Electronic Supplementary Material (ESI) for New Journal of Chemistry.

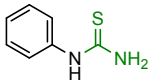
Supplementary Information

Green and Efficient Synthesis of Thioureas, Ureas, Primary O-Thiocarbamates, and Carbamates in Deep Eutectic Solvent/ Catalyst Systems Using Thiourea and Urea

Nastaran Bagherzadeh, [a] Ali Reza Sardarian,*[a] and Iman Dindarloo Inaloo [a]

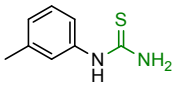
[a] *Chemistry Department, College of Sciences, Shiraz University, Shiraz, Iran. +987136137107; fax: +987136460788*
Email: sardarian@shirazu.ac.ir

Physical data



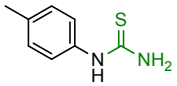
1-Phenylthiourea **(3a)**

White solid (0.114 gr, 75% yield), m.p. 146 °C (Literature report 148-151 °C);[1] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.70 (s, NH), 8.09-7.17 (brNH_2 and m, 3H, aromatic ring), 7.12 (t, J = 9 Hz, 1H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ (ppm) 181.38, 139.51, 129.17, 124.85, 123.48; FT-IR (KBr, cm^{-1}): 3425 (vs), 3278 (s), 3181 (vs), 3001 (m), 1611 (vs), 1590 (s), 1519 (vs), 1461 (m), 1446 (s), 1296-1231 (m) 1061 (m), 810 (w), 750 (s), 693 (s), 638 (w), 605 (w), 499 (s), 481 (s), 463 (m), 416 (vw); Anal. Calcd for $C_7H_8N_2S$, C, 55.24; H, 5.30; N, 18.40; S, 21.06%; Found C, 55.20; H, 5.25; N, 18.46; S, 21.09 %.



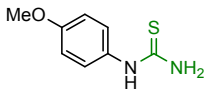
1-(*m*-Tolyl) thiourea **(3b)**

White solid (0.130 gr, 78% yield), m.p. 92-94 °C (Literature report 109-111 °C);[2] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.64 (s, NH), 7.69–7.06 (brNH_2 and m, 3H aromatic ring), 6.94 (d, J = 6.9 Hz, 1H, aromatic ring), 2.28 (s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ 181.29, 139.32, 138.50, 129.03, 125.63, 124.05, 120.67, 21.50; FT-IR (KBr, cm^{-1}): 3421 (s), 3292 (vs), 3184 (vs), 3015 (m), 1610 (vs), 1527 (vs), 1491 (s), 1457 (m), 1298 (m), 1258 (m), 1165 (w), 1064 (m), 876 (vw), 831 (w), 783 (m), 748 (w), 692 (m), 620 (m), 570 (m), 463 (w); Anal. Calcd for $C_8H_{10}N_2S$, C, 57.80; H, 6.06; N, 16.85; S, 19.29%; Found C, 57.76; H, 6.03; N, 16.90; S, 19.31 %.



1-(*p*-Tolyl) thiourea **(3c)**

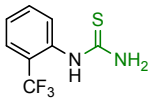
White solid (0.138 gr, 83% yield), m.p. 180 °C (Literature report 185-186 °C); [3] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.68 (s, NH), 7.02-7.74 (brNH_2 and m, 4H aromatic ring), 2.26 (s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ (ppm) 181.35, 136.91, 134.08, 129.60, 123.71, 20.95; FT-IR (KBr, cm^{-1}): 3425 (vs), 3284 (s), 3183 (vs), 2962 (w), 2928 (w), 2856 (w), 1611 (vs), 1594 (m), 1557 (m), 1520 (vs), 1489 (m), 1447 (m), 1396 (m), 1315-1232 (m), 1062 (m), 810 (w), 750 (m), 693 (m), 667 (v), 499 (m); Anal. Calcd for $C_8H_{10}N_2S$, C, 57.80; H, 6.06; N, 16.85; S, 19.29%; Found C, 57.74; H, 6.02; N, 16.91; S, 19.32%.



1-(4-Methoxyphenyl) thiourea **(3d)**

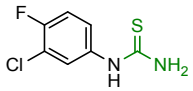
White solid (0.155 gr, 85% yield), m.p. 171 °C (Literature report 172.4 - 173.2 °C); [4] ^{1}H NMR (DMSO-d_6, 400 MHz, 25 °C): δ (ppm) 9.68 (s, NH), 8.00-7.13 (brNH_2), 7.40 (d, 2H, J = 6 Hz, aromatic ring), 7.31 (d, 2H, J = 6 Hz, aromatic ring), 4.13 (s, 3H, OCH_3); ^{13}C{H} NMR (101 MHz, DMSO-d_6, 25 °C) δ (ppm) 180.95, 139.00, 128.62, 124.35, 122.99, 48.51; FT-IR (KBr, cm^{-1}): 3416 (s), 3270 (s), 3134 (vs), 3019 (m), 2831 (vw), 2784 (vw), 1620 (s), 1592 (m), 1514 (s), 1472 (m), 1431 (m),

1392 (m), 1310-1236 (m), 1064 (m), 810 (w), 753 (m), 696 (m), 631 (m), 609 (m), 497 (m); Anal. Calcd for $C_8H_{10}N_2OS$, C, 52.73; H, 5.53; N, 15.37; O, 8.78; S, 17.59%; Found C, 52.70; H, 5.49; N, 15.40; S, 17.61 %.



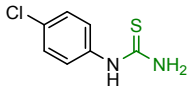
1-(2-(Trifluoromethyl phenyl) thiourea **(3e)**

White solid (0.152 gr, 69% yield), m.p. 159 °C (Literature report 170 °C); [5] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.30 (s, NH), 8.06-7.28 (brNH_2) 7.64-7.72 (m, 2H, aromaticring), 7.54 (d, *J* = 9 Hz, 1H, aromatic ring), 7.45 (t, *J* = 7.5 Hz, 1H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ (ppm) 183.49, 135.54 (q, *J* = 315.75 Hz), 132.39, 127.48, 126.49 (q, *J* = 5.25 Hz), 125.92 (q, *J* = 29.25 Hz), 125.81, 122.19; FT-IR (KBr, cm^{-1}): 3431 (vs), 3250 (m), 3140 (s), 3068 (m), 2982 (w), 1620 (vs), 1513 (s), 1454 (m), 1319 (vs), 1294 (s), 1270 (m), 1230 (w), 1179 (s), 1157 (s), 1131 (vs), 1116 (vs), 1065- 1035 (m), 828 (w), 785 (s), 762 (m), 640 (w), 614 (m), 524 (w), 481 (m), 467 (m); Anal.Calcd for $C_8H_7F_3N_2S$, C, 43.63; H, 3.20; N, 12.72; S, 14.56%; Found C, 43.60; H, 3.18; N, 12.75, 14.57%.



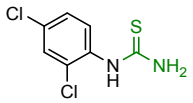
1-(3-Chloro-4-fluorophenyl) thiourea **(3f)**

White solid (0.119 gr, 58% yield), m.p. 187-188 °C (Literature report 236 °C); [6] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.79 (s, NH), 7.76 (d, *J* = 6 Hz, 1H, aromatic ring), 7.39-7.28 (m, 4H, brNH_2 and 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 181.85, 156.11-152.88 (d, *J* = 242.25 Hz), 136.93-136.89 (d, *J* = 3 Hz), 125.46, 124.29-124.20 (d, *J* = 6.75 Hz), 119.43-119.19 (d, *J* = 18 Hz), 117.21-116.92 (d, *J* = 21.75 Hz); FT-IR (KBr, cm^{-1}): 3422 (vs), 3270 (s), 3160 (vs), 3090 (s), 2992 (m), 1625 (s),1590 (m), 1522-1471 (s), 1406 (m), 1396 (m), 1266-1275 (s),1116 (w), 1054 (s), 884 (w), 843 (w), 816 (m), 704 (s), 634 (m), 591 (m), 546 (m), 497 (m). Anal; Calcd for $C_7H_6Cl_FN_2S$, C, 41.08; H, 2.96; N, 13.69; S, 15.67%; Found C, 41.04; H, 2.92; N, 13.72; S, 15.69%.



1-(4-Chlorophenyl) thiourea **(3g)**

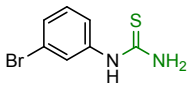
White solid (0.118 gr, 63% yield), m.p.178 °C (Literature report 174.7-178.9 °C); [7] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.72(s, NH), 7.23-7.75 (brNH_2), 7.44 (d, *J* = 10 Hz, 2H, aromatic ring), 7.34 (d, *J* = 10 Hz, 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 101 MHz, 25 °C) δ(ppm) 181.12, 138.17, 128.45, 128.06, 124.54; FT-IR (KBr, cm^{-1}): 3435(vs), 3284 (m), 3187 (s), 3089 (w), 3006 (w), 1622 (vs), 1586 (m), 1529 (vs), 1487 (s), 1401 (m), 1308-1233 (m), 1160 (m), 1088 (m), 1057 (m), 1012 (m), 886 (w), 810 (m), 703 (m), 615 (m), 576 (w), 485 (s), 418 (w); Anal. Calcd for $C_7H_7ClN_2S$, C, 45.04; H, 3.78; N, 15.01; S, 17.18%; Found C, 45.01; H, 3.74; N, 15.04; S, 17.20%.



1-(2, 4-Dichlorophenyl) thiourea **(3h)**

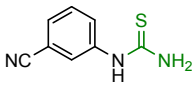
White solid (0.124 gr, 56% yield), m.p.160 °C (Literature report 160 °C); [8] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 9.75 (s, NH), 8.13-7.30 (brNH_2), 7.70 (s, 1H, aromatic ring), 7.65 (d, *J* = 9 Hz, 1H, aromatic ring), 7.43 (d, *J* = 9 Hz, 1H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ (ppm) 181.88, 135.82, 131.67, 131.55, 130.88, 129.44, 127.92. FT-IR (KBr, cm^{-1}): 3698 (vw), 3453 (s), 3398 (s), 3189 (s), 3081 (vw), 2986 (m), 1583 (s), 1523 (vs), 1474 (s), 1382 (w),

1326 (s),1306 (vs), 1234 (m),1227 (m), 1136 (w), 1100 (s), 1060 (m), 867 (s), 845-722 (m), 678 (s), 556 (w), 462 (w); Anal. Calcd for $C_7H_6Cl_2N_2S$, C, 38.03; H, 2.74; N, 12.67; S, 14.50%; Found C, 37.98; H, 2.70; N, 12.71; S, 14.53%.



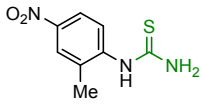
1-(3-Bromophenyl) thiourea **(3i)**

White solid (0.148 gr, 64% yield), m.p. 150-151 °C (Literature report151-152 °C); [2] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 9.83 (s, NH), 7.82 (s, 1H, aromatic ring), 8.27-7.26 (brNH_2 and m, 3H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 181.56, 141.39, 130.94, 127.14, 125.42, 121.94, 121.58; FT-IR (KBr, cm^{-1}): 3422 (vs), 3256 (m), 3158 (vs), 3081 (w), 2993 (vw), 1620 (vs), 1590 (m), 1578 (s), 1522 (vs), 1467 (s), 1405 (w), 1302 (s), 1256 (w), 1222 (w), 1066 (s), 889-830 (vw), 790 (m), 689-609 (w), 492 (m); Anal. Calcd for $C_7H_7BrN_2S$, C, 36.38; H, 3.05; N, 12.12; S, 13.87%; Found C, 36.35; H, 3.01; N, 12.14; S, 13.90 %.



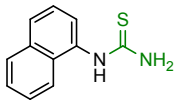
1-(3-Cyanophenyl) thiourea **(3j)**

White solid (0.106 gr, 60% yield), m.p. 159-161 °C (Literature report 158-160 °C); [2] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 10.18 (s, NH), 8.07 (s, 1H, aromatic ring), 7.80-7.17 (brNH_2 and m, 3H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 181.77, 140.81, 130.32, 127.87, 127.69, 125.79, 119.15, 111.59; FT-IR (KBr, cm^{-1}): 3364(m), 3187 (s), 3144 (s), 3042 (s), 2804 (vw), 2053 (w), 1672 9vs), 1623 (vs), 1572 (s), 1530 (vs), 1502 (s), 1449 (s), 1407 (s), 1357 (m), 1334 (w), 1265 (m), 1231 (w), 1201(s), 1158 (w), 1139 (w), 936 (vw), 879 (vw), 761(vw), 714-572 (vw); Anal. Calcd for $C_8H_7N_3S$, C, 54.22; H, 3.98; N, 23.71; S, 18.09%; Found C, 54.17; H, 3.95; N, 23.76; S, 18.12%.



1-(2-Methyl-4-nitrophenyl) thiourea **(3k)**

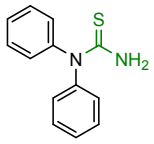
Pale yellow solid (0.110 gr, 52% yield), m.p. 162 °C (Literature report 188.5 °C); [9] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 9.43 (s, NH), 8.28 (s, 1H), 8.18-7.26 (brNH_2), 7.99 (d, *J* = 6 Hz, 1H, aromatic ring, 7.52 (d, *J* = 9Hz, 1H, aromatic ring), 2.31 (s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 182.50, 146.07, 142.58, 138.91, 131.85, 122.42, 120.92, 18.40; FT-IR (KBr, cm^{-1}): 3442 (m), 3431 (m), 3246 (m), 3138 (s), 2962 (m), 2760 (vw), 2666 (vw), 1615 (s), 1540 (vs), 1516 (m), 1491 (m), 1348 (vs), 1308-1257 (m),1188 (w), 1133 (w), 1092 (w), 1056 (m), 835 (m), 742 (m), 703 (w), 649 (w), 604 (w), 528 (w); Anal. Calcd for $C_8H_9N_3O_2S$, C, 45.49; H, 4.29; N, 19.89; S, 15.18%; Found C, 45.45; H, 4.26; N, 21.89; S, 15.21 %.



1-(Naphthalen-1-yl) thiourea **(3l)**

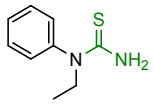
White solid (0.115 gr, 57% yield), m.p. 197 °C (Literature report 193-197 °C); [10] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 9.77 (s, NH), 7.97 (d, *J* = 6 Hz, 1H, aromatic ring), 7.88 (t, *J* = 7.5 Hz, 1H, aromatic ring), 7.46-7.60 (brNH_2 and m, 4H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 182.68, 134.82, 134.41, 130.11, 128.58, 127.34, 126.73, 126.68, 126.25, 125.49, 123.30; FT-IR (KBr, cm^{-1}): 3415 (vs), 3267 (m), 3167 (s), 2993-2928 (vw), 1618 (s), 1522

(s), 1408 (w), 1288 (m), 1097 (m), 1059 (m), 1040 (m), 792 (m), 772 (m), 716 (w), 638 (w), 493 (m); Anal. Calcd for $C_{11}H_{10}N_2S$, C, 65.32; H, 4.98; N, 13.85; S, 15.85%; Found C, 65.27; H, 4.95; N, 13.89; S, 15.89 %.



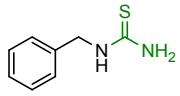
1,1-Diphenylthiourea **(3m)**

White solid (0.114 gr, 50% yield), m.p. 210 °C (Literature report 212 °C); [11] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 8.17-7.01 (brNH_2 and m, 10H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 183.22, 145.13, 129.83, 128.87, 127.53; FT-IR (KBr, cm^{-1}): 3452 (vs), 3277 (s), 3144 (w), 3032 (vw), 1594 (vs), 1491 (s), 1437 (vs), 1352 (vs), 1339 (vs), 1261 (w), 1075 (w), 1020 (vw), 1002 (vw), 819 (m), 769 (w), 756 (w), 705 (s), 693 (m), 625 (w), 561 (m), 543 (m), 491 (w); Anal. Calcd for $C_{13}H_{12}N_2S$, C, 68.39; H, 5.30; N, 12.27; S, 14.04 %; Found C, 68.34; H, 5.27; N, 12.30; S, 14.08 %.



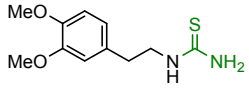
1-Ethyl-1-phenylthiourea **(3n)**

White solid (0.112 gr, 65% yield), m.p. 108 °C (Literature report 110 °C); [12] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 7.20-7.49 (brNH_2 and m, 5H, aromatic ring), 3.98-4.05 (q, J = 15 Hz, 2H, CH_2), 1.04 (t, J = 7.5 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 181.49, 142.33, 130.37, 128.36, 128.32, 49.47, 13.14; FT-IR (KBr, cm^{-1}): 3390 (vs), 3284 (vs), 3226 (s), 3175 (vs), 2976 (w), 2933 (w), 2871 (vw), 1626 (vs), 1597 (vs), 1489 (s), 1470 (vs), 1450 (s), 1422 (m), 1388 (vs), 1374 (s), 1353 (m), 1294 (m), 1186 (w), 1116 (m), 1073 (vw), 1026-997 (w), 938 (w), 817 (s), 772 (s), 709 (m), 700 (s), 677 (m), 640 (w), 615 (vw), 581 (vw), 544 (m), 496 (s); Anal. Calcd for $C_9H_{12}N_2S$, C, 59.97; H, 6.71; N, 15.54; S, 17.78 %; Found C, 59.94; H, 6.68; N, 15.58; S, 17.80 %.



1-Benzylthiourea **(3o)**

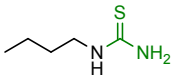
White solid (0.145 gr, 87% yield), m.p. 163-164 °C (Literature report 165 °C); [13] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 8.22 (s, NH), 7.42 –7.14 (brNH_2 and m, 5H, aromatic ring), 4.61 (s, 2H, CH_2); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 183.97, 139.79, 128.71, 127.78, 127.65, 127.31, 47.81; FT-IR (KBr, cm^{-1}): 3412 (s), 3248 (s), 3191 (s), 3025 (w), 2917 (vw), 2853 (vw),1628 (vs), 1557 (vs), 1467 (m), 1317 (m), 1233-961 (m), 699 (m), 644 (m), 605 (w), 517 (w), 453 (w); Anal. Calcd for $C_8H_{10}N_2S$, C, 57.80; H, 6.06; N, 16.85; S, 19.29%; Found C, 57.74; H, 6.01; N, 16.90, 19.35%.



1-(3,4-Dimethoxyphenethyl)thiourea **(3p)**

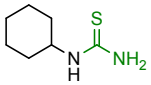
White solid (0.219 gr, 91% yield), m.p. 161-163 °C (Literature report165 °C); [14] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 7.40 (s, NH), 6.86 (d, J = 9 Hz, 1H, aromatic ring), 6.81 (s, 1H, aromatic ring), 6.72 (d, J = 9 Hz ,1H, aromatic ring), 3.73 (s. OMe), 3.71 (s, OMe), 3.57 (brs, 2H, CH_2), 2.71 (t, J = 9 Hz, 2H, CH_2); ^{13}C{H} NMR (DMSO-d_6, 101 MHz, 25 °C): δ(ppm) 183.91, 148.56, 146.97, 132.82, 120.34, 112.37, 111.65, 55.33, 55.21, 43.83, 39.44; FT-IR (KBr, cm^{-1}): 3324 (s), 3310 (s), 2999 (s), 2916 (s), 2837 (s), 1608 (s), 1590 (s), 1518 (vs), 1464 (vs), 1452 (vs),1418 (s), 1382 (s), 1323 (s), 1292

(m), 1262 (vs), 1237 (vs), 1185 (m), 1155 (s), 1141 (s), 1060 (vw), 1026 (s), 934 (vw), 848 (w), 805 (m), 766 (w), 740 (w), 643 (vw), 594 (vw), 553 (vw); Anal. Calcd for $C_{11}H_{16}N_2O_2S$, C, 54.98; H, 6.71; N, 11.66; S, 13.34%; Found C, 54.92; H, 6.67; N, 11.70; S, 13.37%.



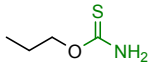
1-Butylthiourea **(3q)**

White solid (0.127 gr, 96% yield), m.p. 78-80 °C (Literature report 81 °C); [15] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ (ppm) 7.54 (s, NH), 6.88 (brNH_2), 3.33 (m, 2H, CH_2), 1.23-1.5 (m, 4H, CH_2), 0.87 (q, *J* = 6 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 75 MHz, 25 °C): δ(ppm) 183.48, 44.02, 31.37, 19.97, 14.14. FT-IR (KBr, cm^{-1}): 3362 (s), 3280 (s), 3235 (s), 3180 (s), 3083-2875 (m), 1618 (s), 1560 (m), 1458 (m), 1432 (m), 1357 (m), 1320 (w), 1163 (m), 1122 (m), 1024 (m), 900 (w), 727(m), 600-502 (m); Anal. Calcd for $C_6H_{14}N_2S$, C, 45.42; H, 9.15; N, 21.19; S, 24.25%; Found C, 45.38; H, 9.12; N, 21.21, S, 24.28 %.



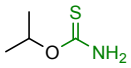
1-Cyclohexylthiourea **(3r)**

White solid (0.141 gr, 89% yield), m.p.160 °C (Literature report 164-165 °C); [3] ^{1}H NMR (DMSO-d_6, 300 MHz, 25 °C): δ(ppm) 7.51(s, NH), 6.80 (brNH_2), 1.11-1.85 (m, 11H, CH_2 and NCH); ^{13}C{H} NMR (DMSO-d_6, 101 MHz, 25 °C): δ(ppm) 188.94, 55.18, 41.57, 30.70, 29.93; FT-IR (KBr, cm^{-1}): 3289 (vs), 3159 (vs), 3101 (vs), 2930 (s), 2853 (m), 2681 (w), 1615 (vs), 1487-1402 (s), 1338 (m), 1259 (w), 1237 (w), 1157 (w), 1089 (m), 1030 (w), 820 (vw), 720 (s), 652 (w), 478 (vw); Anal. Calcd for $C_7H_{14}N_2S$ C, 53.12; H, 8.92; N, 17.70; S, 20.26%; Found C, 53.09; H, 8.88; N, 17.73; S, 20.30 %.



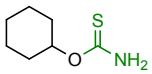
O-Propyl thiocarbamate **(5a)**

Yellow solid (0.107 gr, 90% yield), m.p. 34-35 °C (Literature report: 35 °C); [16] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ (ppm) 8.57 (s, NH), 8.24 (s, NH), 4.19 (t, *J* = 7.5 Hz, 2H, OCH_2), 1.59 (m, *J* = 7.5 Hz, 2H, CH_2), 0.85 (t, *J* = 7.5 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ (ppm) 191.36, 71.07, 21.58,10.05; FT-IR (KBr, cm^{-1}): 3339 (vs), 3277 (s), 3175 (s), 2979 (m), 2927 (m), 1617 (s), 1438 (vs), 1376 (s), 1364 (vw), 1309 (s), 1264 (s), 1185 (m), 1146 (m), 1084 (vs), 917 (s), 859 (m), 694 (m), 670 (vw), 640 (w), 589 (s); Anal. Calcd for C_4H_9NOS: C, 40.31; H, 7.61; N, 11.75, S, 26.90%. Found: C, 40.26; H, 7.57; N, 11.78, S, 26.94%.



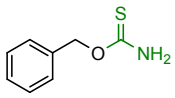
O-2-Propyl thiocarbamate **(5b)**

Yellow solid (0.098 gr, 82% yield), m.p. 80-81 °C (Literature report: 79-80 °C); [17] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.58 (s, NH), 8.23 (s, NH), 5.30 (sept, *J* = 6.25 Hz, 1H, OCH), 1.21 (d, *J* = 6.25 Hz, 6H, CH_3); ^{13}C NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.43, 72.78, 21.56; FT-IR (KBr, cm^{-1}): 3338 (vs), 3276 (s), 3171 (s), 2978 (m), 2929 (w), 1618 (vs), 1438 (s), 1376 (s), 1364 (s), 1310 (s), 1264 (s), 1185 (s), 1147 (m), 1083 (vs), 917 (s), 858 (s), 694 (m), 670 (vw), 640 (w), 589 (m), 493 (vw); Anal. Calcd for C_4H_9NOS: C, 40.31; H, 7.61; N, 11.75, S, 26.90%. Found: C, 40.28; H, 7.57; N, 11.78, S, 26.93%.



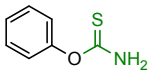
O-Cyclohexyl thiocarbamate **(5c)**

Yellow solid (0.127 gr, 80% yield), m.p. 73-75 °C (Literature report 72.5-73.5 °C); [18] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.57 (s, NH), 8.24 (s, NH), 5.04 (m, 1H, OCH), 1.15-1.88 (m, 10H, CH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.32, 77.40, 31.16, 24.81, 23.34; FT-IR (KBr, cm^{-1}): 3400 (s), 3330 (s), 3272 (vs), 3172 (vs), 2933 (vs), 2858 (vs), 1612 (vs), 1430 (s), 1376 (s), 1353 (s), 1321 (s), 1300 (s), 1154 (m), 1076 (vs), 1008 (s), 942 (s), 932 (s), 892 (m), 845 (m), 807 (w), 789 (w), 736 (vs), 670 (w), 644 (s), 586 (s), 548 (s), 520 (m); Anal. Calcd for $C_7H_{13}NOS$: C, 52.80; H, 8.23; N, 8.80, S, 20.13%. Found: C, 52.77; H, 8.79; N, 8.85, S, 20.12%.



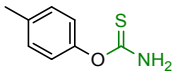
O-Benzyl thiocarbamate **(5d)**

Yellow solid (0.137 gr, 82% yield), m.p. 63-65 °C (Literature report 61-62 °C); [19] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.09 (s, NH), 7.73 (s, NH), 7.41-7.32 (m, 2H, aromatic ring), 7.20 (t, *J* = 7.5 Hz, 1H, aromatic ring), 7.07 (d, *J* = 7.5 Hz, 1H, aromatic ring), 6.70(d, *J* = 7.5 Hz, 1H, aromatic ring), 5.71 (s, 2H, CH_2); ^{13}C{H} NMR (DMSO-d_6, 101 MHz, 25 °C): δ(ppm) δ 183.99, 142.49, 128.05, 126.65, 126.47, 63.08; FT-IR (KBr, cm^{-1}): 3408 (s), 3277 (s), 3161 (s), 2925 (w), 1606 (vs), 1490 (w), 1458 (vw), 1426 (s), 1290 (m), 1227 (m), 1178 (vs), 1156 (w), 1105 (w), 1113 (s), 1040 (w), 1017 (s), 864 (s), 832 (w), 816 (m), 782 (m), 712 (s), 643 (vw), 630 (w), 592 (w), 541 (s), 496 (m), 448 (vw); Anal. Calcd for C_8H_9NOS: C, 57.46; H, 5.42; N, 8.38; S, 19.17%. Found: C, 57.40; H, 5.38; N, 8.42; S, 19.20%.



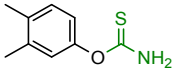
O-Phenyl thiocarbamate **(5e)**

Yellow solid (0.106 gr, 69% yield), m.p. 133-134 °C (Literature report 136-137 °C); [20] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.22 (s, NH), 9.02 (s, NH), 7.37 (t, *J* = 7.5 Hz, 2H, aromatic ring), 7.21 (t, *J* = 7.5 Hz, 1H, aromatic ring),7.04 (d, *J* = 10 Hz, 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.36, 153.16, 129.02, 125.54, 122.78; FT-IR (KBr, cm^{-1}): 3448 (vw), 3410 (vs), 3268 (s), 3160 (s), 1601 (s), 1458 (w), 1430 (s), 1289 (m), 1222 (w), 1199 (vs), 1162 (w), 1110 (vw), 1066 (w), 1024 (s), 1000 (s), 910 (w), 852 (s), 772 (s), 710 (m), 691 (s), 670 (vw), 622 (w), 563 (m), 503 (vw); Anal. Calcd for C_7H_7NOS: C, 54.88; H, 4.61; N, 9.14; S, 20.93%. Found: C, 54.83; H, 4.58; N, 9.17; 20.96%.



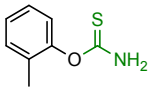
O-(*p*-Tolyl) thiocarbamate **(5f)**

Yellow solid (0.125 gr, 75% yield), m.p. 148-149 °C (Literature report 151-152 °C); [21] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.18 (s, NH), 8.98 (s, NH), 7.15 (d, *J* = 8.5 Hz, 2H, aromatic ring), 6.91 (d, *J* = 8.5 Hz, 2H, aromatic ring), 2.28 (s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.56, 150.99, 134.63, 129.40, 122.44, 20.36; FT-IR (KBr, cm^{-1}): 3448 (w), 3413 (vs), 3270 (s), 3156 (s), 2956 (w), 2923 (w), 1602 (vs), 1501 (m), 1420 (vs), 1291 (s), 1220 (s), 1198 (vs), 1162 (s), 1104 (m), 1017 (vs), 864 (s), 832 (w), 816 (m), 782 (w), 712 (m), 643 (vw), 630 (vw), 592 (w), 541 (s), 596 (m), 448 (vw); Anal. Calcd for C_8H_9NOS: C, 57.46; H, 4.42; N, 8.38, S, 19.17%. Found: C, 57.41; H, 4.38; N, 8.43, S, 19.21%.



