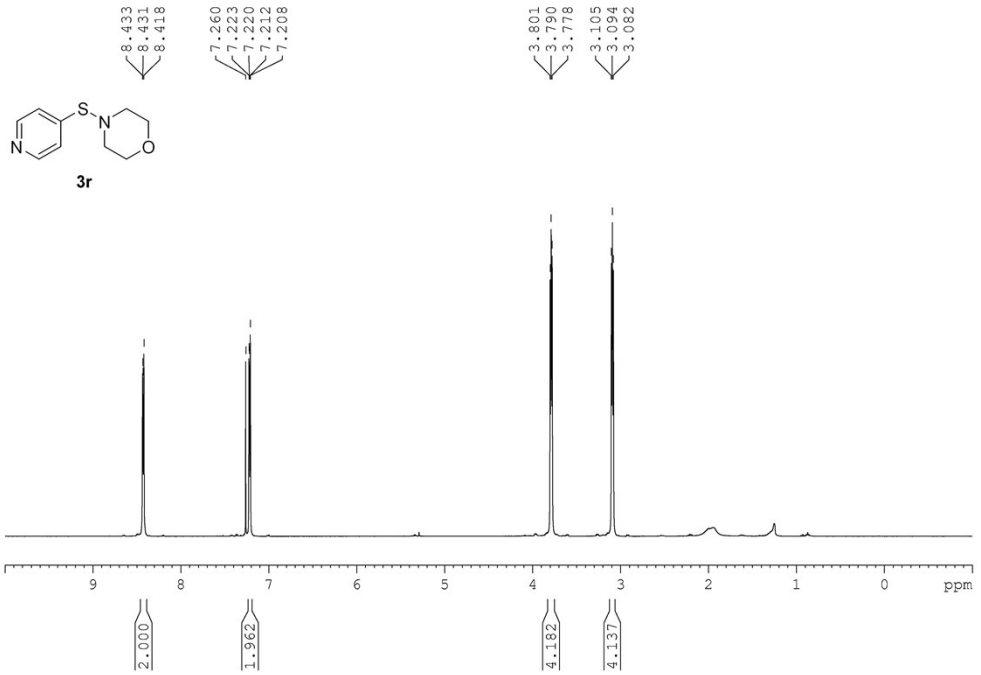


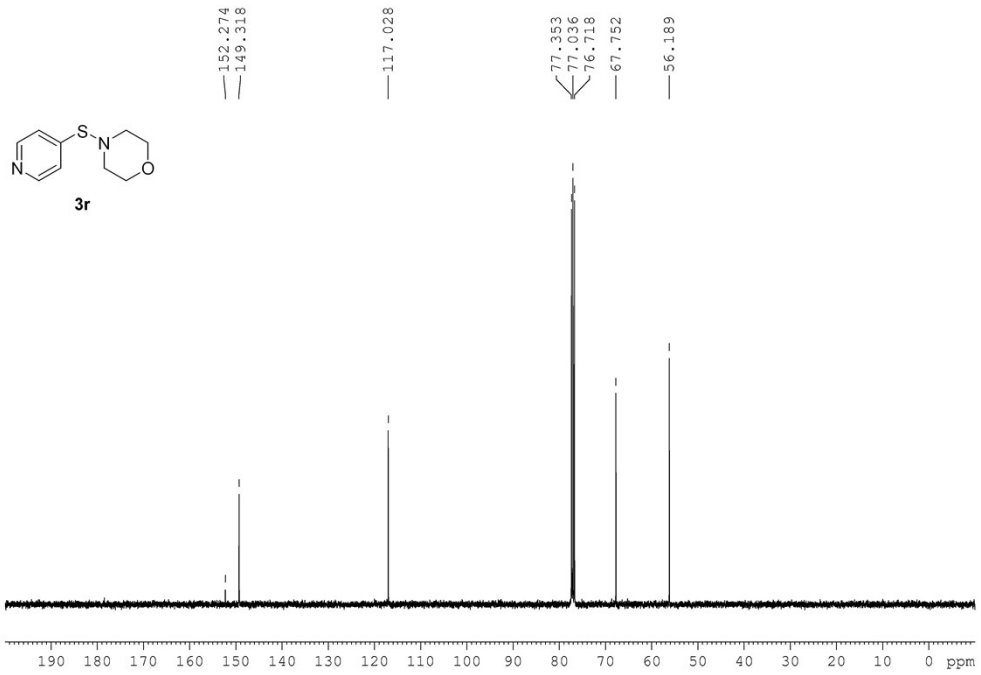
4-(2-pyridinylthio)-Morpholine (3q):