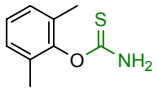
O- (3,4-Dimethylphenyl) thiocarbamate **(5g)**

Yellow solid (0.140 gr, 77% yield), m.p.140-141 °C; ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.13 (s, NH), 8.93 (s, NH), 7.10 (d, *J* = 8.0 Hz, 2H, aromatic ring), 6.81 (s, 1H, aromatic ring), 6.74 (d, *J*= 7.5, 1H, aromatic ring), 2.19 (s, 3H, aromatic CH_3), 2.18 (s, 3H, aromatic CH_3); ^{13}C NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.64, 151.13, 136.99, 133.36, 129.70, 123.38, 119.77, 19.31; FT-IR (KBr, cm^{-1}): 3409 (s), 3282 (s), 3182 (s), 2957 (w), 2924 (w), 1612 (vs), 1474 (m), 1466 (w), 1459 (w), 1421 (vs), 1376 (w), 1302 (s), 1242 (m), 1169 (vs), 1092 (s), 1025 (s), 961 (w), 857 (s), 782 (s), 748 (w), 739 (w), 656 (vw), 628 (m), 590 (vw), 529 (vs); Anal. Calcd for $C_9H_{11}NOS$: C, 59.64; H, 6.12; N, 7.73, S, 17.69%. Found: C, 59.61; H, 6.10; N, 7.76, S, 17.65%.



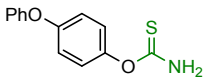
O-(*o*-Tolyl) thiocarbamate **(5h)**

Yellow solid (0.120 gr, 72% yield), m.p.134-135 °C (Literature report 132-134°C); [22] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.22 (s, NH), 9.03 (s, NH), 7.17 (m, 3H, aromatic ring), 6.96 (m, 1H, aromatic ring), 2.13(s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 195.13, 156.89, 135.92, 132.50,131.90, 130.94,128.28, 20.98; FT-IR (KBr, cm^{-1}): 3402 (vs), 3274 (vs), 3170 (vs), 2934 (w), 1606 (vs), 1490 (w), 1474 (w), 1458 (m), 1426(vs), 1290 (s), 1227 (s), 1178 (vs), 1156 (m), 1113 (s), 1040 (m), 1017 (s), 865 (w), 856 (s), 787 (w), 774 (m), 719 (s), 664 (w), 640 (w), 623 (w), 569 (s), 473 (vw); Anal. Calcd for C_8H_9NOS: C, 57.46; H, 4.42; N, 8.38, S, 19.17%. Found: C, 57.42; H, 4.37; N, 8.44, S, 19.20%.



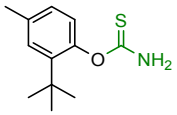
O-(2,6-Dimethylphenyl) thiocarbamate **(5i)**

Yellow solid (0.120 gr, 66% yield), m.p.168-169 °C (Literature report 171-172 °C); [19] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.17 (s, NH), 8.98 (s, NH), 7.03 (m, 3H, aromatic ring), 2.09 (s, 6H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, DMSO-d_6): δ(ppm) 189.18, 150.18, 130.63, 128.21, 125.37,15.93; FT-IR (KBr, cm^{-1}): 3410 (s), 3292 (s), 3181 (s), 2956 (vw), 2923 (w), 1611 (vs), 1466 (w), 1459 (w), 1420 (vs), 1376 (w), 1302 (s), 1383 (s), 1267 (m), 1239 (w), 1174 (vs), 1167 (vs), 1092 (s), 1025 (s), 898 (w), 857 (s), 782 (s), 748 (w), 739 (w), 656 (w), 628 (w), 590 (vw), 529 (vs); Anal. Calcd for $C_9H_{11}NOS$: C, 59.64; H, 6.12; N, 7.73, S, 17.69%. Found: C, 59.60; H, 6.10; N, 7.76, S, 17.68%.



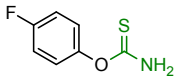
O-(4-Phenoxyphenyl) thiocarbamate **(5j)**

Yellow solid (0.191 gr, 78% yield), m.p. 139-141 °C; ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.25 (s, NH), 9.04 (s, NH), 7.40 (m, 2H, aromatic ring), 7.05 (m, 7H, aromatic ring); ^{13}C NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.53, 156.60, 153.96, 148.74, 130.05, 124.24, 123.51, 118.86, 118.54; FT-IR (KBr: cm^{-1}): 3418 (s), 3276 (m), 3172 (w), 2998 (vw), 1602 (s), 1504 (s), 1438 (w), 1358 (w), 1344 (w), 1294 (w), 1211 (vs), 1094 (w), 1074 (w), 1010 (w), 978 (m), 875 (s), 850 (vs), 815 (s), 752 (vs), 691 (m), 629 (w), 549 (w), 501 (s); Anal. Calcd for $C_{13}H_{11}NO_2S$: C, 63.65; H, 4.52; N, 5.71, S, 13.07%. Found: C, 63.61; H, 4.48; N, 5.73, S, 13.10%.



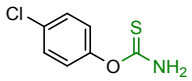
O-(2-(*tert*-Butyl)-4-methylphenyl) thiocarbamate **(5k)**

Yellow solid (0.116 gr, 52% yield), m.p. 164-165 °C; ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.15 (s, NH), 8.96 (s, NH), 7.10 (s, 1H, aromatic ring), 6.98 (d, *J* = 7.5 Hz, 1H, aromatic ring), 6.83 (d, *J* = 7.5 Hz, 1H, aromatic ring), 2.07 (s, 3H, aromatic CH_3), 1.28(s, 9H, $C(CH_3)_3$); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.44, 149.32, 140.34, 134.07, 127.15, 126.60, 125.21, 34.01, 30.17, 20.70; FT-IR (KBr, cm^{-1}): 3382 (s), 3283 (vs), 3178 (vs), 3033 (w), 3009 (w), 2961 (s), 2922 (m), 2869 (w), 1611 (s), 1420 (vs),1340 (w), 1288 (m), 1274 (s),1261 (w), 1204 (vs), 1141 (w) 1092 (s), 1021 (s), 937 (w), 913 (vw), 878 (w), 846 (s), 815 (w), 748 (vw), 682 (vw), 670 (vw), 663 (vw), 631 (w), 614 (w), 526 (s), 450 (vw); Anal. Calcd for C_7H_6FNOS: C, 49.11; H, 3.53; N, 8.18, S, 18.73%. Found: C, 49.07; H, 3.51; N, 8.20, S, 18.75%.



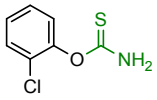
O-(4-Fluorophenyl) thiocarbamate **(5l)**

Yellow solid (0.087 gr, 51% yield), m.p. 157-158 °C; ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.25 (s, NH), 9.04 (s, NH), 7.18 (d.d, *J* = 9.0 Hz, *J* = 4.5 Hz, 2H, aromatic ring), 7.07 (d.d, *J* = 9.0 Hz, *J* = 4.5 Hz, 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.40, 157.56-161.39 (d, *J* = 241.3 Hz), 147.29-147.31 (d, *J* = 1.3 Hz), 124.50-124.64 (d, *J* = 8.2 Hz), 115.38-115.75 (d, *J* = 23.3 Hz); FT-IR (KBr, cm^{-1}): 3344 (s), 3265 (s), 3160 (s), 3043 (w), 1612 (s), 1508 (s), 1501 (s), 1474 (w), 1466 (w), 1458 (w), 1430 (vs), 1294 (m), 1254 (m), 1201 (vs), 1087 (m), 1038 (vs), 1016 (m), 878 (m), 859 (m), 841 (m), 803 (s), 718 (w), 670 (vw), 644 (vw), 634 (vw), 592 (m), 510 (vw), 463 (vw); Anal. Calcd for C_7H_6FNOS: C, 49.11; H, 3.53; N, 8.18, S, 18.73%. Found: C, 49.07; H, 3.50; N, 8.20, S, 18.71%.



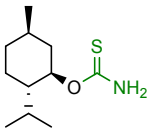
O-(4-Chlorophenyl) thiocarbamate **(5m)**

Yellow solid (0.101 gr, 54% yield), m.p.152-153 °C (Literature report 155-157 °C); [16] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ (ppm) 9.32 (s, NH), 9.10 (s, NH), 7.43 (d, *J* = 8.75 Hz, 2H, aromatic ring), 7.09 (d, *J* = 8.75 Hz, 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ (ppm) 190.02, 151.9, 129.76, 128.94, 124.78; FT-IR (KBr, cm^{-1}): 3370 (s), 3270 (vs), 3173 (vs), 2925 (w), 1603 (vs), 1478 (s), 1465 (s), 1458 (s), 1438 (vs), 1283 (m), 1214 (vs), 1084 (vs), 1012 (vs), 864 (s), 842 (m), 822 (w), 738 (s), 714 (w), 631 (w), 622 (m), 548 (m), 522 (s), 469 (m), 439 (w); Anal. Calcd for C_7H_6ClNOS: C, 44.81; H, 3.22; N, 7.46, S, 17.09%. Found: C, 44.78; H, 3.18; N, 7.51, S, 17.03%.



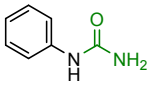
O-(2-Chlorophenyl) thiocarbamate **(5n)**

Yellow solid (0.086 gr, 46% yield), m.p.158-160 °C; ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 9.35 (s, NH), 9.18 (s, NH), 7.50 (d, *J* = 7.5 Hz, 1H, aromatic ring), 7.35 (t, *J* = 7.5 Hz, 1H, aromatic ring), 7.22 (m, 2H, aromatic ring); ^{13}C NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 189.18, 148.90, 129.81, 127.90, 127.20, 126.81, 125.48; FT-IR (KBr, cm^{-1}): 3368 (s), 3277 (vs), 3176 (vs), 1618 (vs), 1474 (s), 1458 (s), 1442 (s), 1285 (m), 1260 (s), 1223 (vs), 1064 (s), 1034 (m), 1017 (s), 871 (m), 856 (m), 767 (m), 728 (m), 717 (m), 670 (w), 633 (w), 617 (w), 560 (m), 494 (w), 426 (vw); Anal. Calcd for C_7H_6ClNOS: C, 44.81; H, 3.22; N, 7.46, S, 17.09%. Found: C, 44.78; H, 3.16; N, 7.52, S, 17.04%.



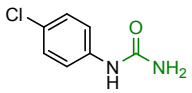
L-(–)-Menthyl thiocarbamate **(5o)**

Yellow solid (0.151 gr, 70% yield), m.p. 126-127 °C (Literature report 124 °C); [23] $[\alpha]_D^{18}$=-125 (*c* 0.05, $CHCl_3$); HPLC (254 nm, H_2O/CH_3CN (30: 70%)): retention time, 3.06 min; ^{1}HNMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.58 (s, NH), 8.28 (s, NH), 5.02 (m, 1H, OCH), 1.90 (m, 2H, CH_2), 1.63 (m, 2H, CH_2), 1.56 (m, 1H, CH), 1.40 (m, 1H, CH), 1.26 (m, 1H, CH), 1.06 (m, 2H, CH_2), 0.89 (m, 6H, CH_3), 0.84 (d, *J* = 8.5 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 190.73, 79.16, 46.70, 33.70, 30.75, 25.82, 23.08, 21.88, 20.38, 16.65; FT-IR (KBr, cm^{-1}): 3401 (vs), 3292 (vs), 3180 (vs), 2964 (vs), 2928 (vs), 2873 (s), 1608 (vs), 1422 (s), 1303 (s), 1179 (s), 1073 (vs), 1055 (s), 981 (s), 954 (s), 917 (s), 878 (s), 848 (s), 808 (vw), 775 (vw), 738 (vs), 706 (w), 626 (m), 556 (s); Anal. Calcd for $C_{11}H_{21}NOS$: C, 62.83; H, 10.11; N, 6.11, S, 13.98%. Found: C, 62.80; H, 10.08; N, 6.14, S, 14.00%.



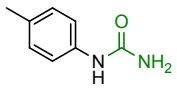
1-Phenylurea **(7a)**

white solid (0.113 gr, 83% yield), m. p. 146-147 °C (Literature report: 143-145 °C); [24] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.48 (s, NH), 7.36 (d, *J* = 7.5 Hz, 2H, aromatic ring), 7.19 (t, *J* = 7.5 Hz, 2H, aromatic ring), 6.86 (t, *J* = 7.5 Hz, 1H, aromatic ring), 5.81 (s, NH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 155.94, 140.46, 128.52, 120.98, 117.64; FT-IR (KBr, cm^{-1}): 3428 (vs), 3312 (vs), 3038 (m), 1652 (vs), 1616 (vs), 1594 (vs), 1558 (vs), 1500 (m), 1357 (s), 1291 (w), 1257 (m), 1194 (w), 1117 (w), 1075 (vw), 1034 (w), 904 (w), 860 (w), 774 (w), 752 (vs), 697 (vs), 621 (w), 588 (s), 496 (m), 443 (vw), 438 (vw); Anal. Calcd for $C_7H_8N_2O$: C, 61.75; H, 5.92; N, 20.58%. Found: C, 60.83; H, 5.83; N, 21.04%.



1-(4-Chlorophenyl) urea **(7b)**

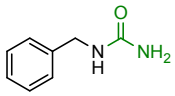
White solid(0.123 gr, 72% yield), m.p. 210 °C (Literature report: 208-210 °C); [24] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.65 (s, NH), 7.41 (d, *J* = 8.0 Hz, 2H, aromatic ring), 7.22 (d, *J* = 8.0 Hz, 2H, aromatic ring), 5.90 (s, NH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 155.85, 139.43, 128.33, 124.51, 119.16; FT-IR (KBr, cm^{-1}): 3420 (vs), 3289 (vs), 2874 (w), 1652 (vs), 1614 (vs), 1591 (vs), 1548 (vs), 1492 (m), 1401 (m), 1357 (s), 1296 (w), 1275 (m), 1251 (m), 1112 (vw), 1092 (s), 1014 (m), 870 (s), 820 (vs), 773 (m), 731 (s), 686 (w), 622 (w), 504 (s), 491 (s), 452 (vw); Anal. Calcd for $C_7H_7ClN_2O$: C, 49.28; H, 4.14; N, 16.42 %. Found: C, 49.21; H, 4.16; N, 16.44 %.



1-(*p*-Tolyl) urea **(7c)**

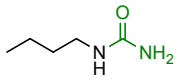
White solid (0.132 gr, 88% yield), m. p.180-182 °C (Literature report: 182-184 °C); [24] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 8.37 (s, NH), 7.25 (d, *J* = 8.5 Hz, 2H, aromatic ring), 6.99 (d, *J* = 8.5 Hz, 2H, aromatic ring), 5.76 (s, NH_2), 2.18 (s, 3H, aromatic CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 156.03, 137.89, 129.70, 128.92, 117.78, 20.22; FT- IR (KBr, cm^{-1}): 3428 (vs), 3311 (vs), 3042 (m), 2919 (m), 1652 (vs), 1600 (vs), 1553 (vs), 1408 (m), 1357 (s), 1304 (w),

1280 (w), 1257 (m), 1110 (m), 1024 (m), 931 (vw), 871 (w), 825 (vw), 812 (vs), 779 (s), 708 (vw), 638 (vw), 551 (m), 502 (m), 484 (vw), 416 (vw); Anal. Calcd for $C_8H_{10}N_2O$: C, 63.98; H, 6.71; N, 18.65 %. Found: C, 63.86; H, 6.75; N, 18.64 %.



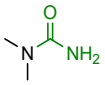
1-Benzylurea **(7d)**

White solid (0.134 gr, 89% yield), m. p. 143-146 °C (Literature report: 144-145 °C); [25] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 7.28 (m, 5H, aromatic ring), 6.44 (s, NH), 4.17 (s, 2H, CH_2), 5.56 (s, NH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 158.72, 140.82, 128.13, 126.43, 126.47, 42.75; FT-IR (KBr, cm^{-1}): 3429 (s), 3321 (s), 3031(m), 2932 (m), 2881 (m), 1652 (s), 1594 (s), 1565 (s), 1468 (m), 1457 (m), 1383 (m), 1328 (v), 1312 (m), 1208 (vw), 1143 (m), 1110 (w), 1026 (w), 912 (vw), 750 (m), 696 (s), 585 (s), 547 (vw), 464 (m); Anal. Calcd for $C_8H_{10}N_2O$: C, 43.98; H, 6.71; N, 18.65 %. Found: C, 43.83; H, 6.63; N, 18.74 %.



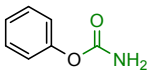
1-Butylurea **(7e)**

White solid (0.114 gr, 98% yield), m.p. 97°C (Literature report: 95-96.5 °C); [26] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 6.57 (s, NH), 6.00 (s, NH_2), 3.51 (t, J = 6.2 Hz, 2H, CH_2), 1.89 (m, 4H, CH_2), 1.45 (t, J = 7.5 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 158.84, 38.75, 32.00, 19.44, 13.61; FT-IR (KBr, cm^{-1}): 3430 (vs), 3355 (vs), 2960 (vs), 2936 (vs), 2872 (vs), 1649 (vs), 1602 (vs), 1566 (vs), 1478 (m), 1461 (m), 1389 (w), 1362 (s), 1328 (s), 1265 (m), 1158 (s), 1125 (w), 1060 (vw), 996 (vw), 780 (m), 744 (m), 660 (vw), 653 (vs), 434 (m); Anal. Calcd for $C_5H_{12}N_2O$: C, 51.70; H, 10.41; N, 24.12 %. Found: C, 51.61; H, 10.45; N, 24.04 %.



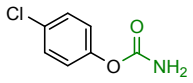
1,1-Dimethylurea **(7f)**

White solid (0.079 gr, 90% yield), m. p. 178-181 °C (Literature report: 181.05 °C); [27] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C), δ(ppm) 5.74 (s, NH_2), 2.73 (s, 6H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 159.01, 35.85; FT-IR (KBr, cm^{-1}): 3407 (s), 3204 (s), 2934(m), 2871 (vw), 1650 (s), 1611 (s), 1513 (s), 1407 (s), 1277 (m), 1180 (w), 1102 (m), 1072 (m), 1027 (m), 876 (vw), 775 (s), 722 (m), 606 (s), 556 (s); Anal. Calcd for $C_3H_8N_2O$: C, 40.90; H, 9.15; N, 31.79 %. Found: C, 40.83; H, 9.19; N, 31.84 %.



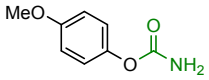
Phenyl carbamate **(7g)**

White solid (0.110 gr, 80% yield), m. p. 143-144°C (Literature report: 145.1 °C); [28] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 7.35 (t, J = 7.5 Hz, 2H, aromatic ring), 7.17 (t, J = 7.5 Hz, 1H, aromatic ring), 7.07 (d, J = 7.5 Hz, 2H, aromatic ring), 6.89 (s, NH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 154.76, 151.02, 129.11, 124.77,121.88; FT-IR (KBr, cm^{-1}): 3410 (s), 3335 (s), 3271 (s), 3189 (s), 3071 (s), 1707 (vs), 1614 (s), 1486 (s), 1372 (vs), 1201 (vs), 1162 (s), 1069 (m), 1003 (m), 1022 (m), 973 (vs), 915 (w), 838 (m), 762 (s), 696 (vs), 585 (s); Anal. Calcd for $C_7H_7NO_2$: C, 61.31; H, 5.14; N, 10.21%. Found: C, 61.28; H, 5.16; N, 10.32%.



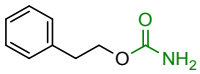
4-Chlorophenyl carbamate **(7h)**

White solid (0.113 gr, 66% yield), m. p. 167-168 °C (Literature report: 165-166 °C); [29] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 6.99 (brs, NH), 7.33 (d, J = 7.5 Hz, 2H, aromatic ring), 7.26 (brs, NH), 7.42 (d, J = 7.5 Hz, 2H, aromatic ring); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 154.38, 149.82, 129.00, 128.84, 123.75; FT-IR (KBr, cm^{-1}): 3413 (m), 3334 (w), 3272 (m), 3192 (w), 1706 (vs), 1595 (s), 1478 (s), 1365 (s), 1225 (vs), 1097 (s), 1013 (m), 970 (vs), 859 (m), 827 (s), 763 (m), 736 (m), 501 (m); Anal. Calcd for $C_7H_6ClNO_2$: C, 49.00; H, 3.52; N, 8.16%. Found: C, 48.67; H, 3.58; N, 8.21%.



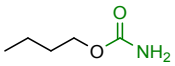
4-Methoxyphenyl carbamate **(7i)**

White solid (0.140 gr, 84% yield), m. p. 129-130 °C (Literature report: 127.3-129 °C); [30] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 7.08 (brs, NH), 6.99 (d, J = 9 Hz, 2H, aromatic ring), 6.87 (brs, NH and d, J = 9 Hz, 2H, aromatic ring), 3.71 (s, 3H, OCH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 156.18, 155.16, 144.45, 122.72, 114.05, 55.27; FT-IR (KBr, cm^{-1}): 3410 (s), 3340 (s), 3270 (s), 3208 (s), 3065 (vw), 3016 (vw), 2974 (m), 2938 (m), 2844 (m), 1764 (w), 1714 (vs), 1624 (w), 1595 (vw), 1507 (s), 1459 (m), 1445 (w), 1376 (vs), 1298 (m), 1246 (s), 1206 (vs), 1186 (s), 1127 (w), 1102 (m), 1030 (s), 1008 (m), 978 (s), 954 (m), 933 (vw), 848 (s), 821 (s), 784 (m), 765 (m), 726 (w), 705 (w), 670 (w), 564 (s), 524 (s), 419 (w); Anal. Calcd for $C_8H_9NO_3$: C, 57.48; H, 5.43; N, 8.38%. Found: C, 57.41; H, 5.47; N, 8.45%.



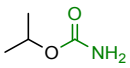
Phenethyl carbamate **(7j)**

White solid (0.142 gr, 86% yield), m. p. 94-97 °C (Literature report: 93-95 °C); [31] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 7.16-7.32 (m, 5H, aromatic ring), 6.46 (brs, NH_2), 4.10 (t, J =7.5 Hz, 2H, CH_2), 2.83 (t, J = 7.5 Hz, 2H, CH_2); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 34.87, 63.89, 126.17, 128.25, 128.77, 138.26, 156.65; FT-IR (KBr, cm^{-1}): 3429 (s), 2965(m), 1694 (vs), 1412(vs), 1343 (vs), 1240 (m), 1079(s), 1046 (m), 752 (s), 702 (vs), 645 (m), 570 (m), 497 (m); Anal. Calcd for $C_9H_{11}NO_2$: C, 65.44; H, 6.71; N, 8.48%. Found: C, 65.40; H, 6.68; N, 8.48%.



n-Butyl carbamate **(7k)**

White solid (0.011 gr, 93% yield), m. p. 54-55 °C (Literature report: 55 °C); [32] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 6.38 (brs, NH_2), 3.87 (t, J = 5.0 Hz, 2H, CH_2), 1.50 (m, 2H, CH_2), 1.28 (m, 2H, CH_2), 0.86 (t, J = 7.5 Hz, 3H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C): δ(ppm) 156.83, 62.91, 30.69, 18.54, 13. 51; FT-IR (KBr, cm^{-1}): 3417 (m), 3200 (m), 2962 (m), 2874 (m), 1696 (s), 1435 (m), 1339 (m), 1254 (m), 1121 (w), 1080 (vs), 943 (m), 887 (vw), 788 (m), 740 (w), 638 (s), 556 (s), 438 (m); Anal. Calcd for $C_5H_{11}NO_2$: C, 51.26; H, 9.46; N, 11.96%. Found: C, 51.18; H, 9.48; N, 12.05%.



Isopropyl carbamate **(7l)**

White solid (0.086 gr, 83% yield), m. p. 89-90 °C (Literature report: 89-93 °C); [33] ^{1}H NMR (DMSO-d_6, 250 MHz, 25 °C): δ(ppm) 6.33 (brs, NH_2), 4.67 (h, J = 6.3 Hz, 1H, CH), 1.12 (d, J = 6.3 Hz, 6H, CH_3); ^{13}C{H} NMR (DMSO-d_6, 63 MHz, 25 °C), δ(ppm): 156.7, 66.0, 22.0; FT-IR (KBr, cm^{-1}): 3429 (vw), 3218 (v), 2985 (m), 2985 (s), 1684 (s), 1417 (s), 1320 (s), 1108 (s), 1046 (s), 901 (m), 825 (m), 793 (s), 600 (vs), 460 (m), 412 (m); Anal. Calcd for $C_4H_9NO_2$: C, 46.59; H, 8.80; N, 13.58%. Found: C, 46.58; H, 8.78; N, 13.65%.

References

1. C.D. Pawar, S. L. Chavan, U. D. Pawar, D. N. Pansare, S. V. Deshmukh and D. B. Shinde, *J. Chin. Chem. Soc.*, 2019, **66**, 257-264.
2. M. P. Hay, S. Turcotte, J. U. Flanagan, M. Bonnet, D. A. Chan, P. D. Sutphin, p. Nguyen, A. J. Giaccia and W. A. J. Denny, *Med. Chem.*, 2010, **53**, 787–797.
3. S. Grosjean, S. Trikib, J.C. Meslina, K. Julienne, D. Deniaud. *Tetrahedron*, **2010**, *66*, 9912–9924.
4. **Z.** Ngaini, W. S. H. Wan Zulkiplee and A. N. Abd Halim, *J. Chem.,* 2017.
5. A. K. Verma, A. Bishnoi, S. Fatma, H. Parveen and V. Singh. *Drug Res.*, 2018, **68**, 222–231.
6. P. D. Zalavadiya, R. M. Ghetiya, B. L. Dodiya, P. B. Vekariya and H. S. Joshi, *J. Heterocycl. Chem.,* 2013, **50**, 973–978.
7. J. L. Woodring, S. H. Lu, L. Krasnova, S. C. Wan, J. B. Chen, C. C. Chou, Y. C. Huan, T. J. Rachel Cheng, Y. T. Wu, Y. H. Chen, J. M. Fang, M. D. Tsai and C. H. Wong, *J. Med. Chem.,* 2020, **63**, 205–215.
8. G. M. Dyson, H. J. George and R. F. Hunter, *J. Chem. Soc.,* 1926, **129**, 3041–3044.
9. G. M. Dyson and H. J. George, *J. Chem. Soc., Trans.* 1924, **125**, 1702–1708.
10. R. V. Patel, S. W. Park, *Eur. J. Med. Chem.,* 2014, **71**, 24–30.
11. R. G. Neville and J. J. McGee, *Can. J. Chem.*, 1963, **41**, 2123–2129.
12. G. V. Nair, *Indian J. Chem.,* 1966, **4**, 516–520
13. M. M. Aly, A. M. Fahmy and A. M. Gaber, 1990, **53**, 253–258.
14. J. Kosary, E. Kasztreiner, F. Andrasi, *Die Pharmazie*, 1989, **44**, 191–193.
15. J. Fatimi, J. F. Lagorce, J. L. Duroux, M. L. Chabernaud, J. Buxeraud and C. Raby, *Chem. Pharm. Bull.,* 1994, **42**, 698–701.
16. M. Delepine and P. Schving, *Bull. Soc. Chim.,* 1910, **7**, 895–901.
17. M. Battegay and E. Hegazi, *Helv.Chim. Acta*, 1933, **16**, 999–1008.
18. C. Weibull, *Biochim. Biophys. Acta*, 1948, **2**, 351–361.
19. K. A. Jensen, A. Holm and J. Wolffjen, *Acta Chem. Scand.,* 1969, **23**, 1567.
20. O. Ponomarov, Z. Padelkova and J. Hanusek, *J. Heterocycl. Chem.,* 2011, **48**, 1225–1228.
21. W. Walter and K. D. Bode, *Justus Liebigs Ann. Chem*., 1965, **681**, 64–84.
22. A. R. Modarresi-Alam, I. D. Inaloo and E. Kleinpeter, *J. Mol. Struct.*, 2012, **1024**, 156–162.
23. F. Peudru, F. Le Cavelier, J. F. Lohier, M. Gulea and V. Reboul, *Org. Lett.,* 2013, **15**, 5710-5715.
24. D. Habibi, S. Heydari, A. Faraji, H. Keypour and M. Mahmoudabadi, *Polyhedron*, 2018, **151**, 520–529.
25. C. H. Wang, T. H. C. C. Hiseh, C. C. Lin, W. H. Yeh, C. A. Lin and T. C. Chien, Synlett, 2015, **26**, 1823–1826.
26. D. M. Manidhar, K. Uma Maheswara Rao, C. Suresh Reddy, Ch. Syamasunder, K. Adeppa and K. Misra, *Res. Chem. Intermed.,* 2012, **9**, 2479–2489.
27. D. Ferro, G. Barone, G. Della Gatta and V. Piacente, J. Chem. Thermodyn., 1987, **19**, 915–923.
28. S. Wishkerman and J. Bernstein, *Chem. Erup. J.,* 2008, **14**, 197–203.
29. E. Grigat and R. Puetter, *Chem. Ber.*, 1966, **99**, 958–975.
30. Y. Liang, M.L. Tang, Z. Huo, C. Zhang and X. Sun, *Molecules*, 2020, **25**, 1138.
31. N. Hen, M. Bialer and B. Yagen, *J. Med. Chem.,* 2012, **55**, 2835–2845.
32. P. Wang, Sh. Liu, L. Lu, X. Ma, Y. He and Y. Deng, *RSC Adv.*, 2015, **5**, 62110–62115.
33. V. Valenta, M. Bartosova and M. Protiva, *Collect. Czech. Chem. Commun.*, 1980, **45**, 517–528.

Spectral of Products

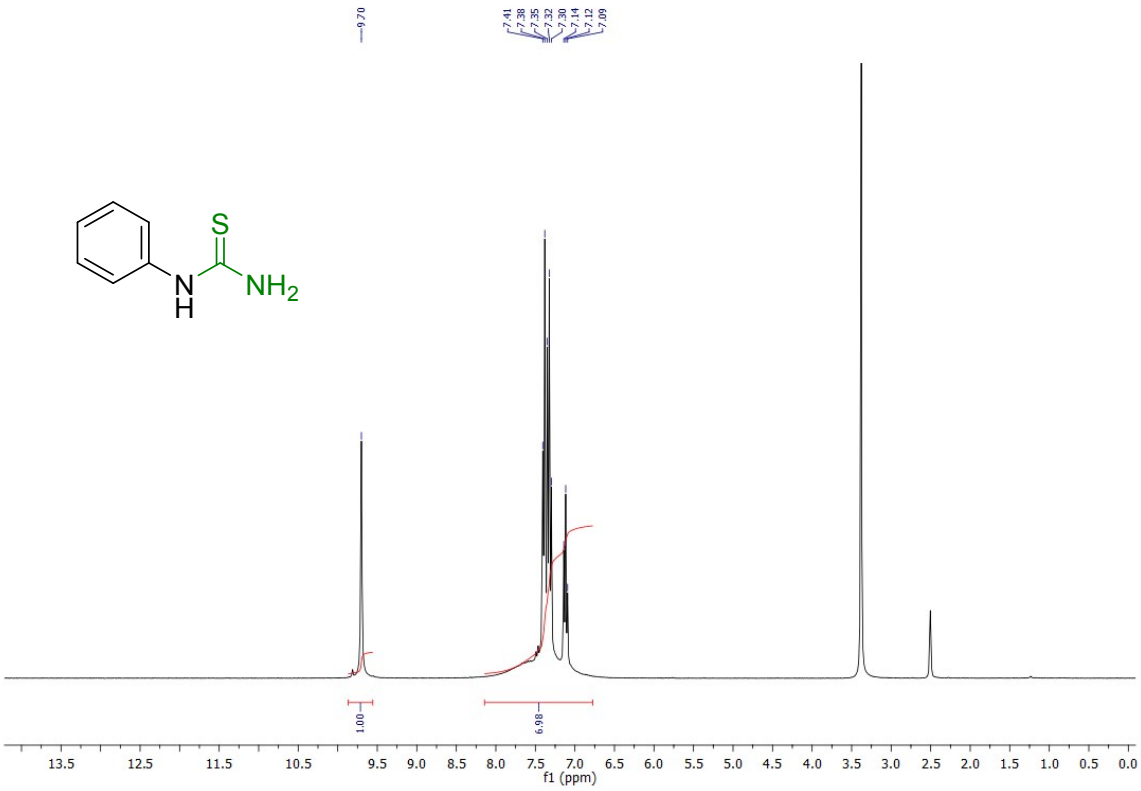


Figure S1. ^{1}H NMR spectrum of 3a in DMSO-d_6 (300MHz)

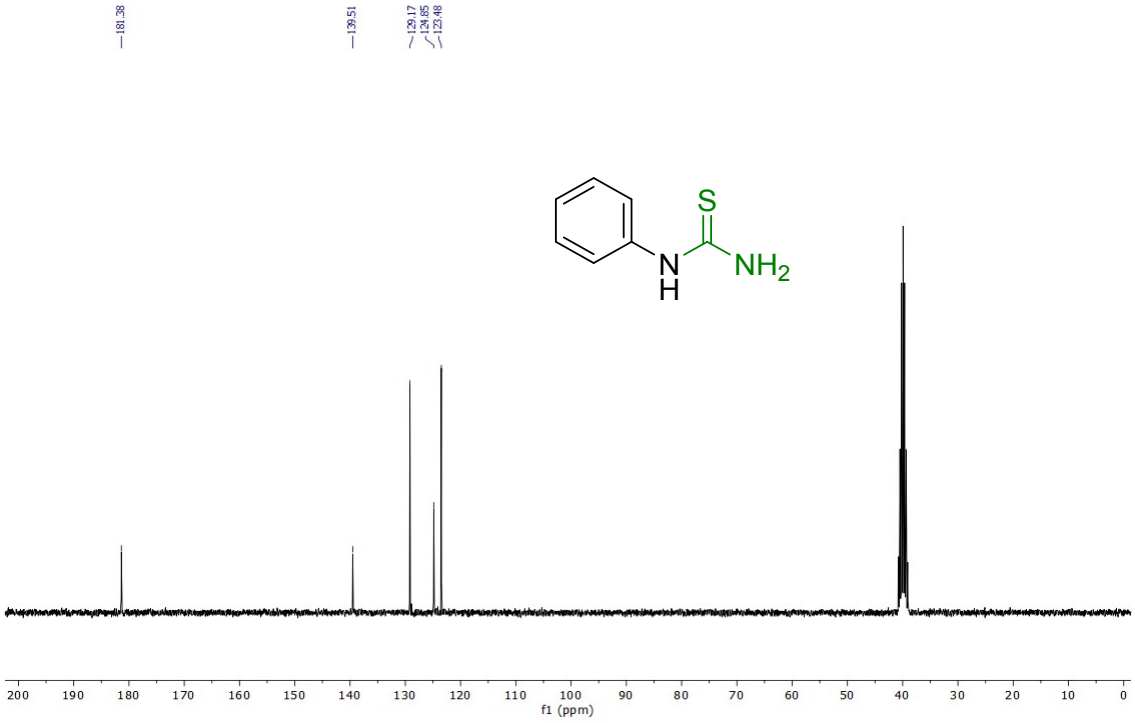


Figure S2. ^{13}C NMR spectrum of 3a in DMSO-d_6 (75MHz)

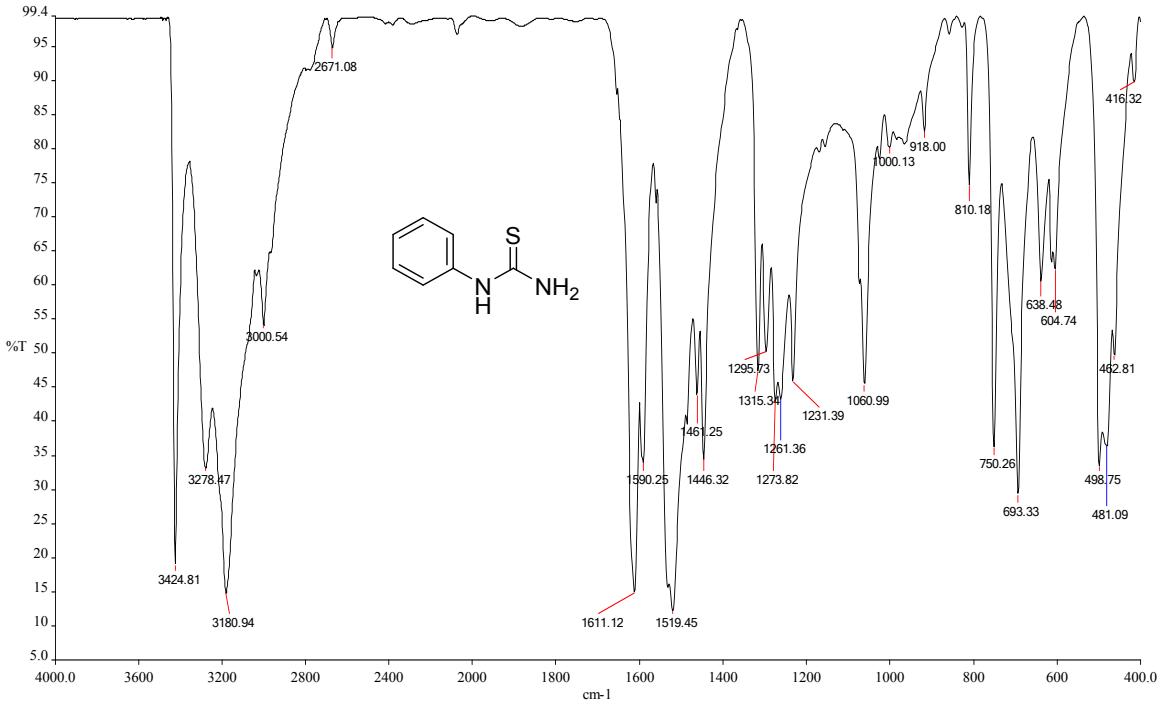
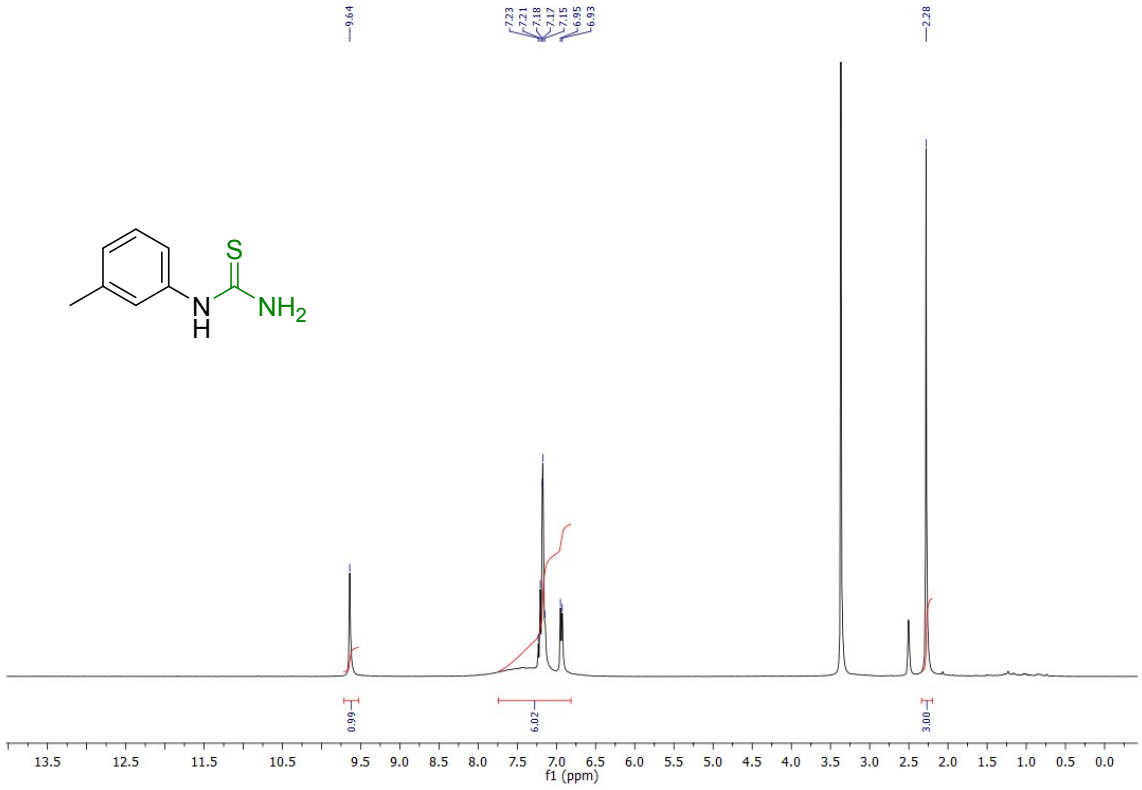
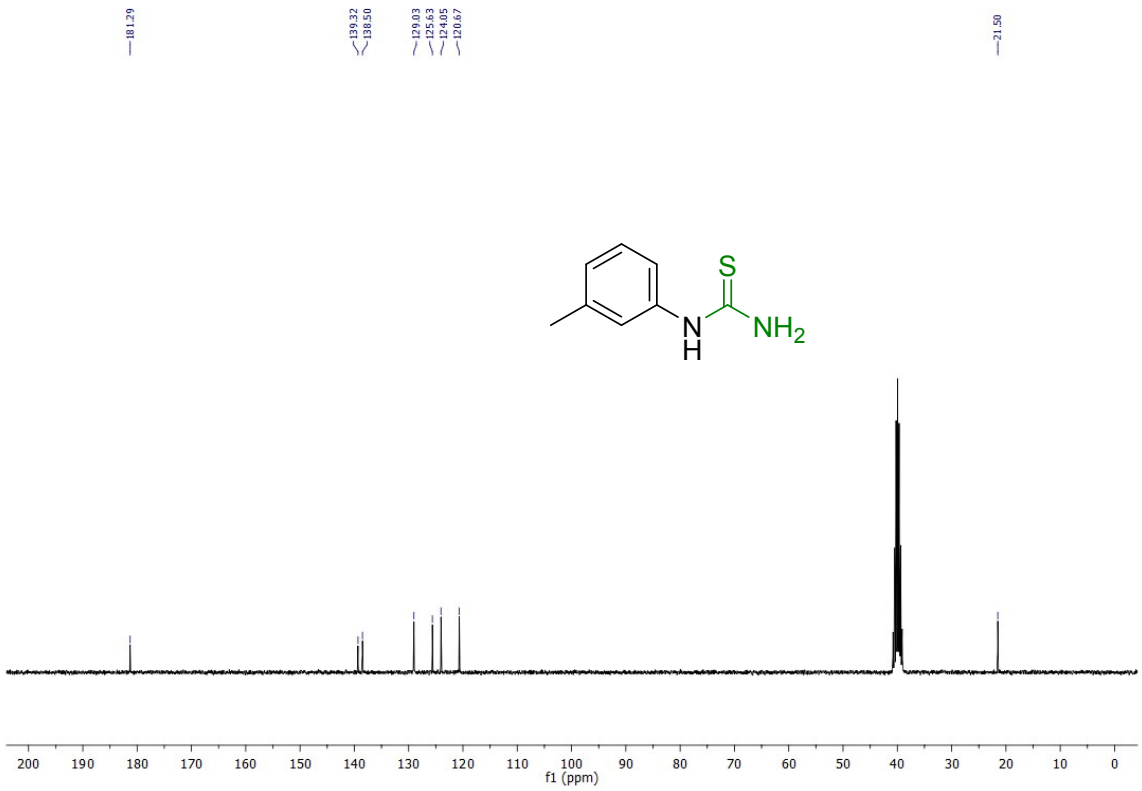


Figure S3. FT-IR spectrum of 3a in KBr



FigureS4. ^{1}H NMR spectrum of 3b in DMSO-d_6 (300MHz)



FigureS5. ^{13}C NMR spectrum of 3b in DMSO-d_6 (75MHz)

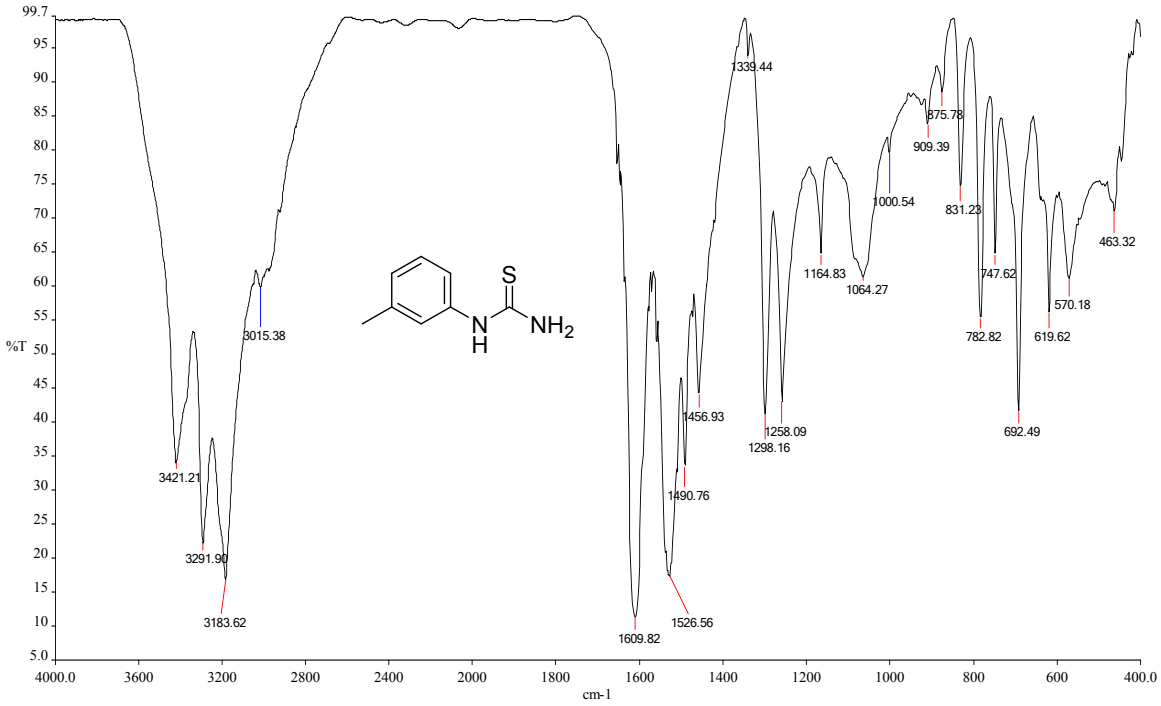


Figure S6. FT-IR spectrum of 3b in KBr

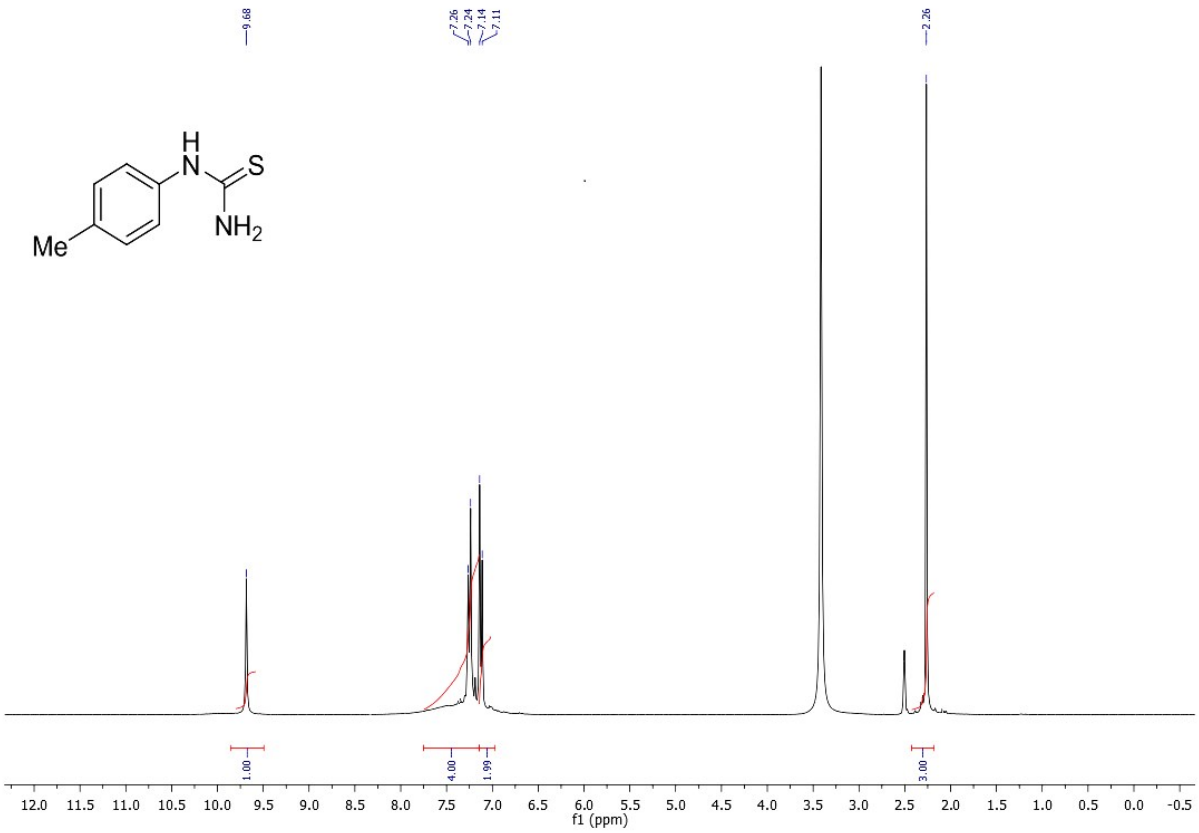


Figure S7. ^{1}H NMR spectrum of 3c in DMSO-d_6 (300MHz)

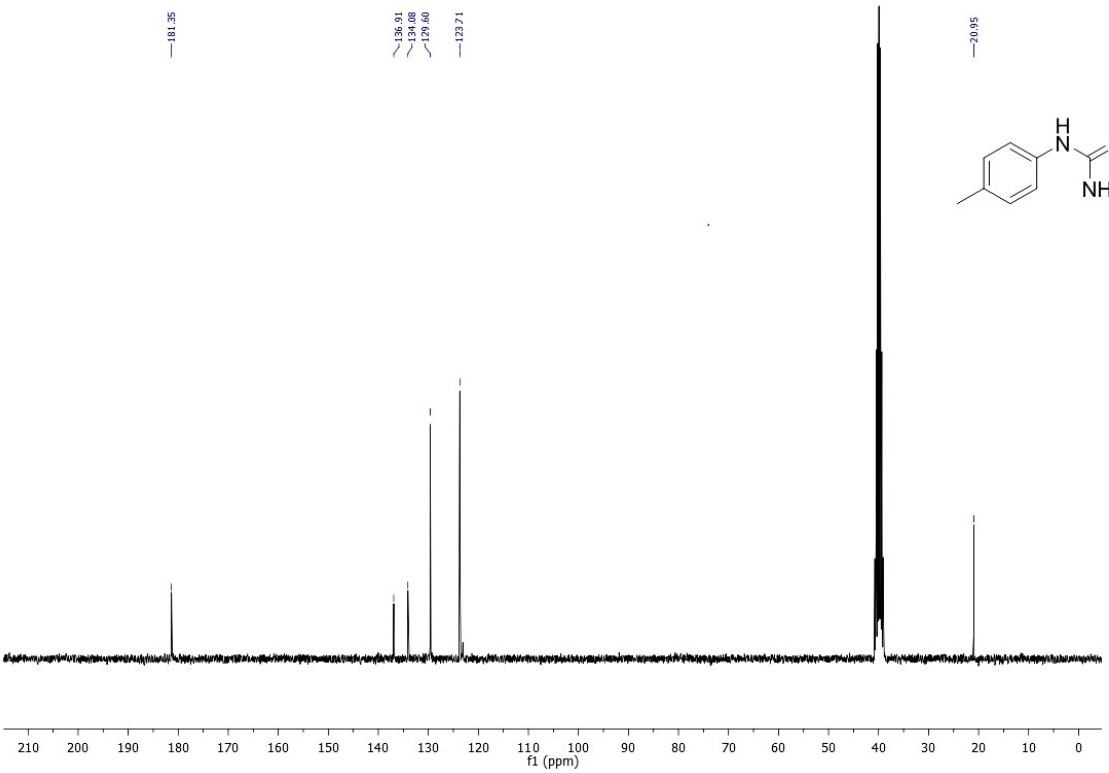


Figure S8. ^{13}C NMR spectrum of 3C in DMSO-d_6 (75MHz)

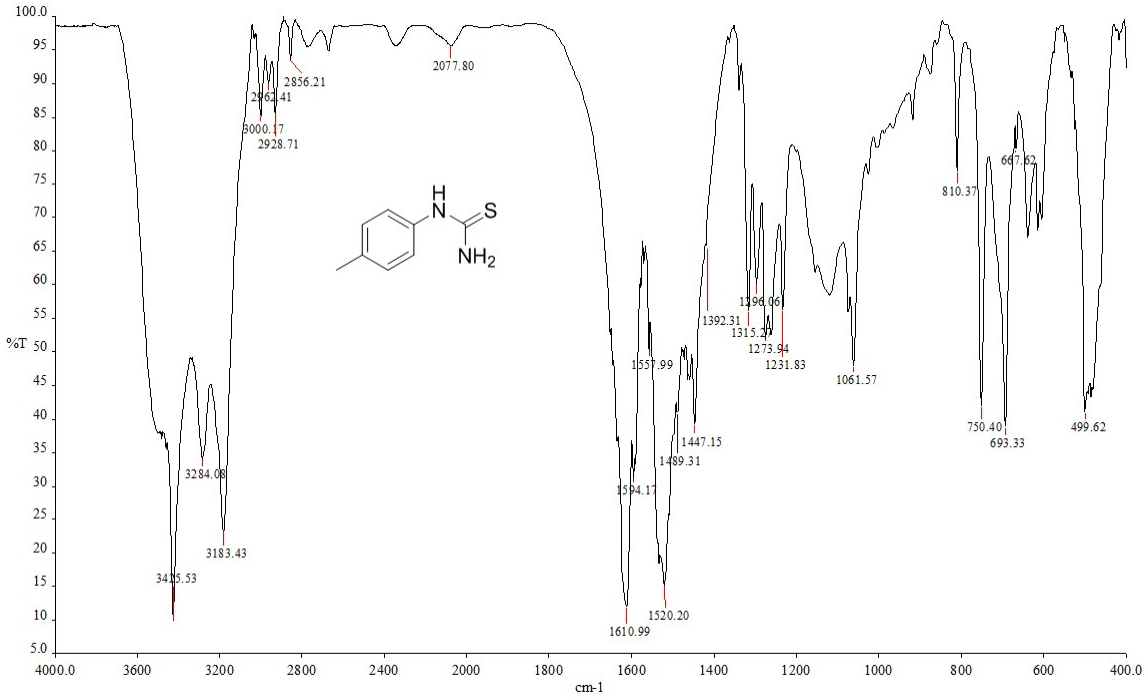


Figure S9. FT-IR spectrum of 3C in KBr

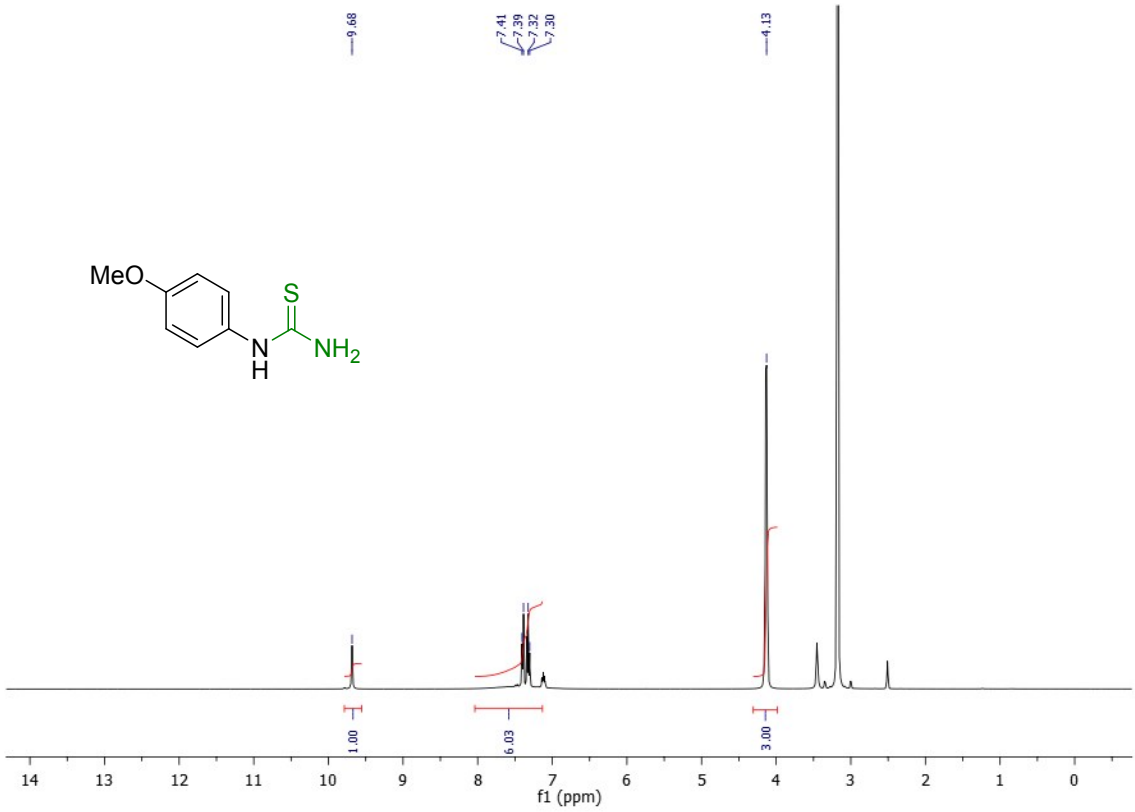


Figure S10. ^{1}H NMR spectrum of 3d in DMSO-d_6 (400MHz)