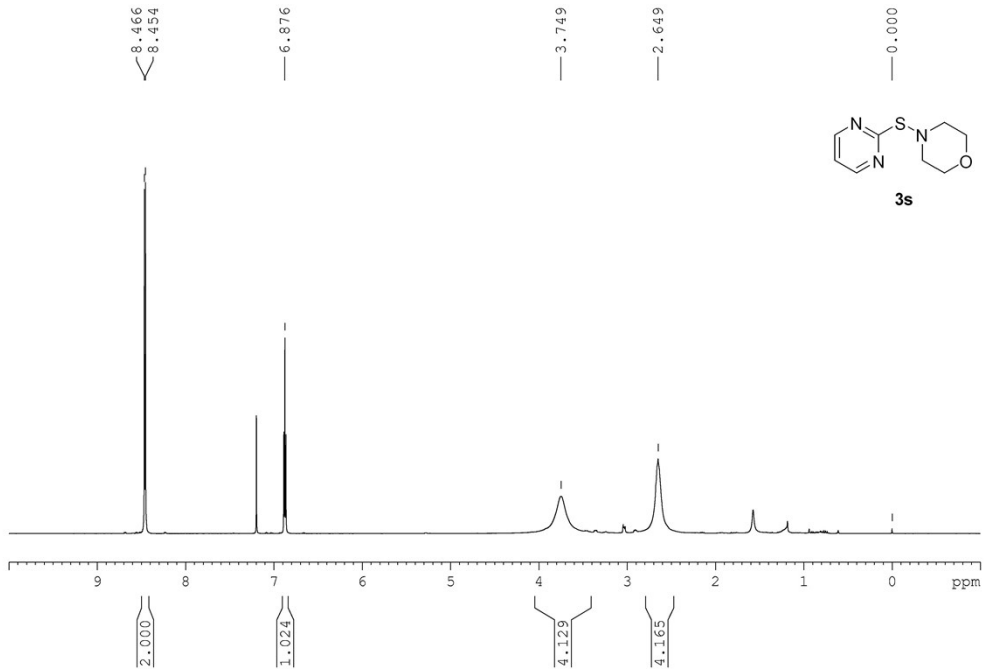


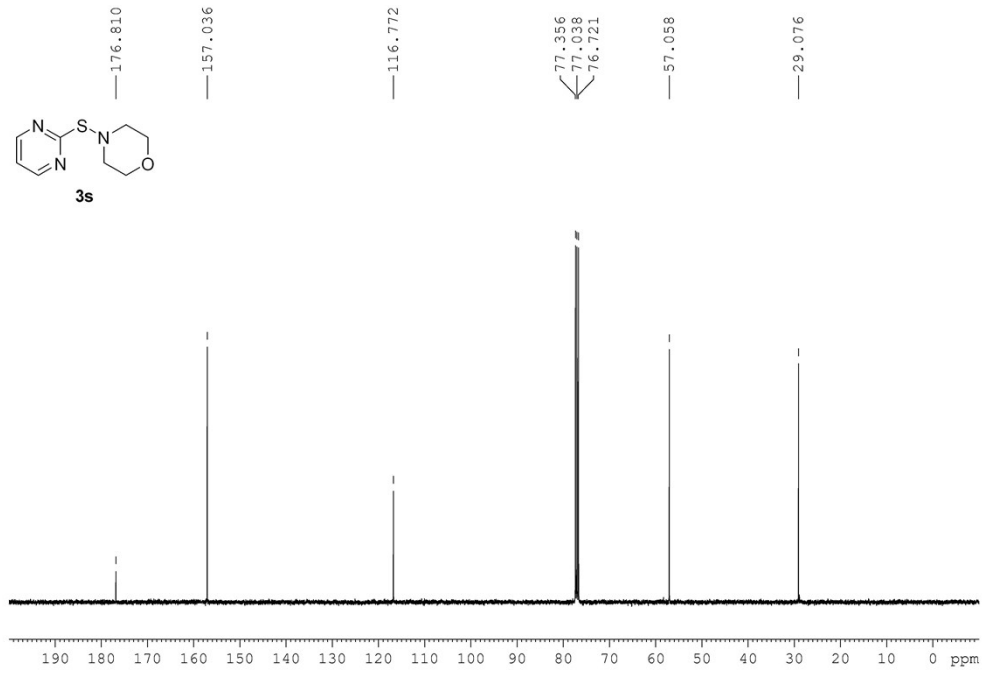
4-(4-pyridinylthio)-Morpholine (3r):





4-(2-pyrimidinylthio)-Morpholine (3s):





2-(4-morpholinylthio)-Benzoxazole (3t):