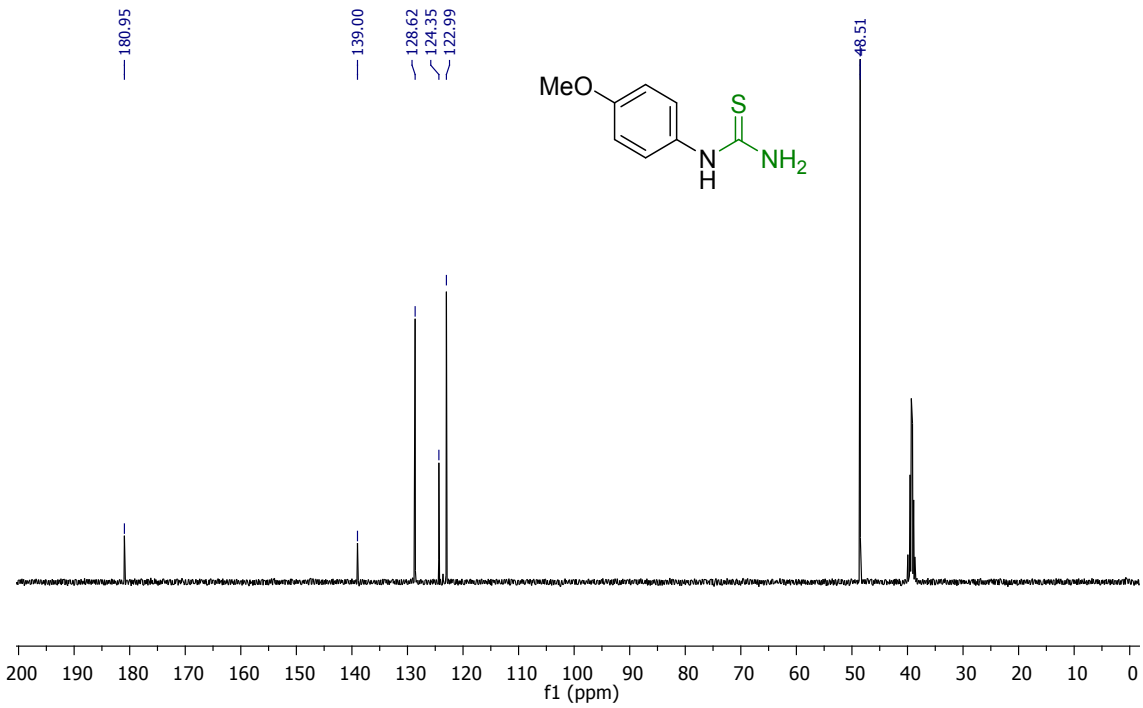


Figure S11. ^{13}C NMR spectrum of 3d in DMSO-d_6 (101MHz)

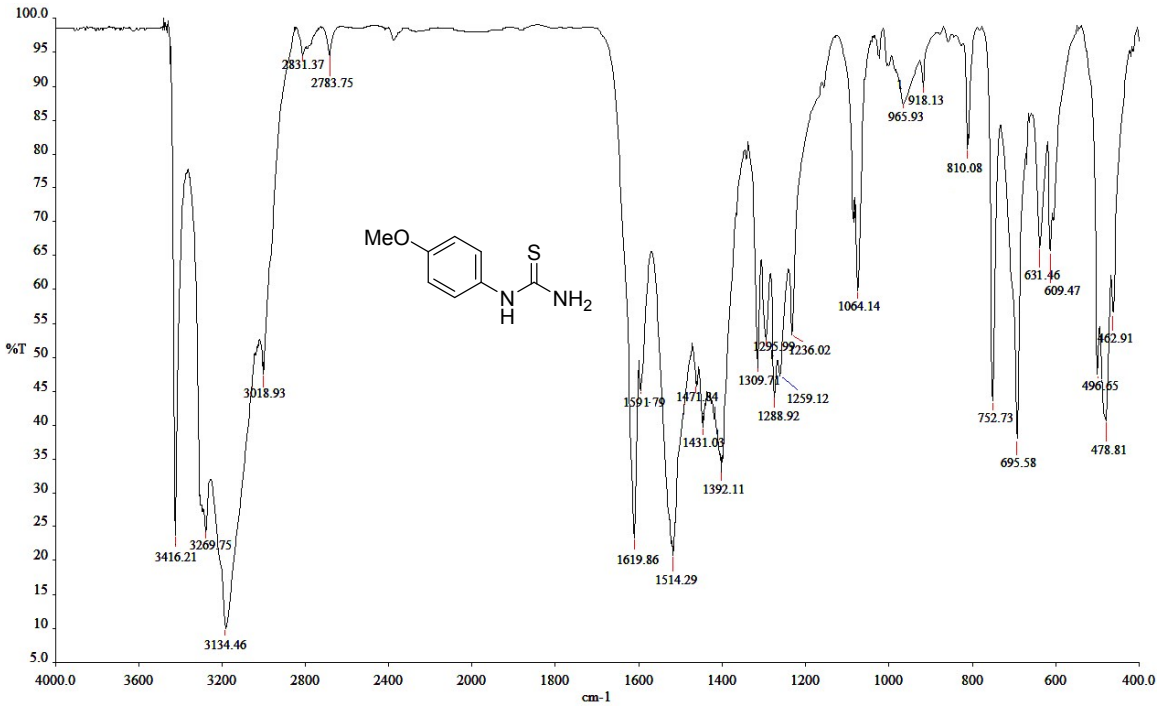


Figure S12. FT-IR spectrum of 3d in KBr

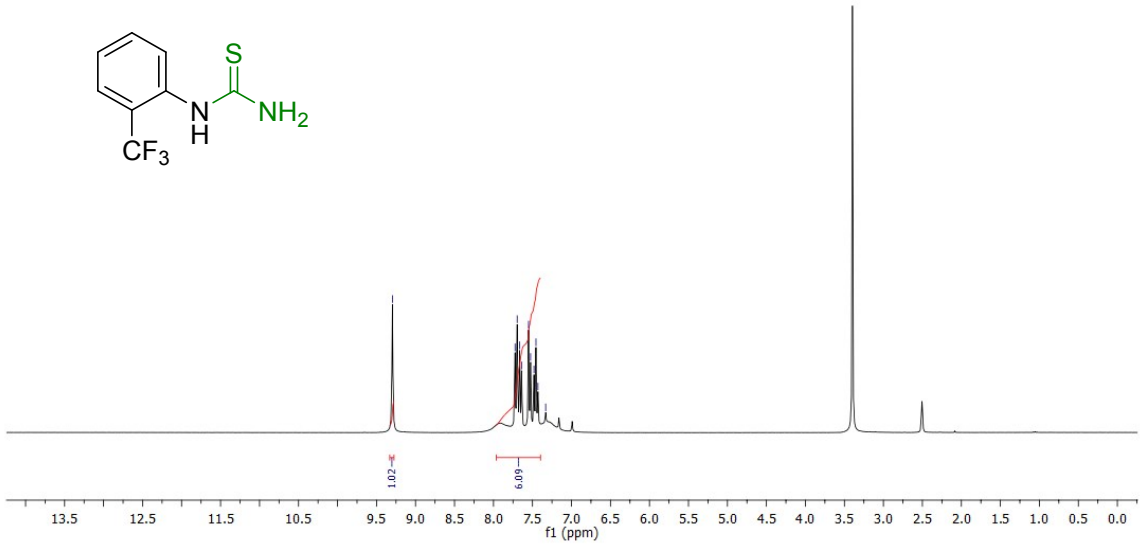


Figure S13. ^{1}H NMR spectrum of 3e in DMSO-d_6 (300MHz)

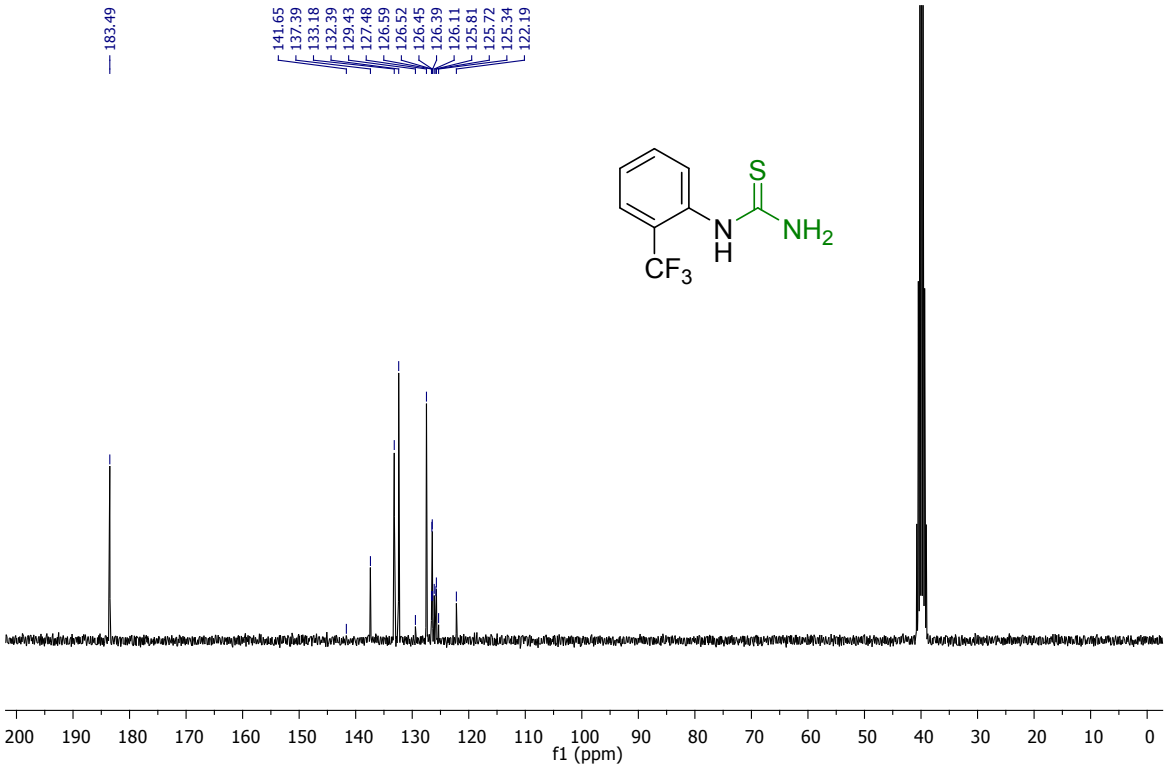


Figure S14.^{13} C NMR spectrum of 3e in DMSO-d_6 (75MHz)

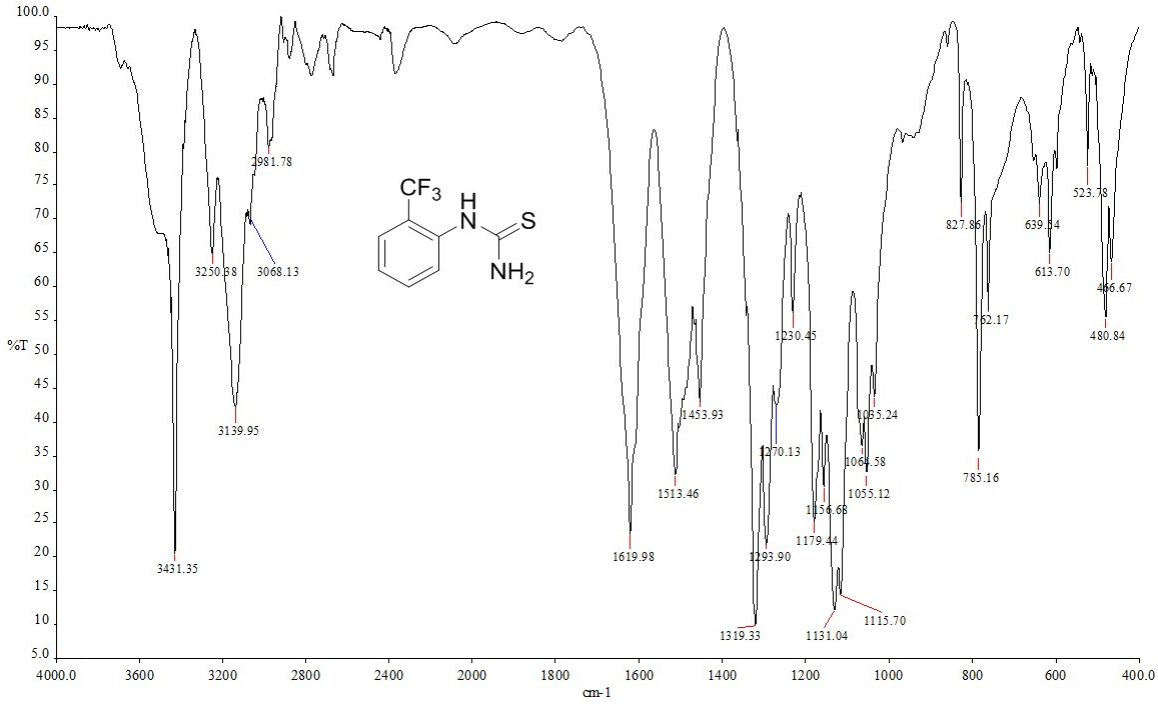


Figure S15. FT-IR spectrum of 3e in KBr

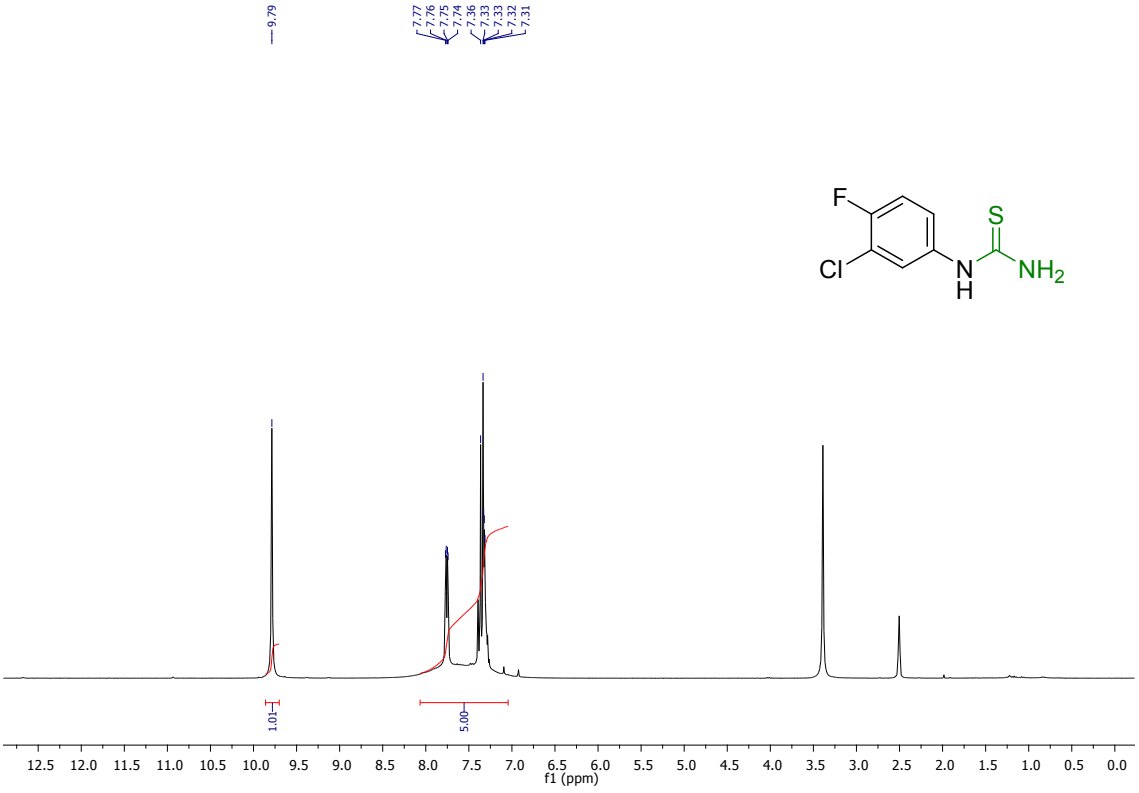


Figure S16. ^{1}H NMR spectrum of 3f in DMSO-d_6 (300MHz)

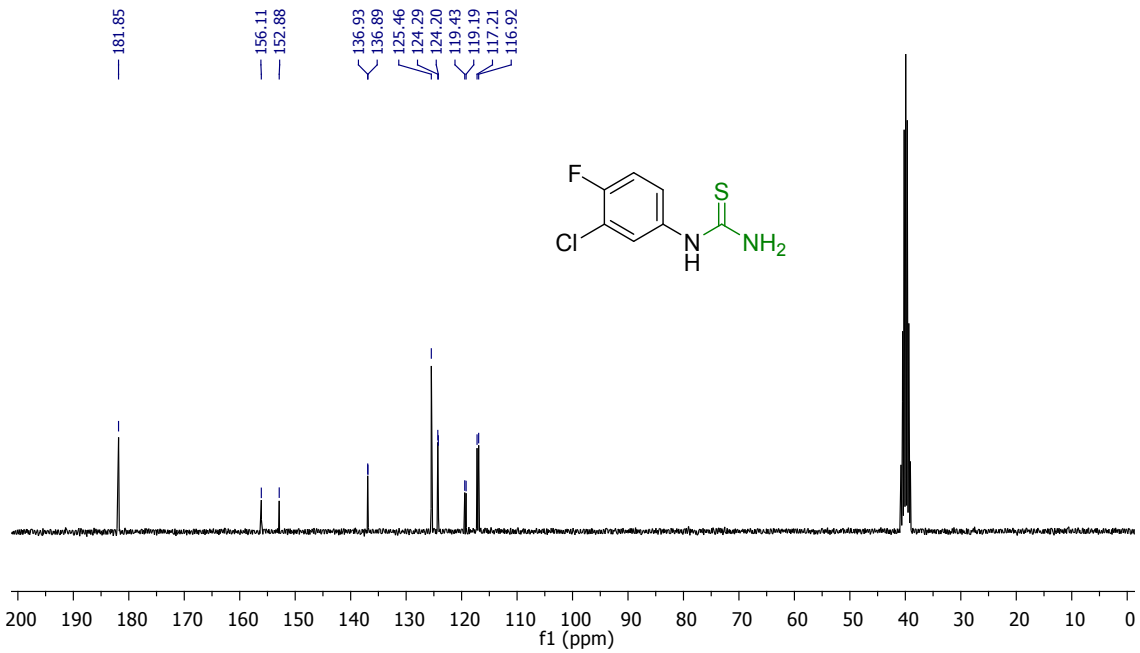


Figure S17. ^{13}C NMR spectrum of 3f in DMSO-d_6 (75MHz)

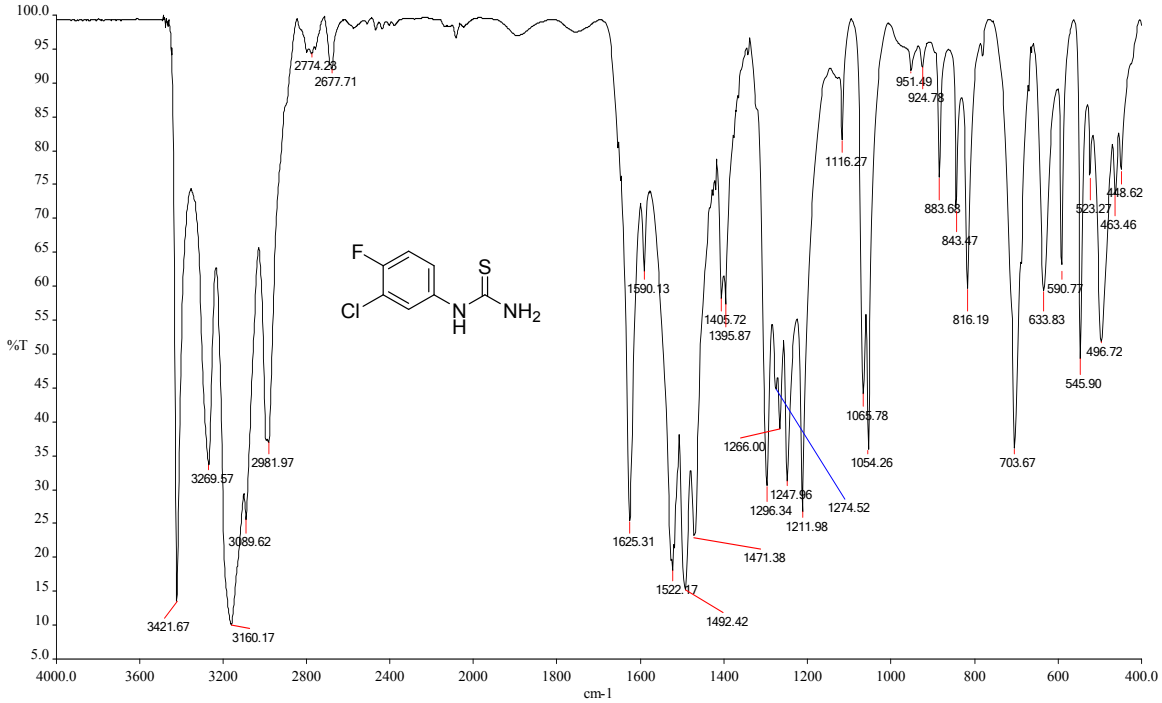


Figure S18. FT-IR spectrum of 3f in KBr

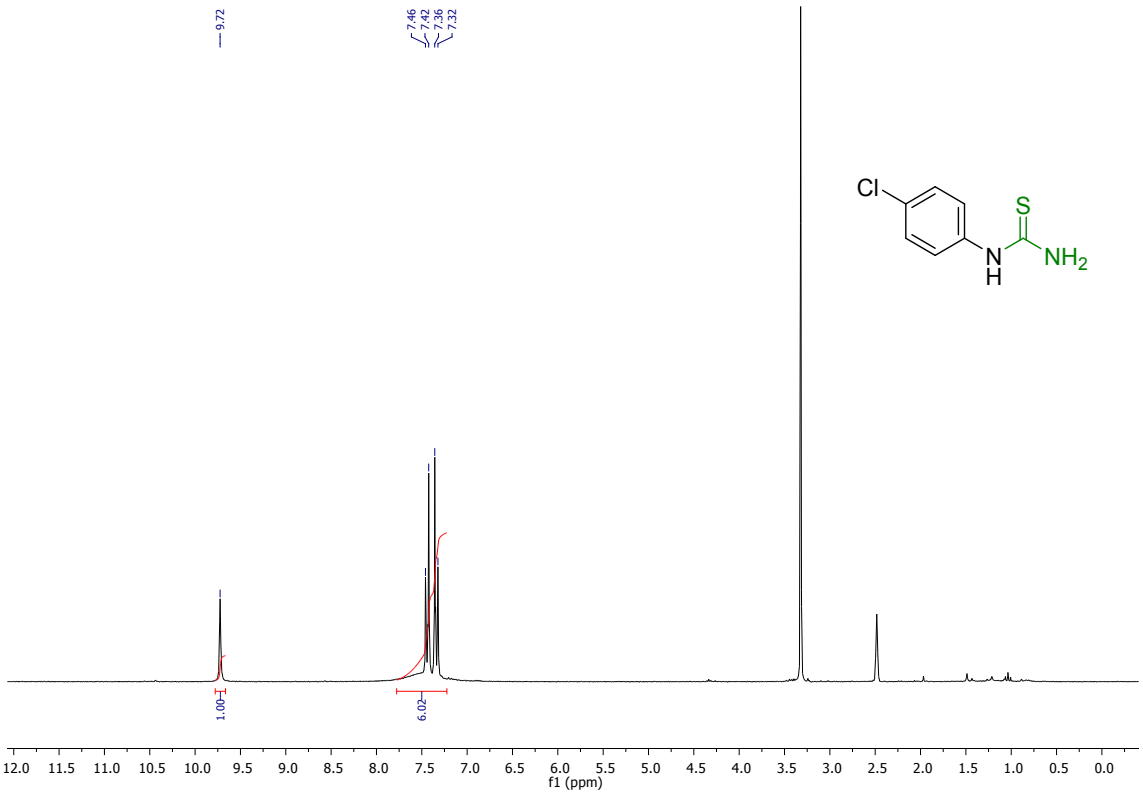


Figure S19. ^{1}H NMR spectrum of 3g in DMSO-d_6 (250MHz)

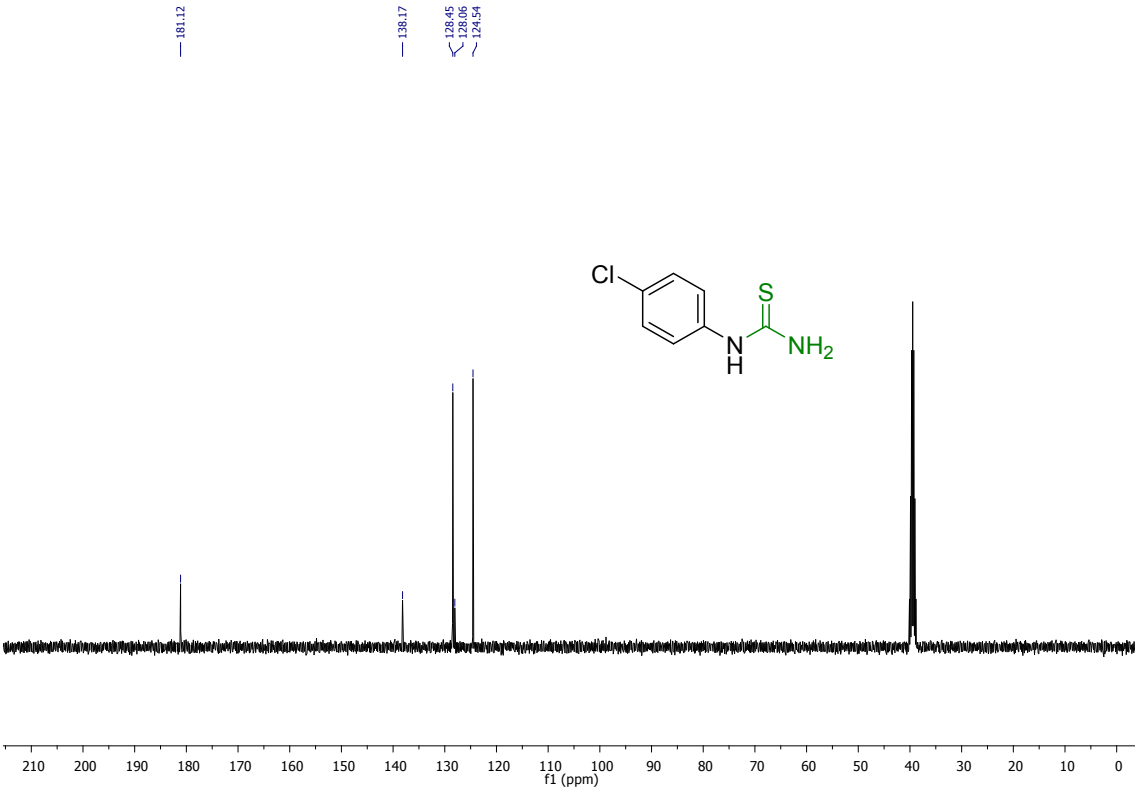


Figure S20. ^{13}C NMR spectrum of 3g in DMSO-d_6 (101MHz)

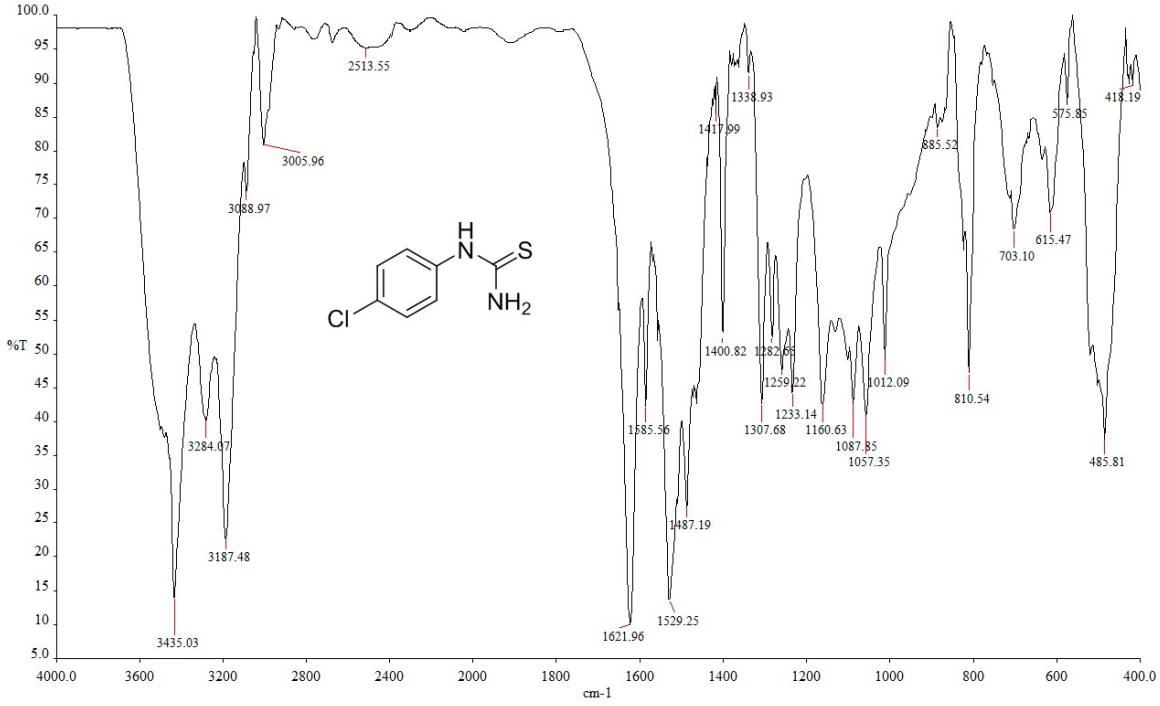


Figure S21. FT-IR spectrum of 3g in KBr

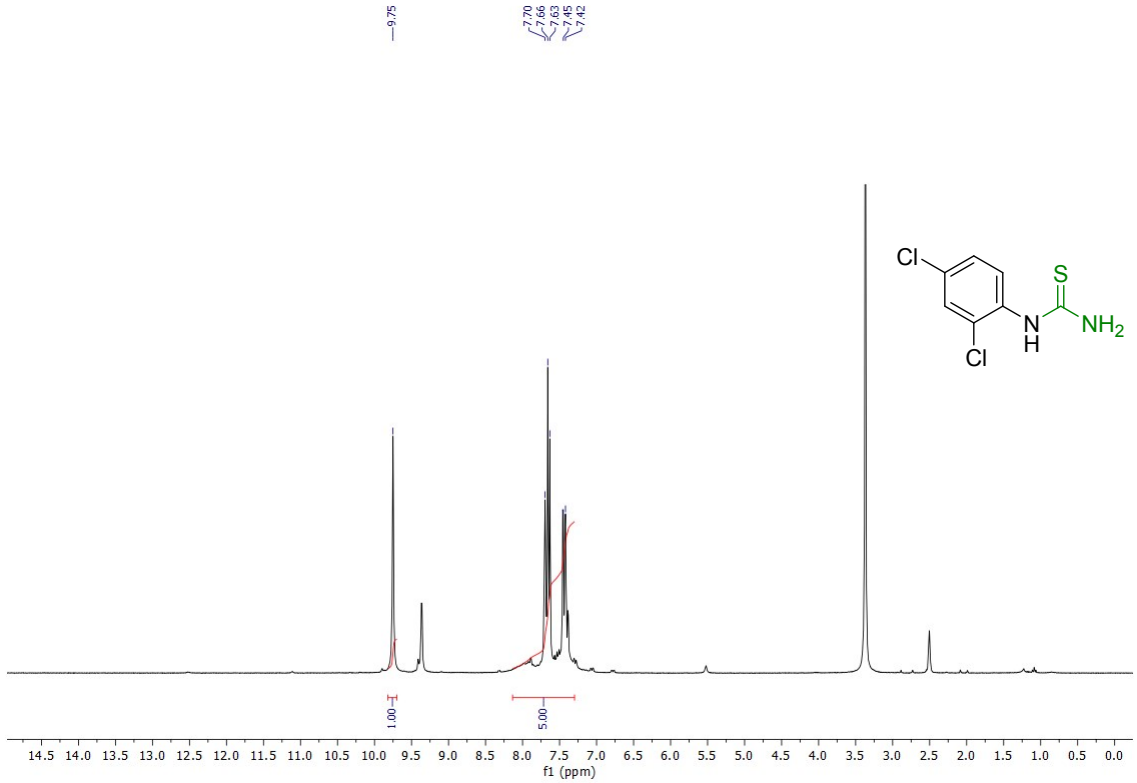


Figure S22. ^{1}H NMR spectrum of 3h in DMSO-d_6 (300MHz)

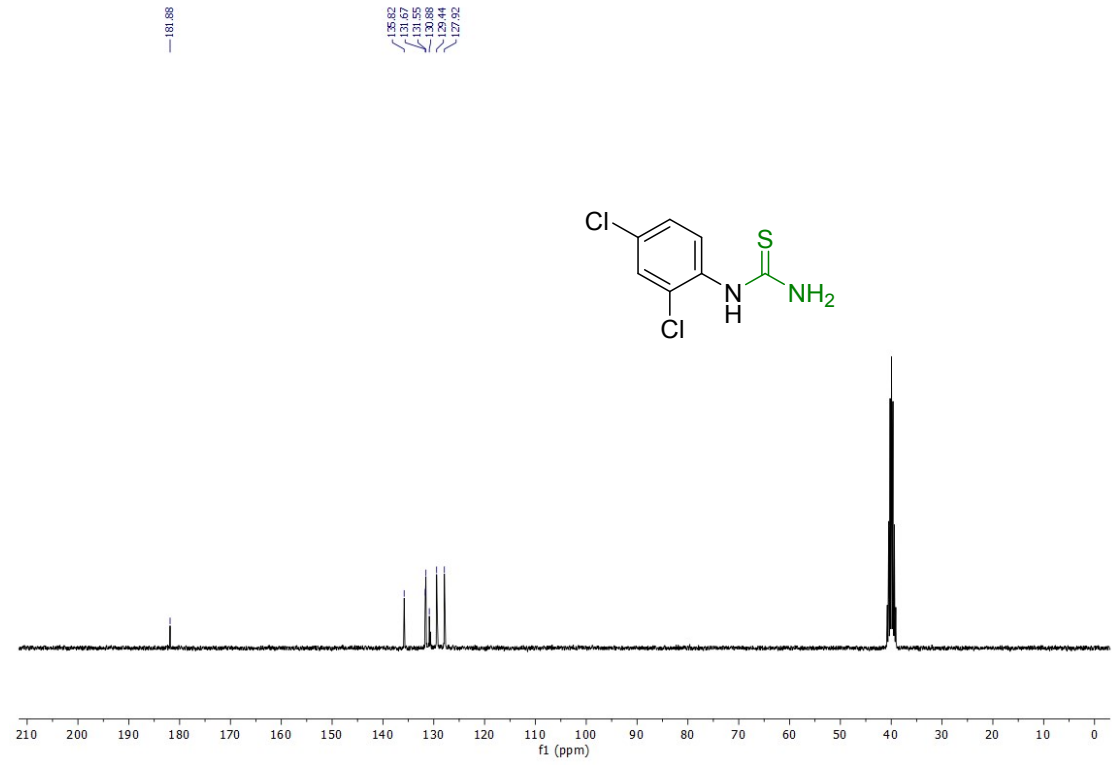


Figure S23. ^{13}C NMR spectrum of 3h in DMSO-d_6 (75MHz)

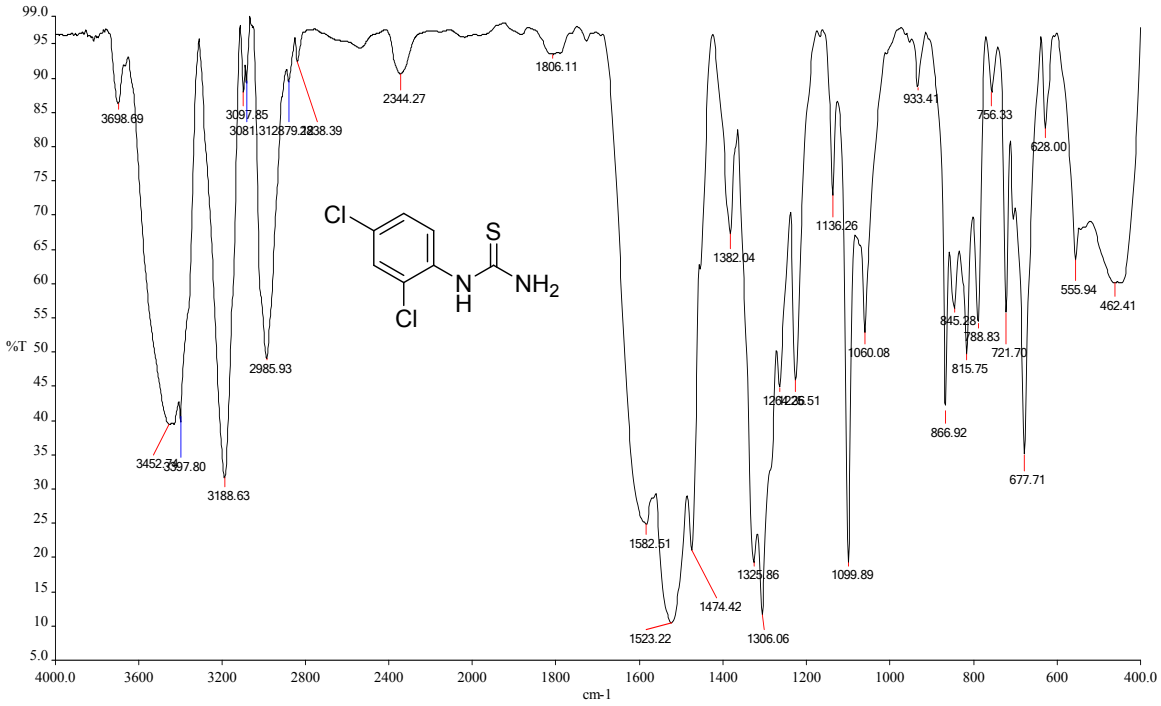


Figure S24. FT-IR spectrum of 3h in KBr

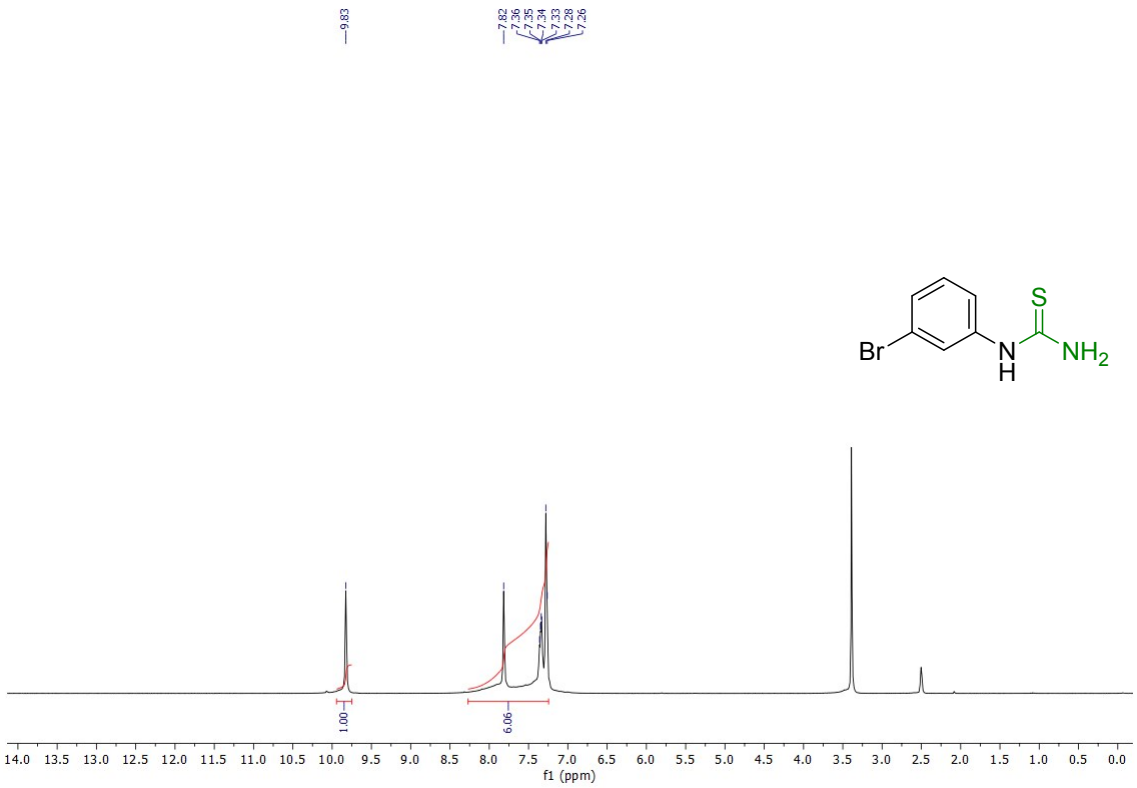


Figure S25. ^{1}H NMR spectrum of 3i in DMSO-d_6 (300MHz)

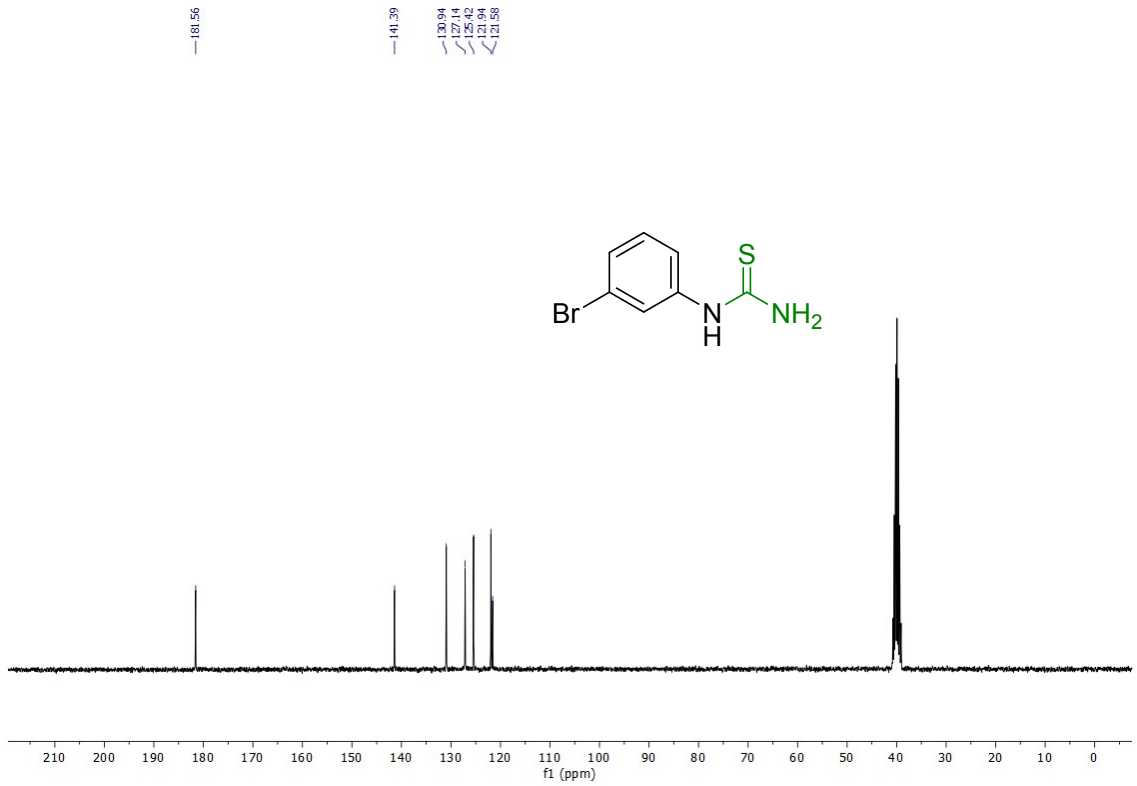


Figure S26. ^{13}C NMR spectrum of 3i in DMSO-d_6 (75MHz)

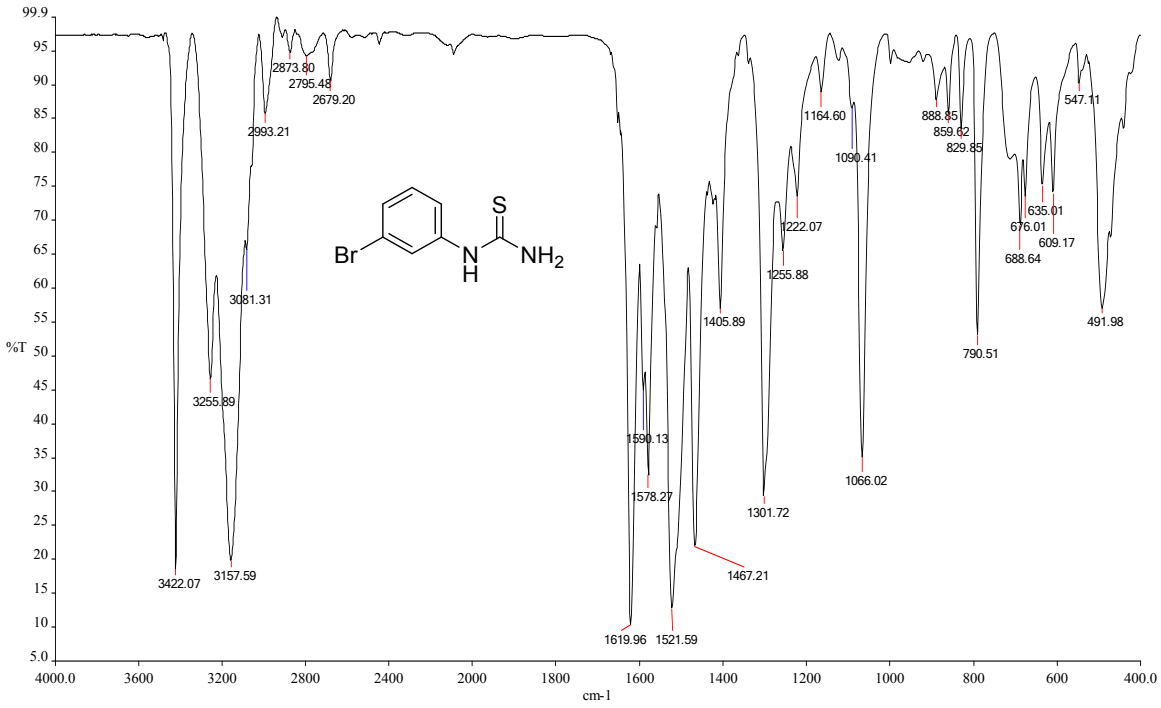


Figure S27. FT-IR spectrum of 3i in KBr

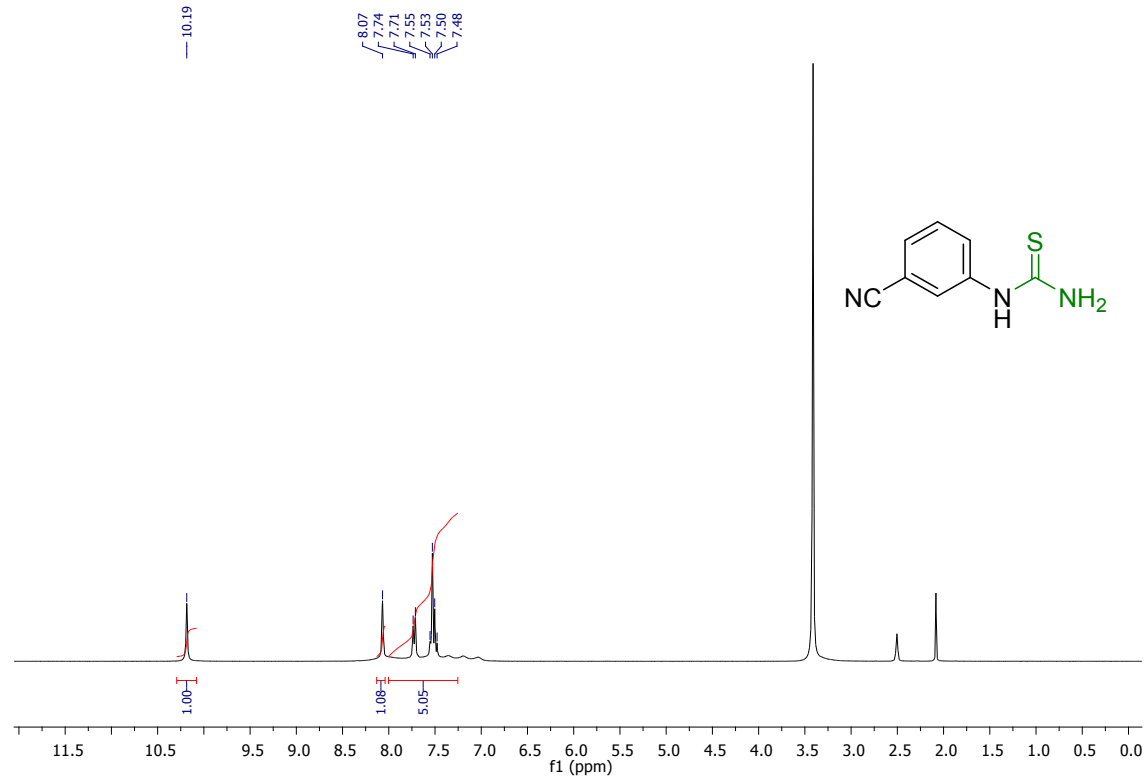


Figure S28. ^{1}H NMR spectrum of 3j in DMSO-d_6 (300MHz)

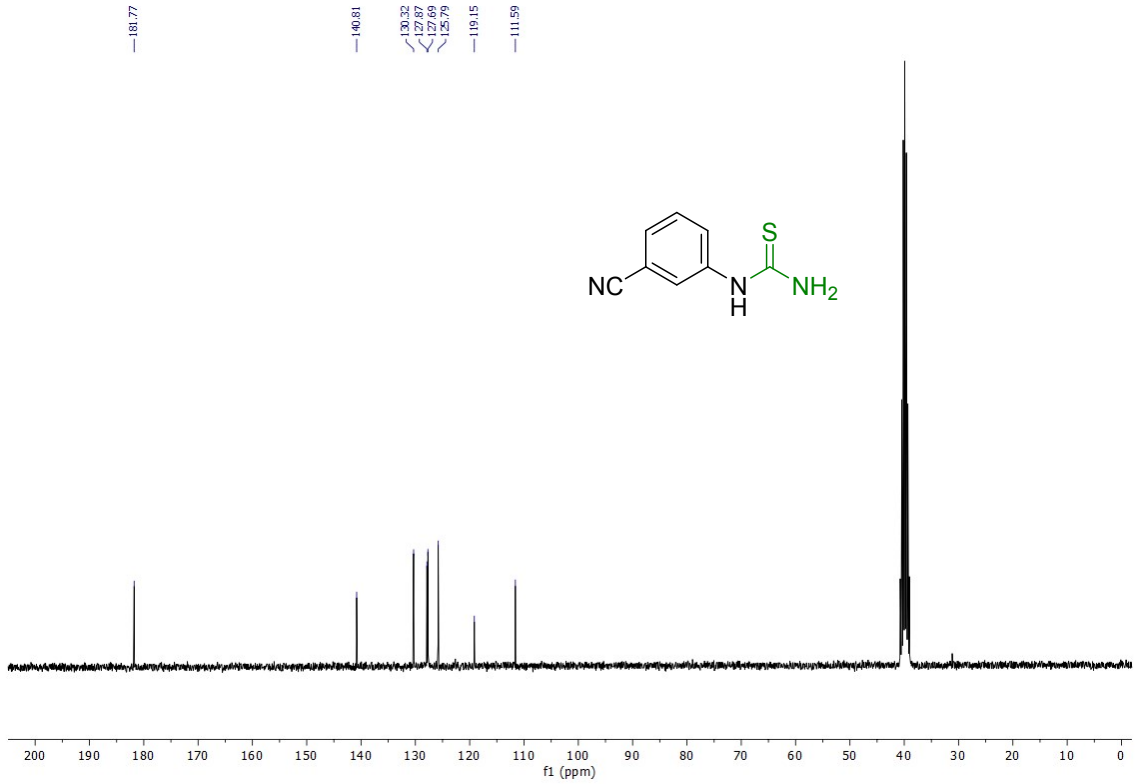


Figure S29. ^{13}C NMR spectrum of 3j in DMSO-d_6 (75MHz)

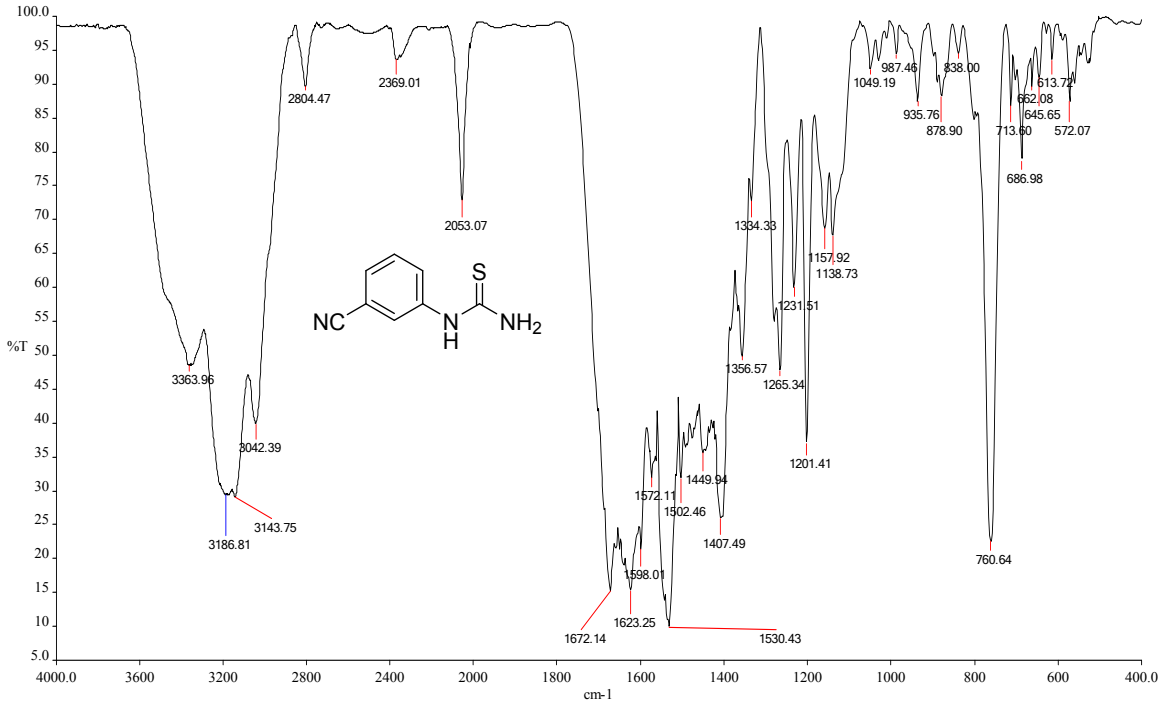


Figure S30. FT-IR spectrum of 3j in KBr

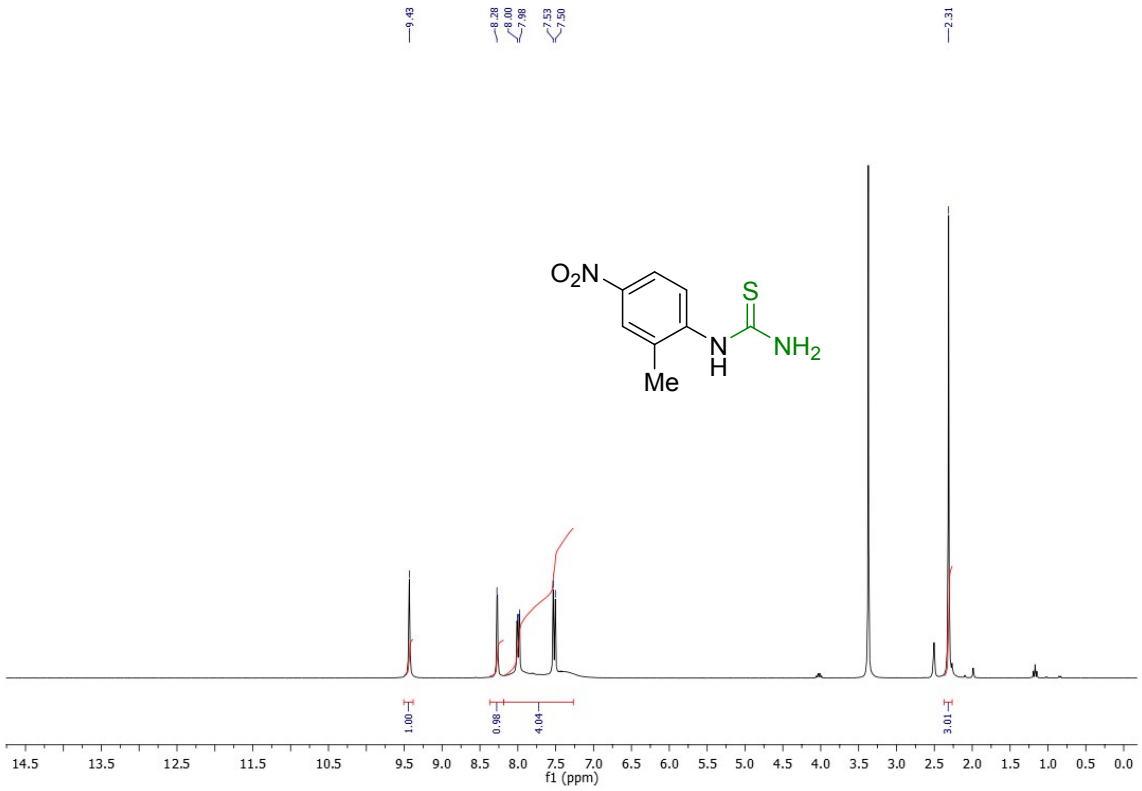


Figure S31. ^{1}H NMR spectrum of 3k in DMSO-d_6 (300MHz)

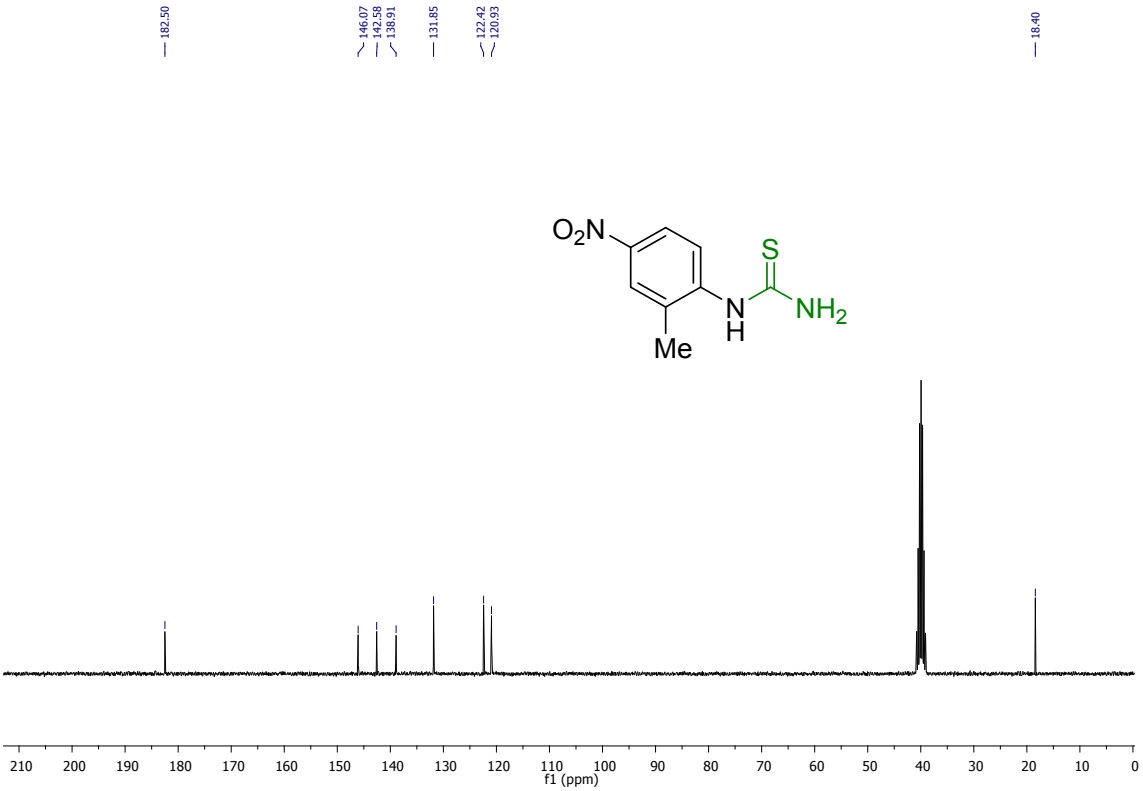


Figure S32. ^{13}C NMR spectrum of 3k in DMSO-d_6 (75MHz).

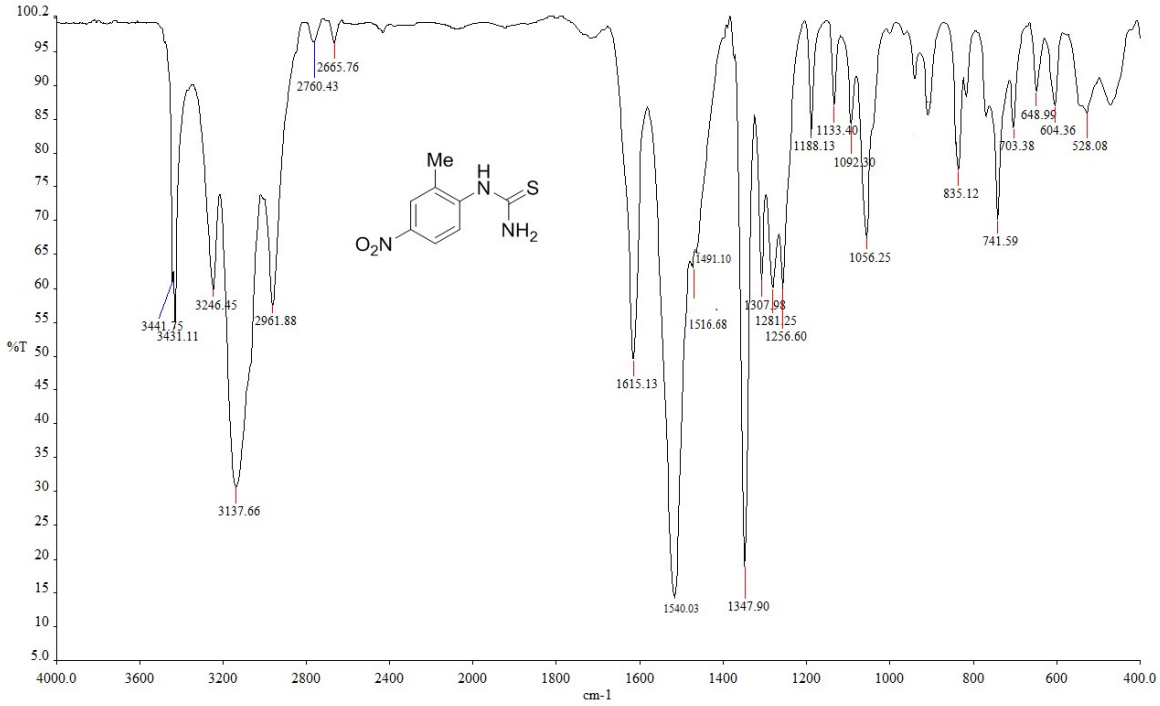


Figure S33. FT-IR spectrum of 3k in KBr

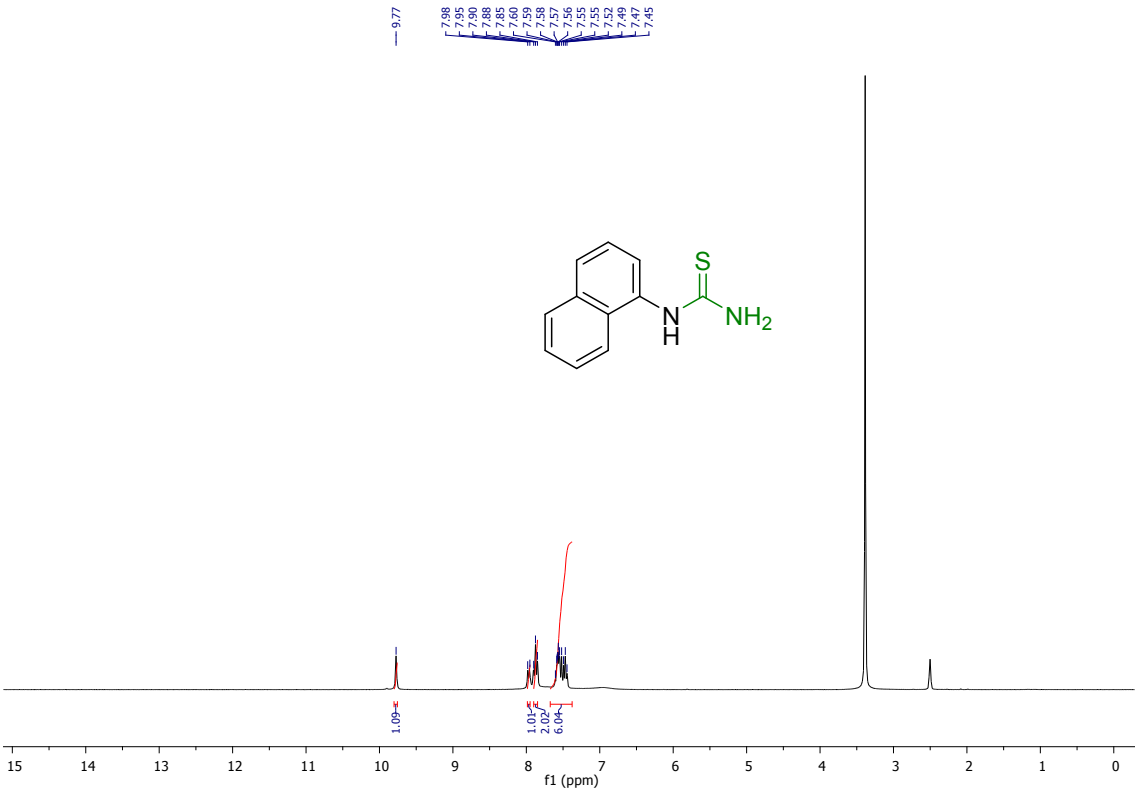


Figure S34. ^{1}H NMR spectrum of 3l in DMSO-d_6 (300MHz)

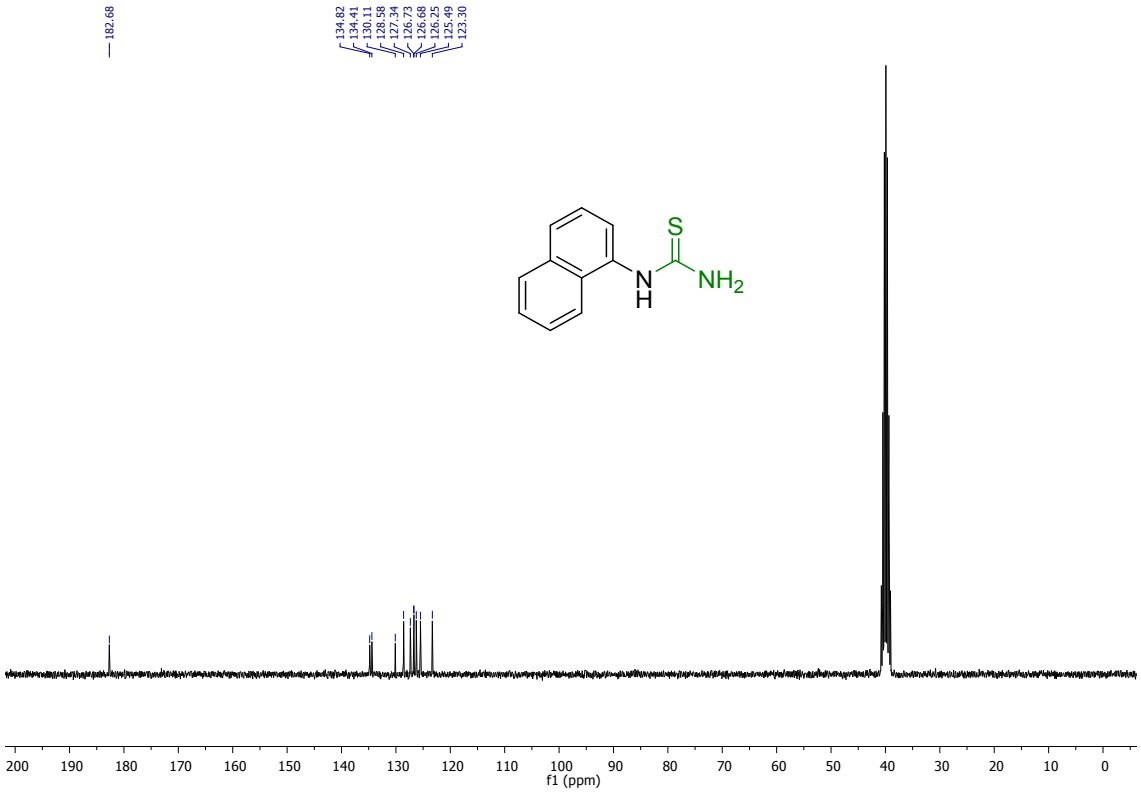


Figure S35. ^{13}C NMR spectrum of 3l in DMSO-d_6 (75MHz).

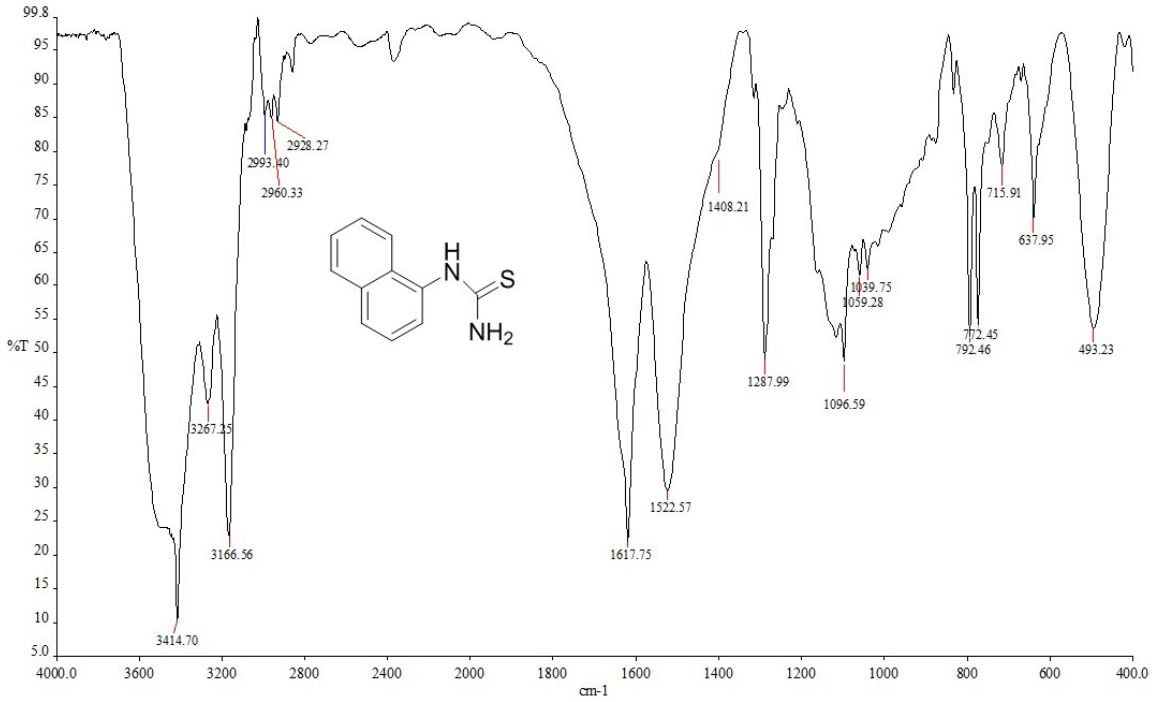


Figure S36. FT-IR spectrum of 3l in KBr

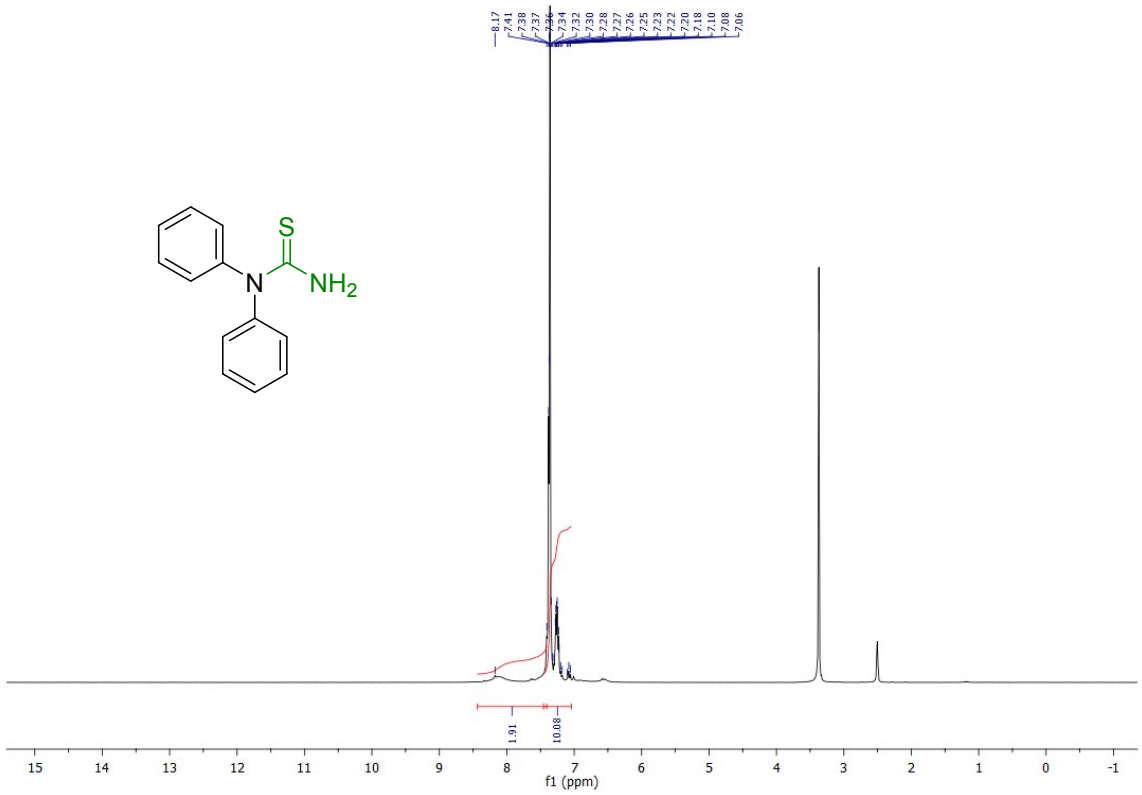


Figure S37. ^{1}H NMR spectrum of 3m in DMSO-d_6 (300MHz).

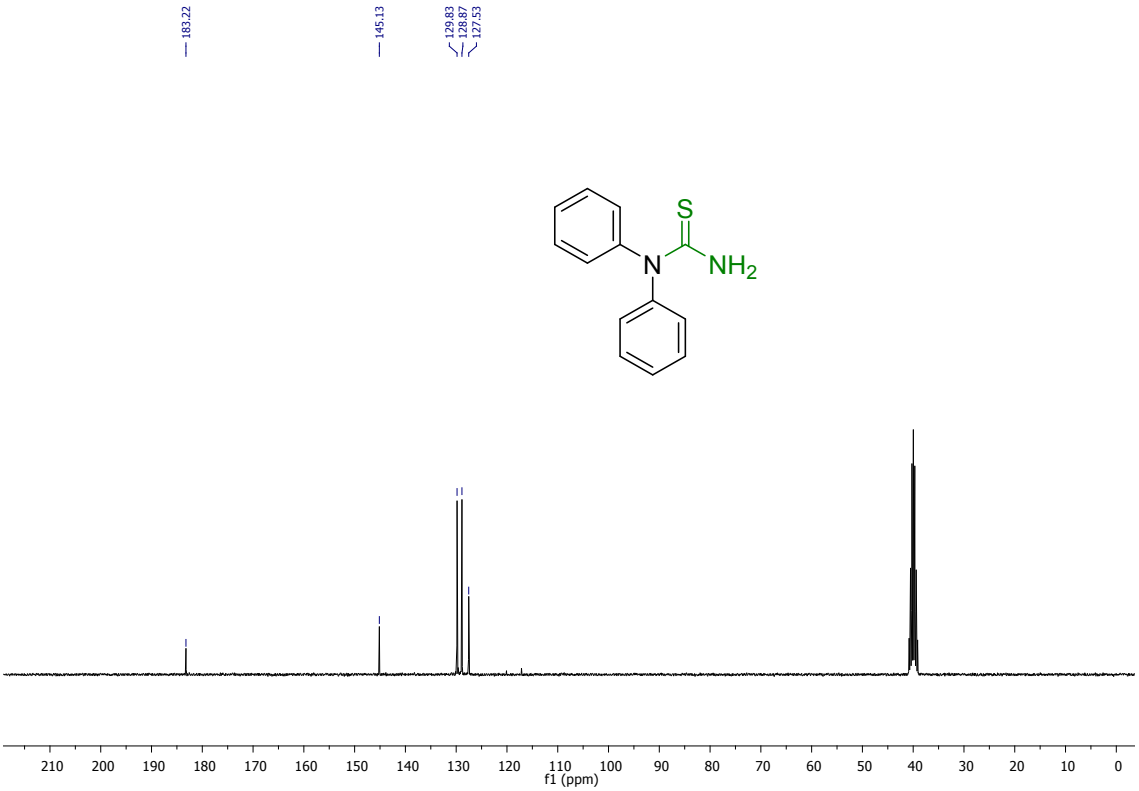


Figure S38. ^{13}C NMR spectrum of 3m in DMSO-d_6 (75 MHz)

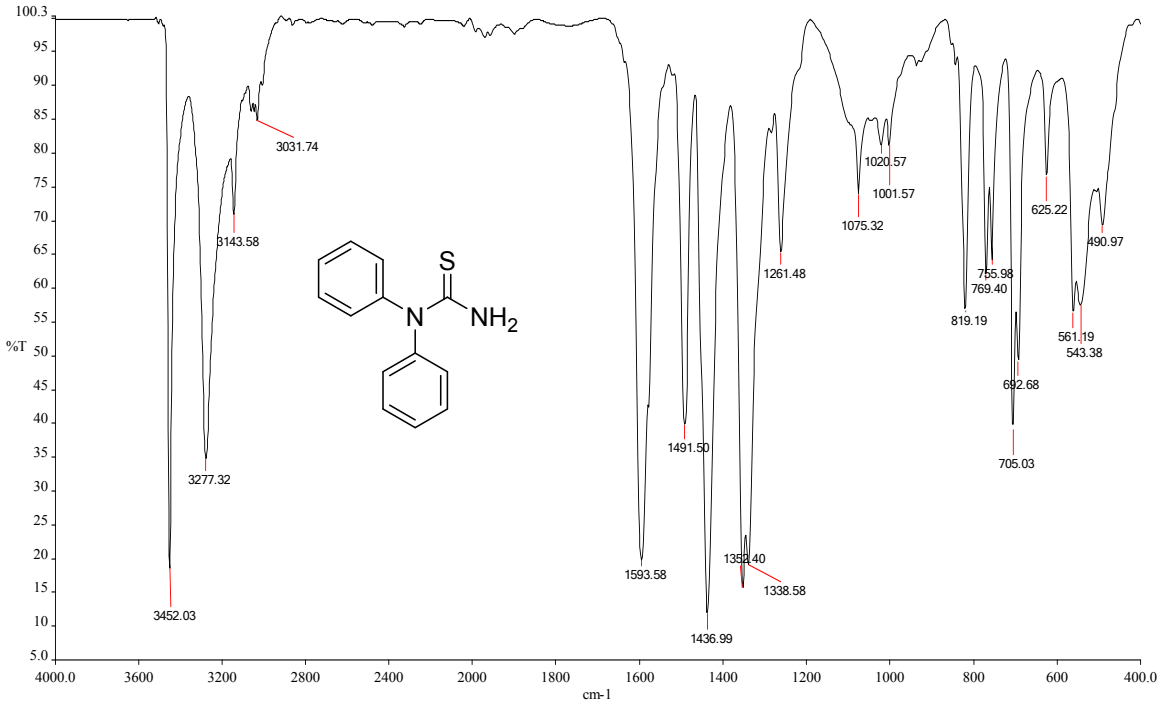


Figure S39. FT-IR spectrum of 3m in KBr

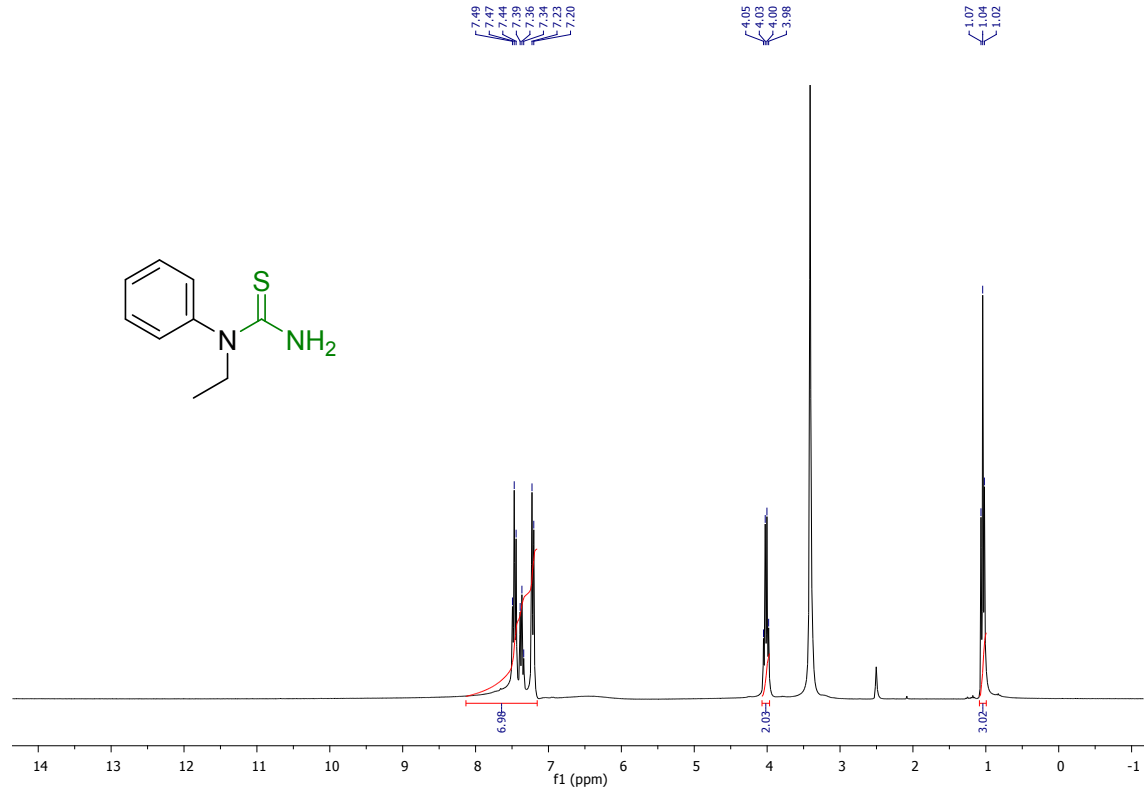


Figure S40. ^{1}H NMR spectrum of 3n in DMSO-d_6 (300MHz)

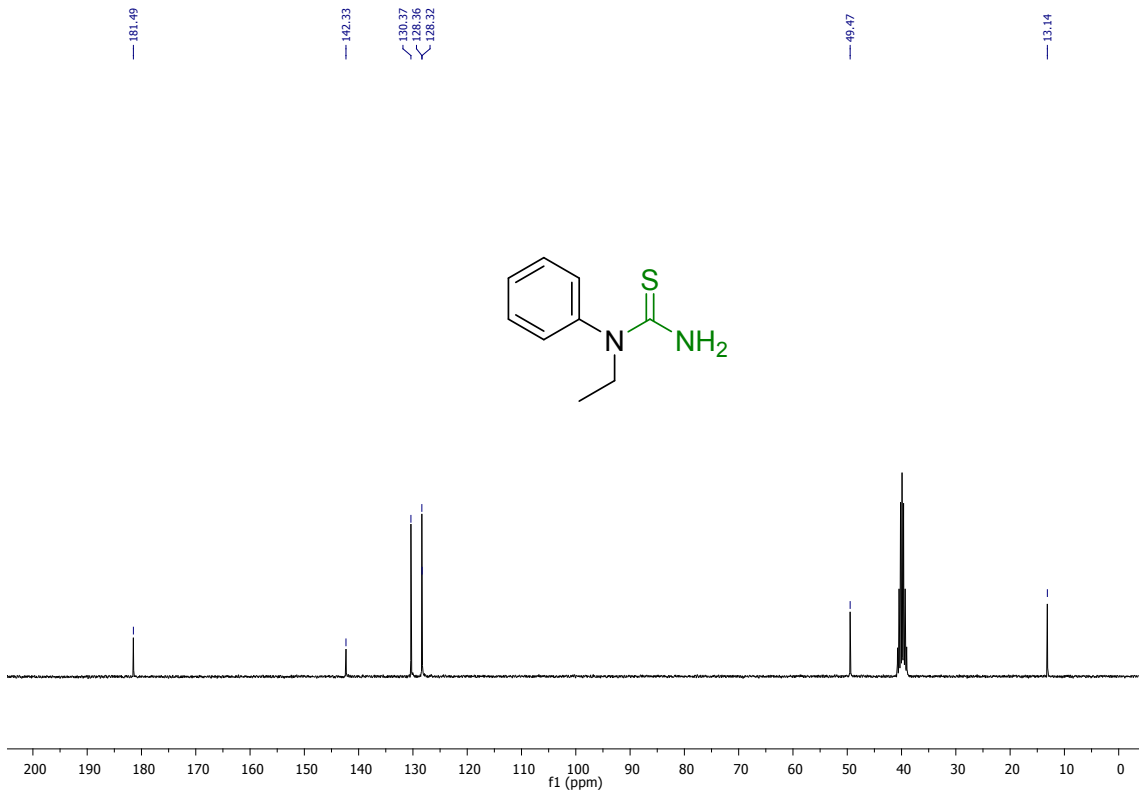


Figure S41. ^{13}C NMR spectrum of 3n in DMSO-d_6 (75MHz)

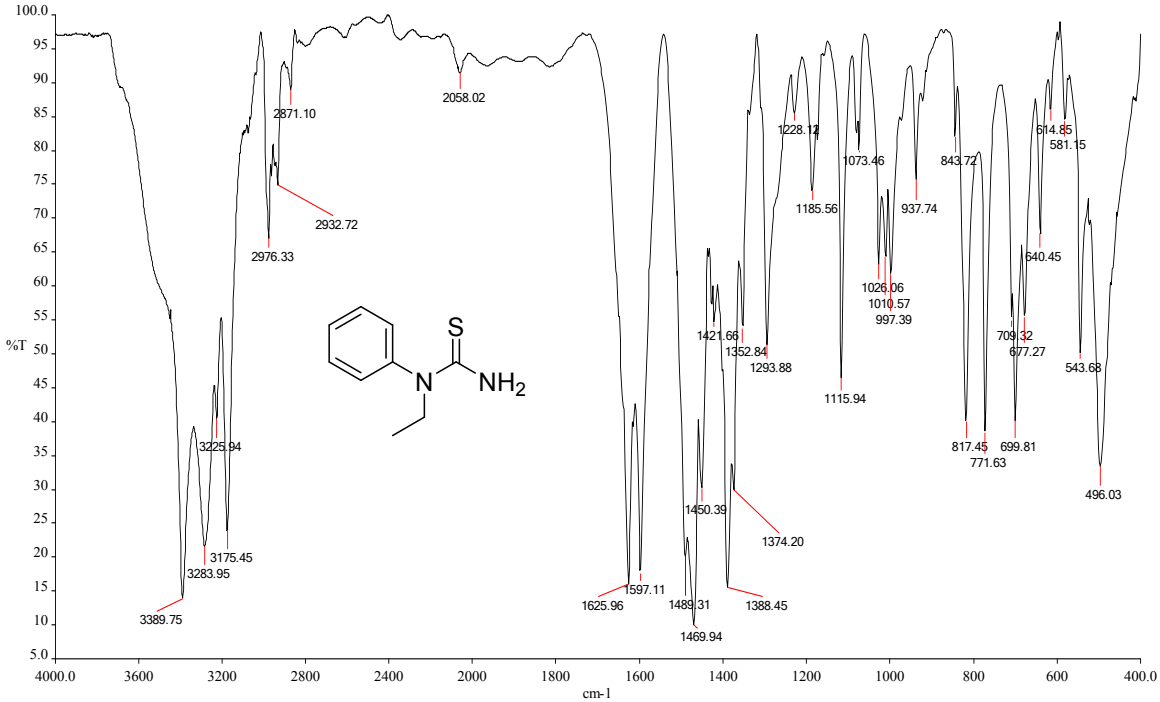


Figure S42. FT-IR spectrum of 3n in KBr

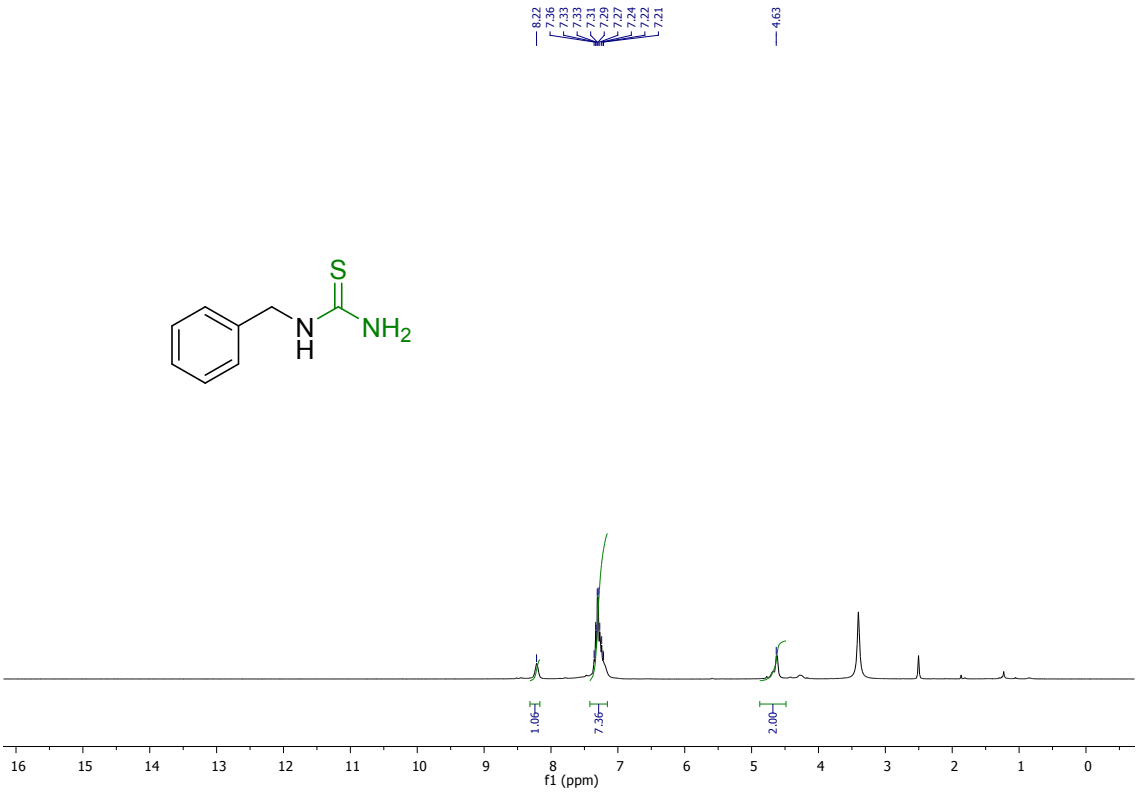


Figure S43. ^{1}H NMR spectrum of 3o in DMSO-d_6 (300MHz)

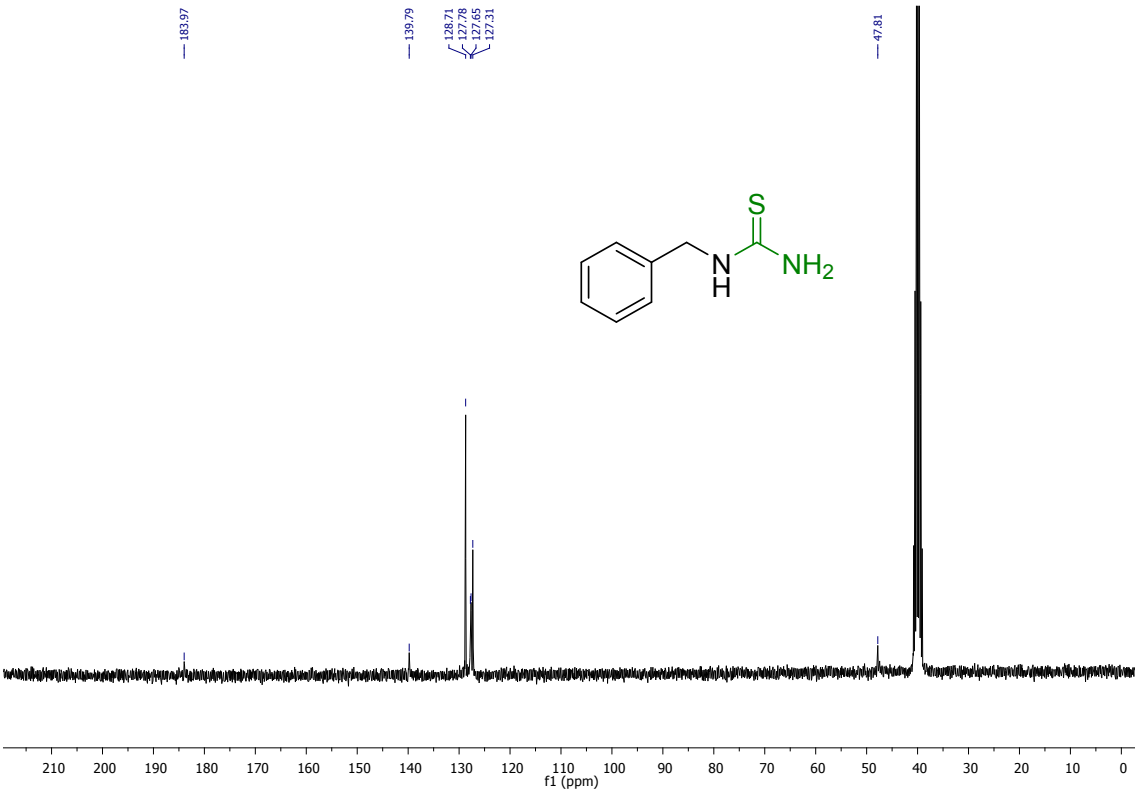


Figure S44. ^{13}C NMR spectrum of 3O in DMSO-d_6 (75MHz)

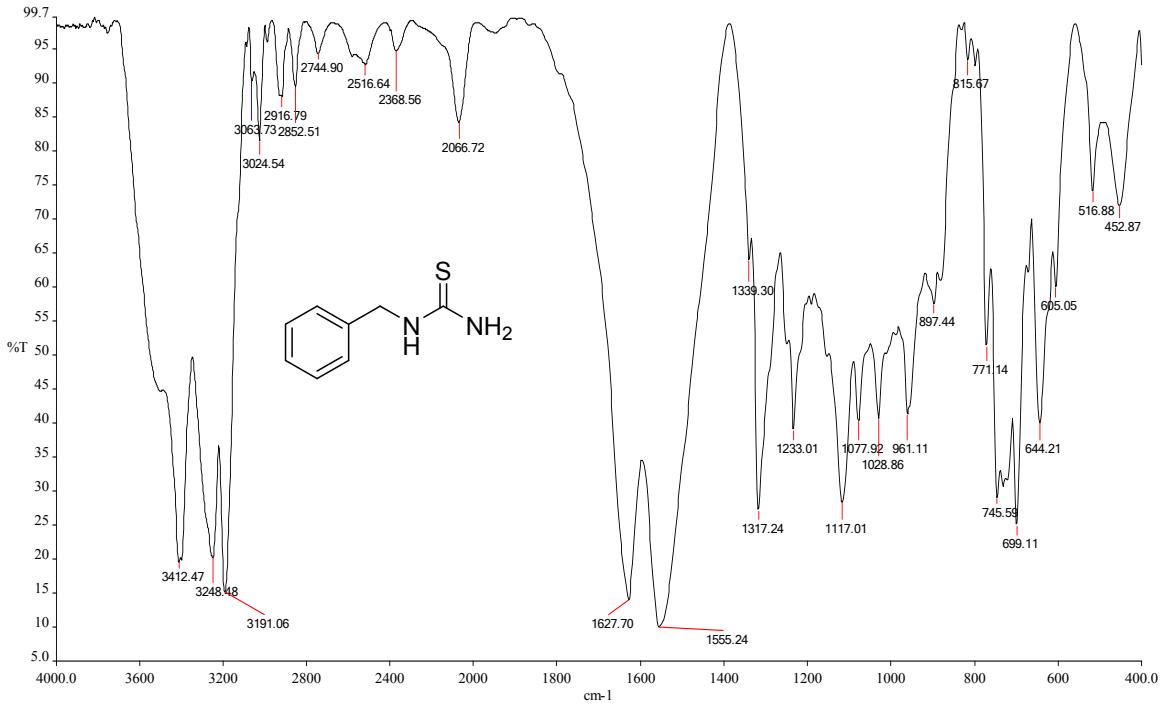


Figure S45. FT-IR spectrum of 3o in KBr

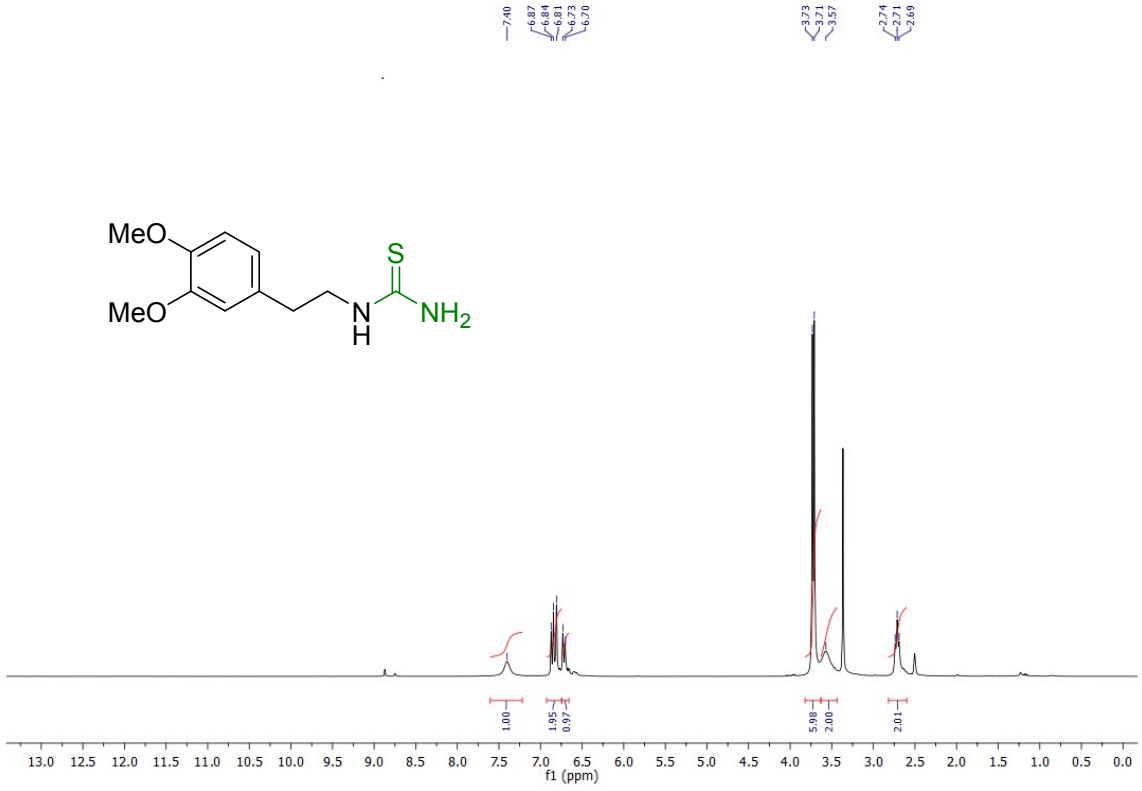


Figure S46. ^{1}H NMR spectrum of 3p in DMSO-d_6 (300MHz)

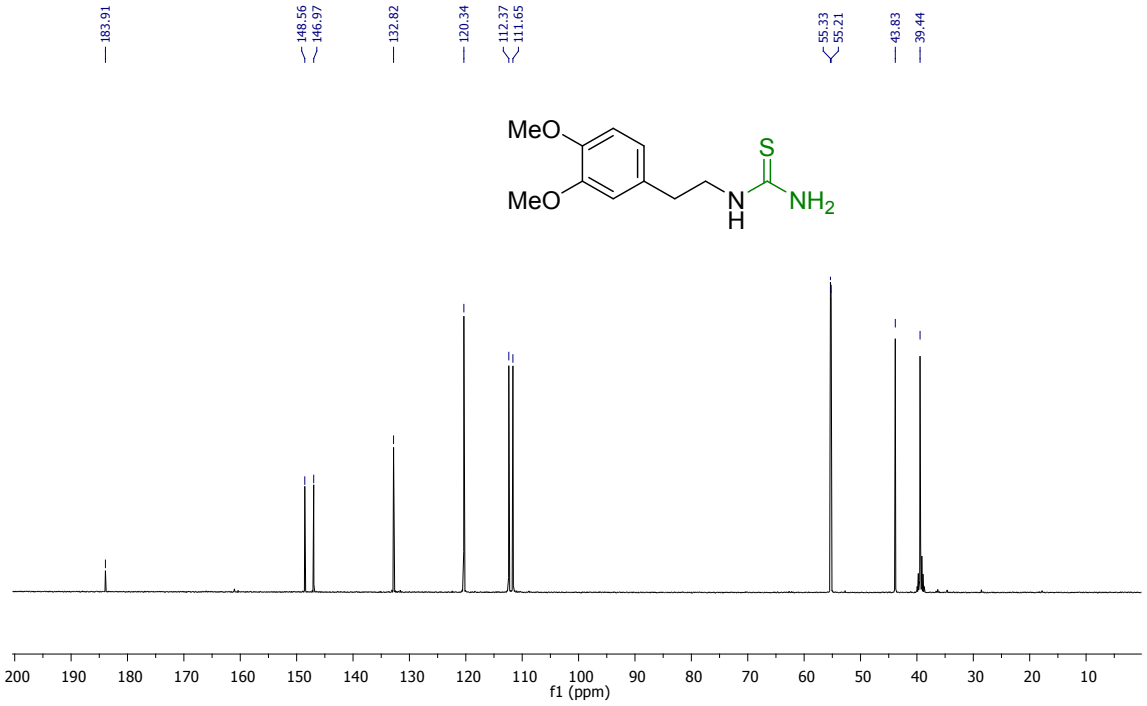


Figure S47. ^{13}C NMR spectrum of 3p in DMSO-d_6 (101MHz)

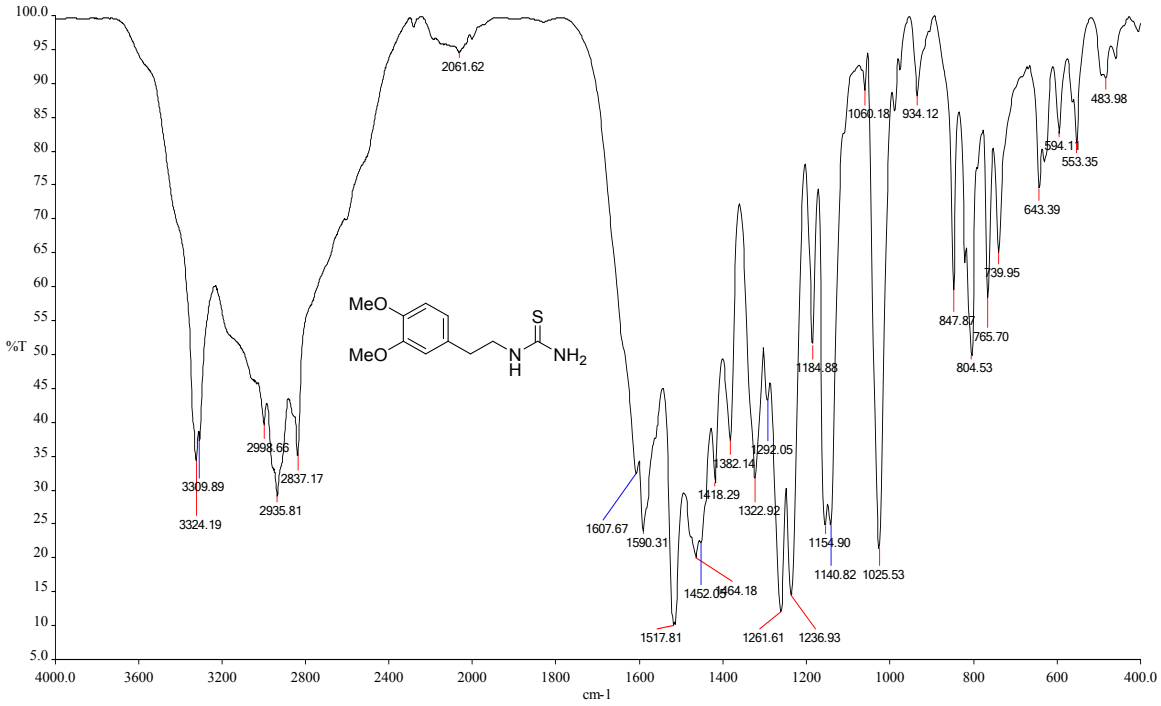


Figure S48. FT-IR spectrum of 3p in KBr

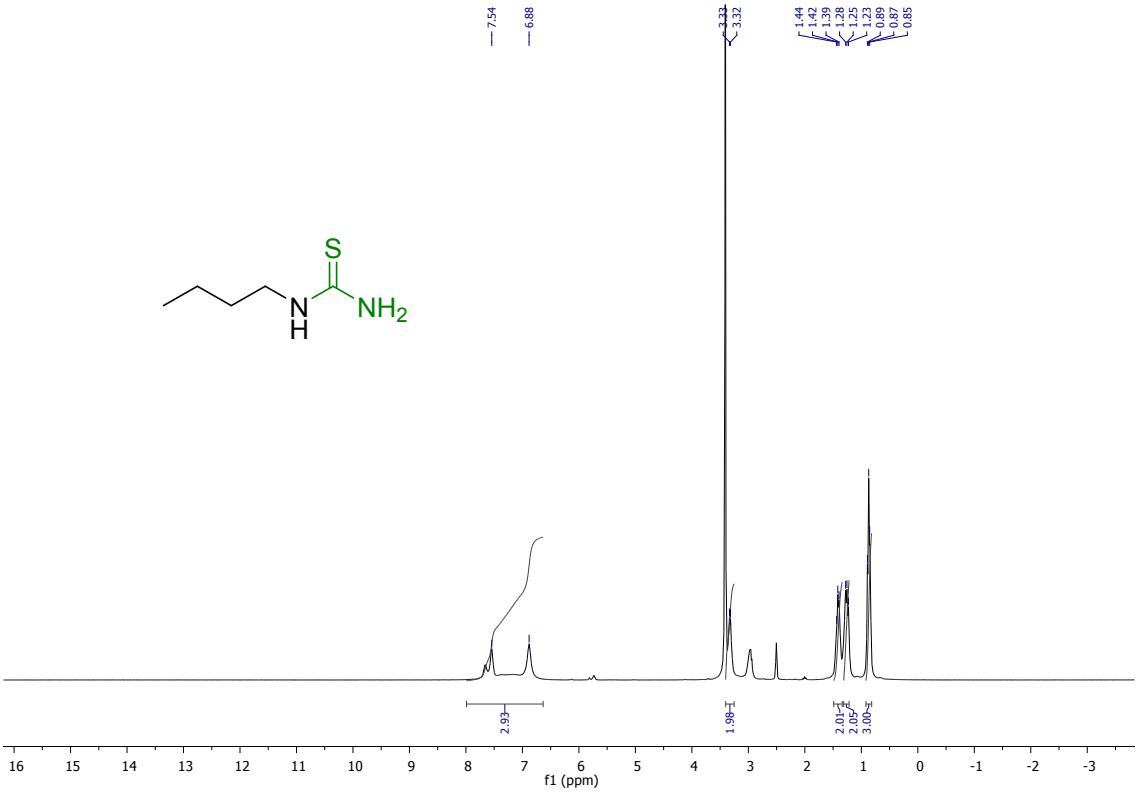


Figure S49. ^{1}H NMR spectrum of 3q in DMSO-d_6 (300MHz)

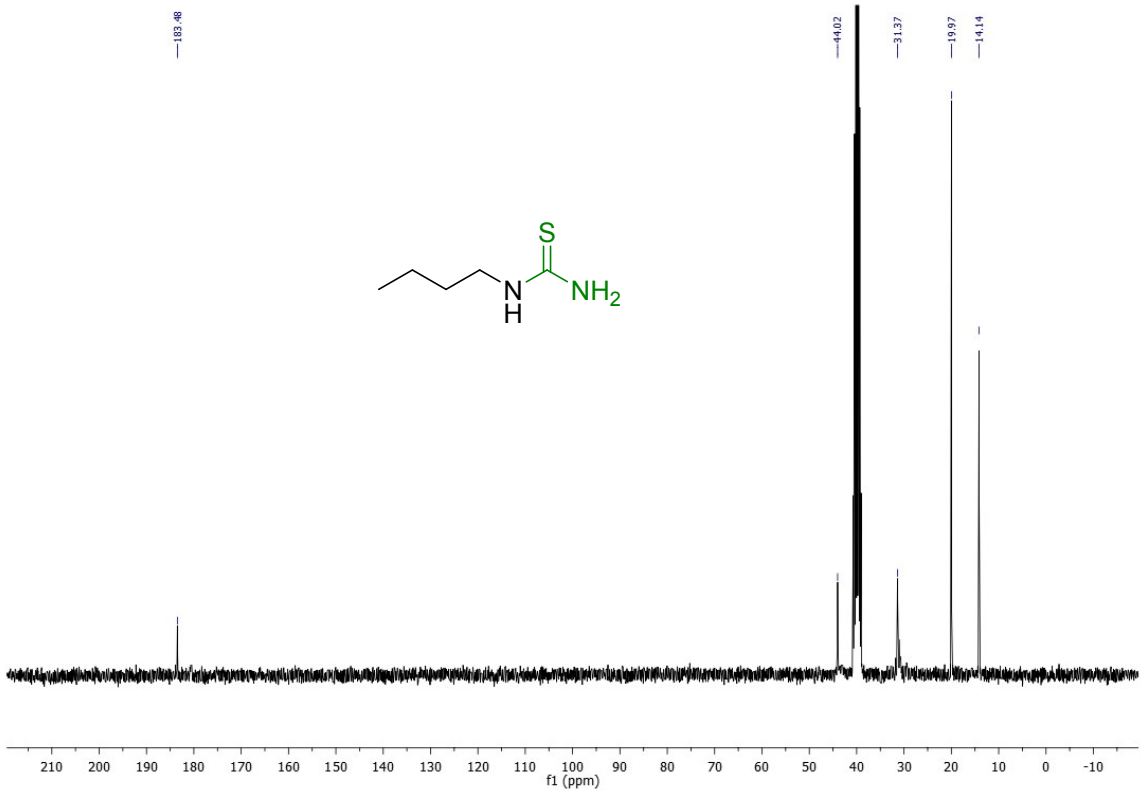


Figure S50. ^{13}C NMR spectrum of 3q in DMSO-d_6 (75MHz)

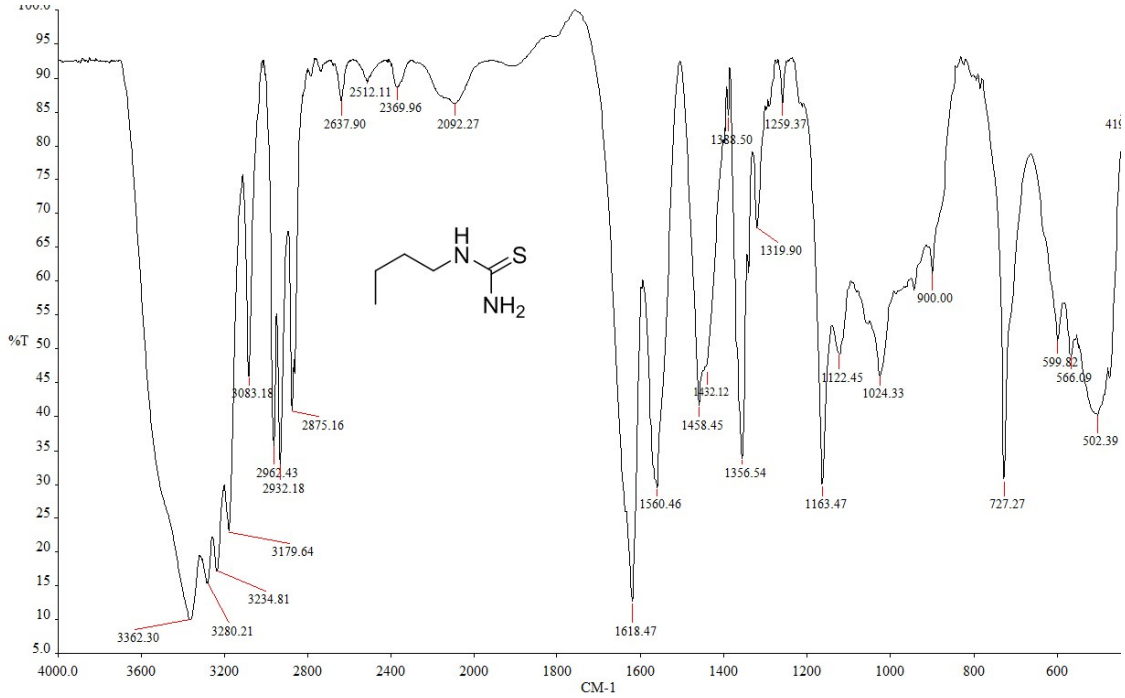


Figure S51. FT-IR spectrum of 3p in KBr

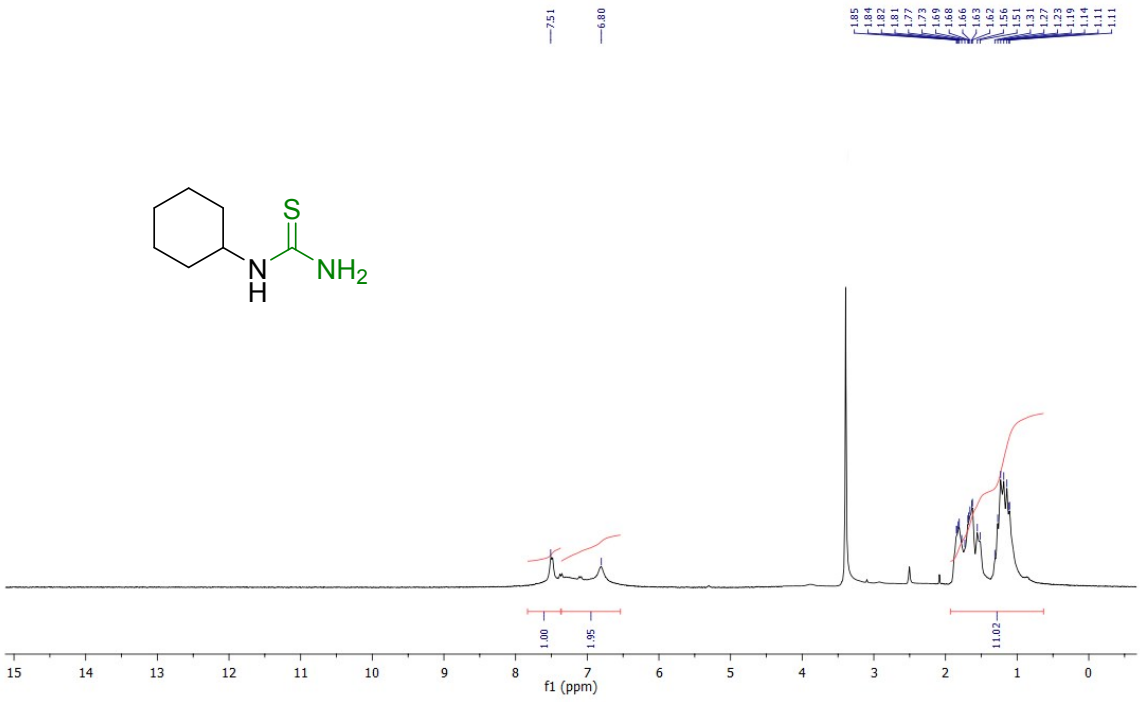


Figure S52. ^{1}H NMR spectrum of 3r in DMSO-d_6 (300MHz)

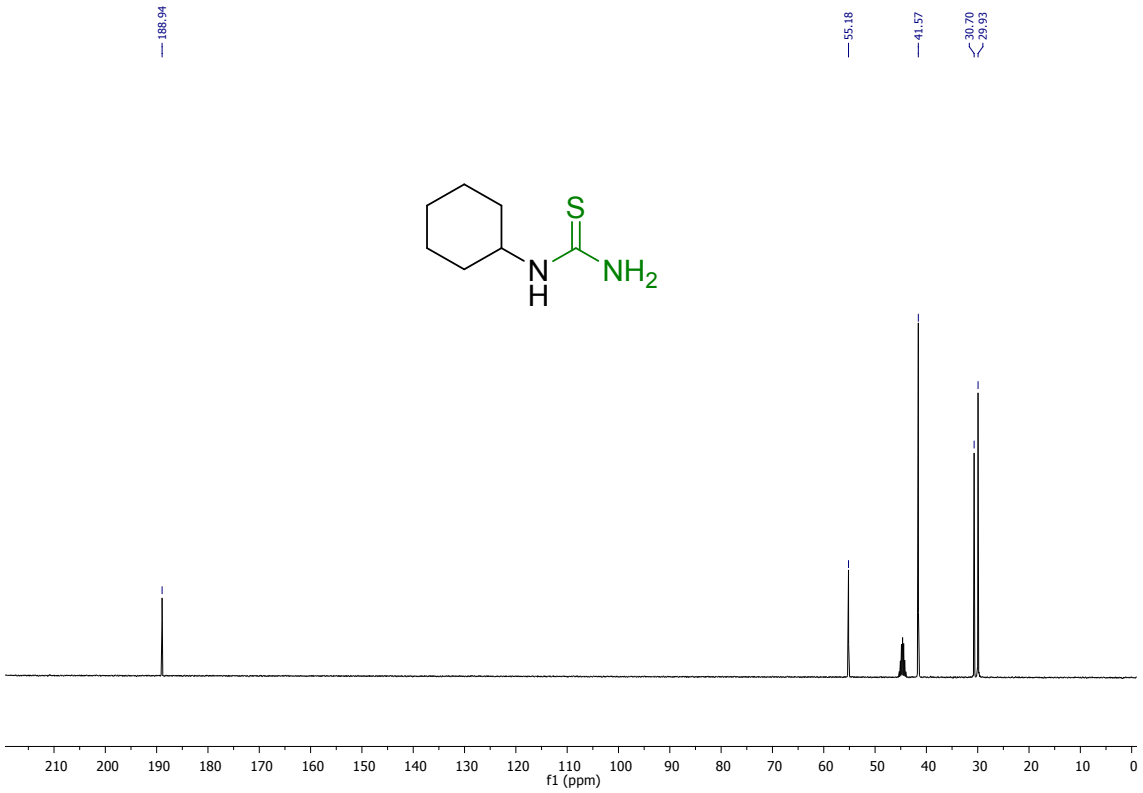


Figure S53. ^{13}C NMR spectrum of 3r in DMSO-d_6 (101MHz)

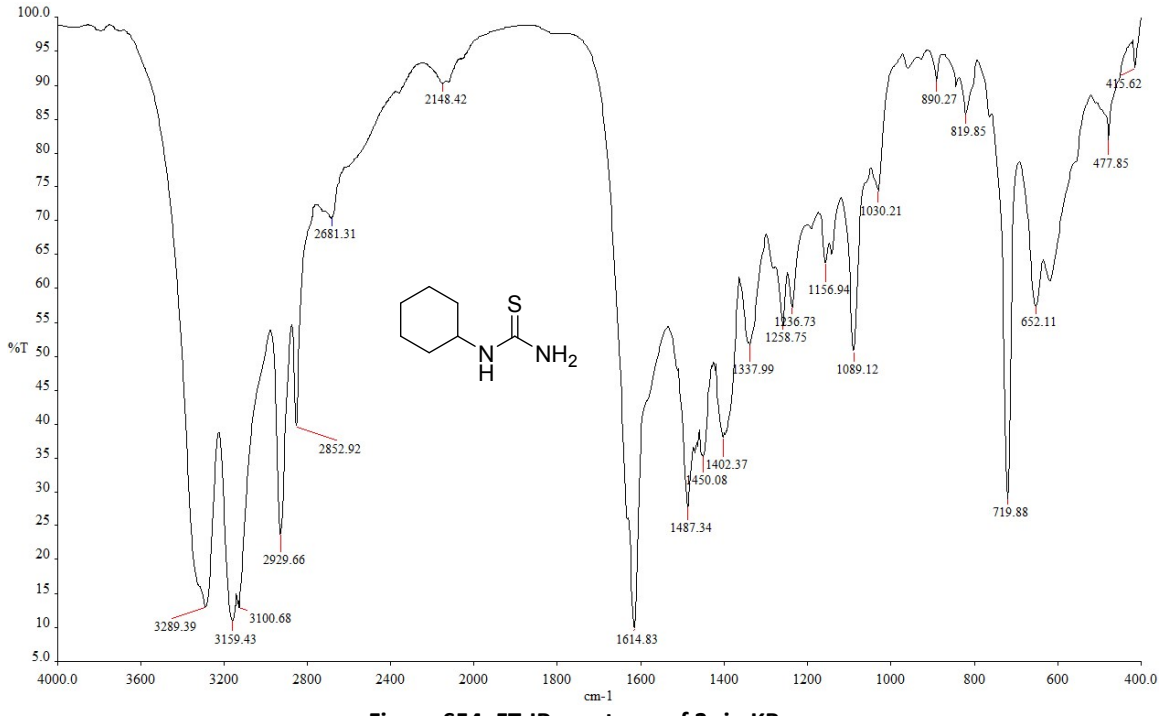


Figure S54. FT-IR spectrum of 3r in KBr

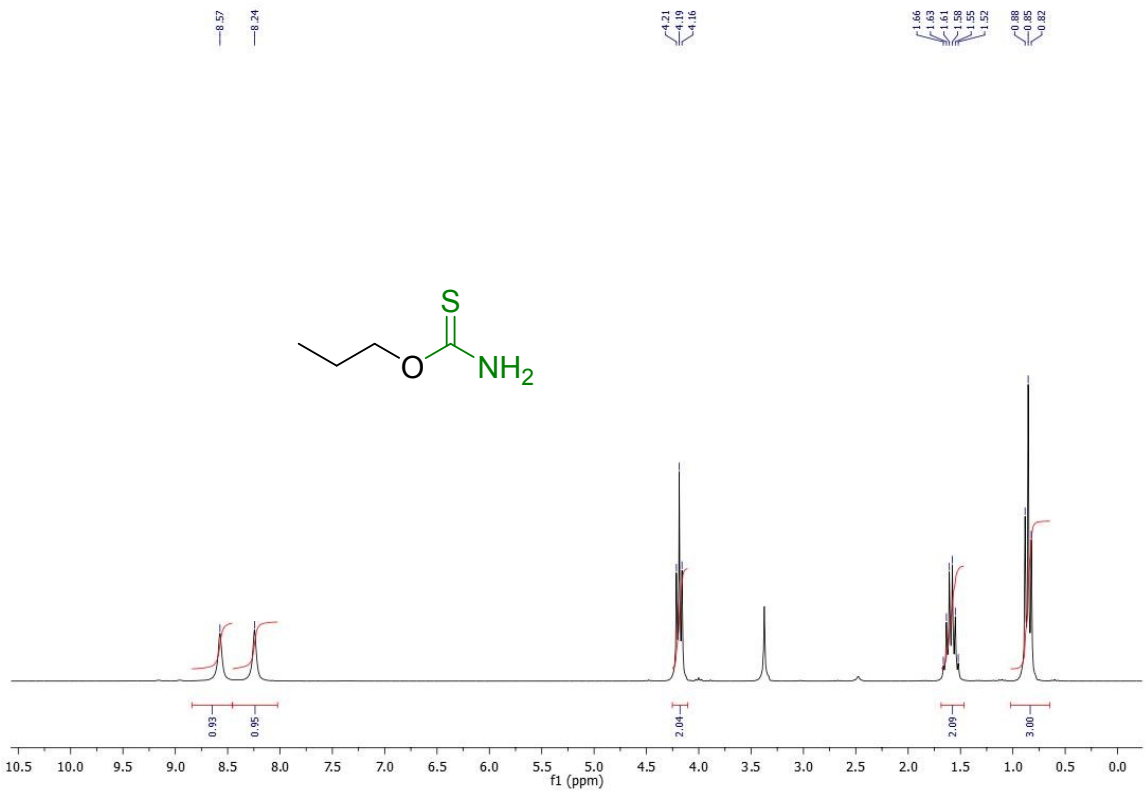


Figure S55. ^{1}H NMR spectrum of 5a in DMSO-d_6 (250MHz).

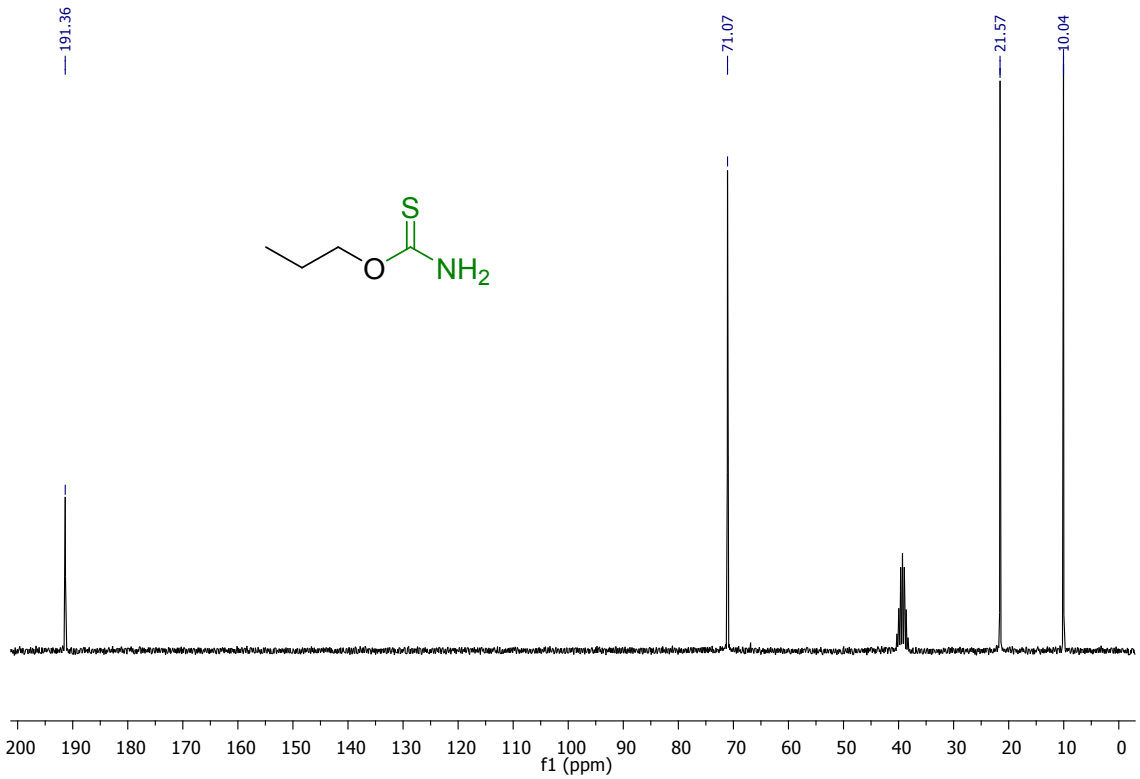


Figure S56. ^{13}C NMR spectrum of 5a in DMSO-d_6 (63MHz)

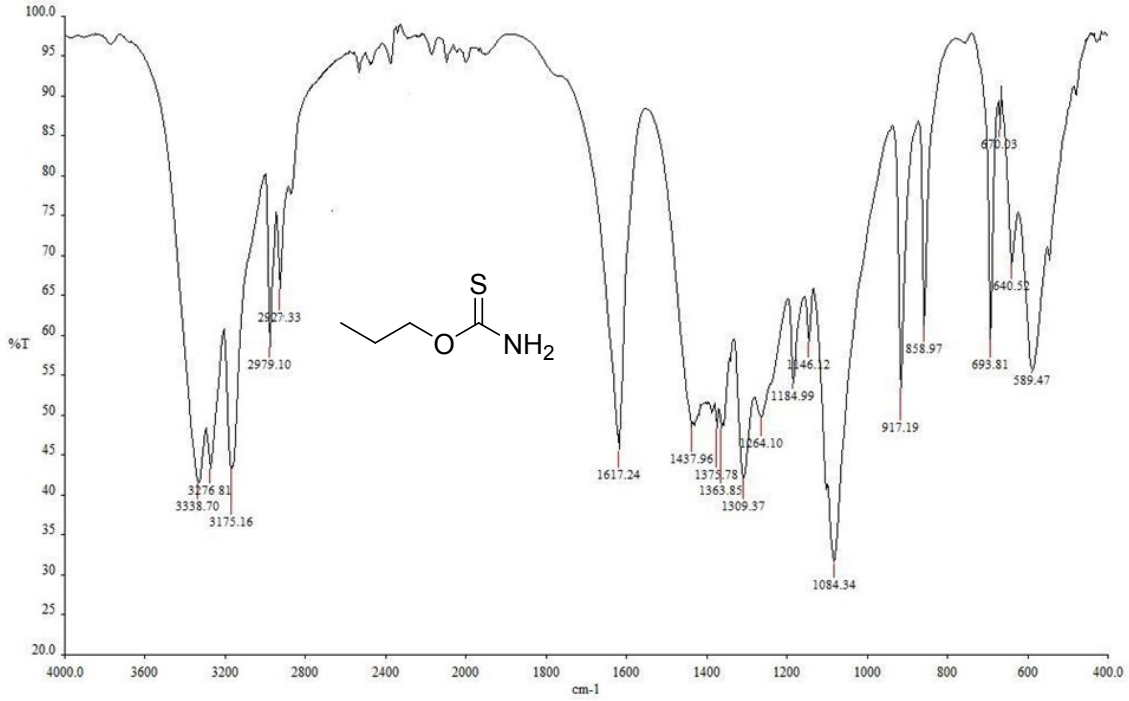


Figure S57. FT-IR spectrum of 5a in KBr

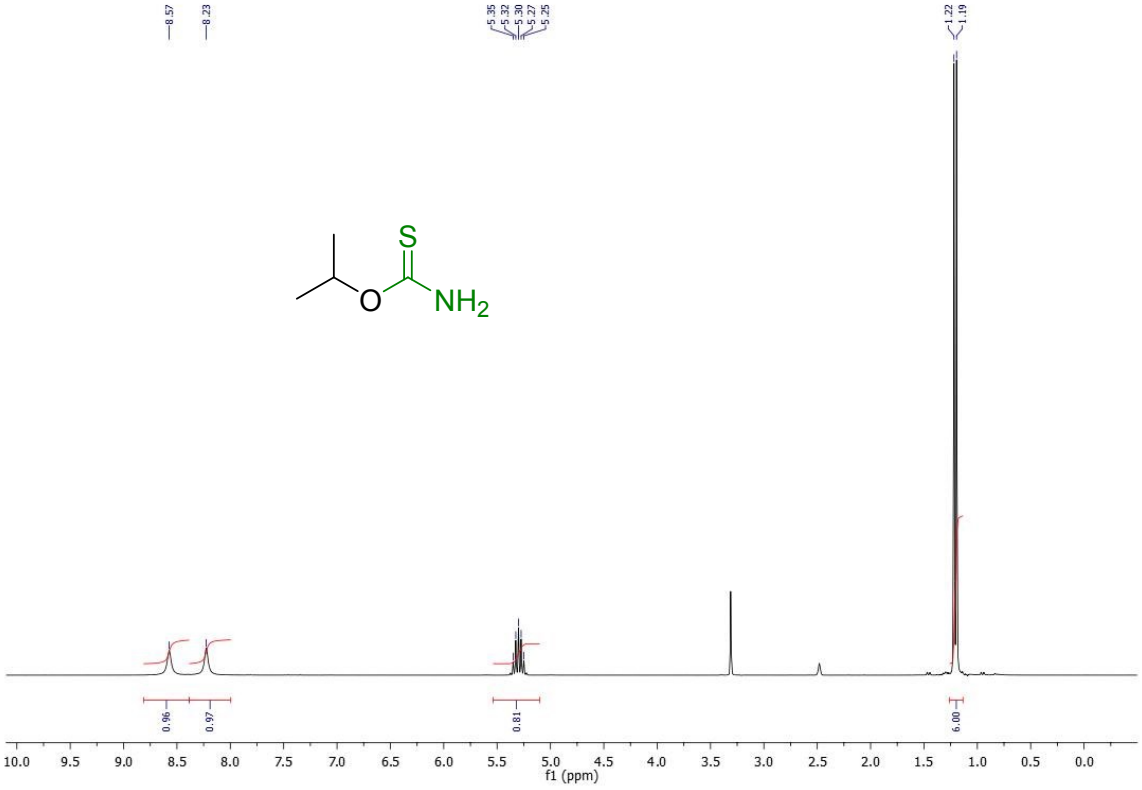


Figure S58. ^{1}H NMR spectrum of 5b in DMSO-d_6 (250MHz)

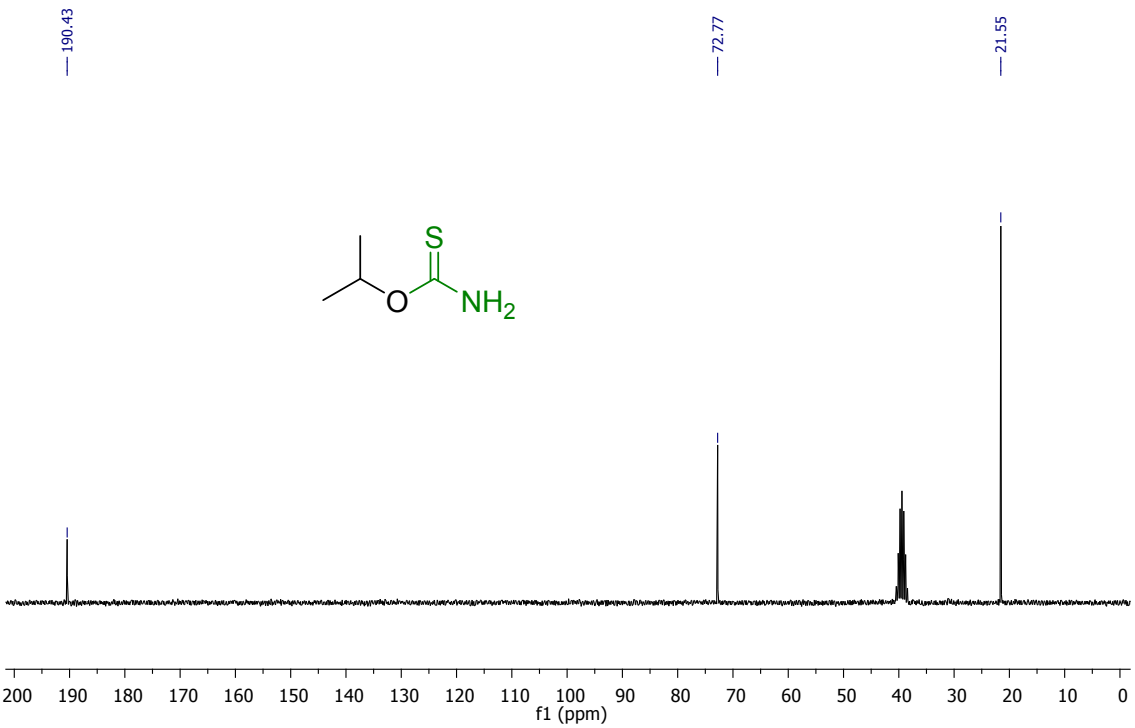


Figure S59. ^{13}C NMR spectrum of 5b in DMSO-d_6 (63MHz)

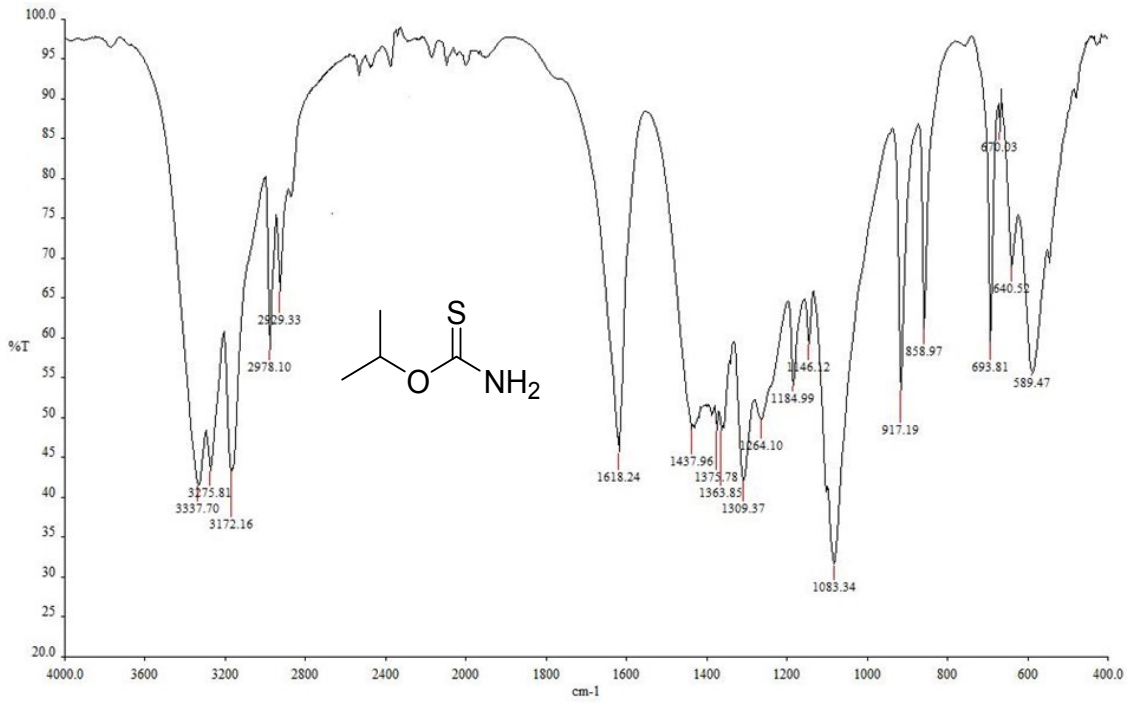


Figure S60. FT-IR spectrum of 5b in KBr

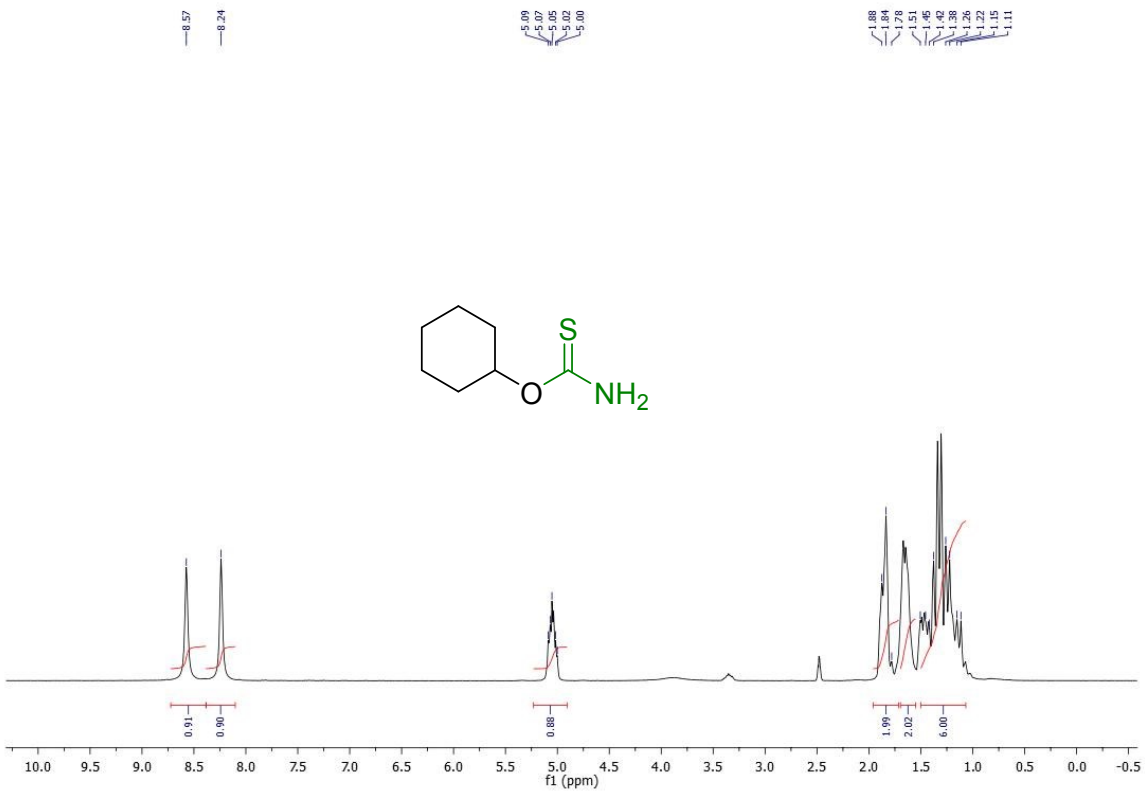


Figure S61. ^{1}H NMR spectrum of 5c in DMSO-d_6 (250MHz)

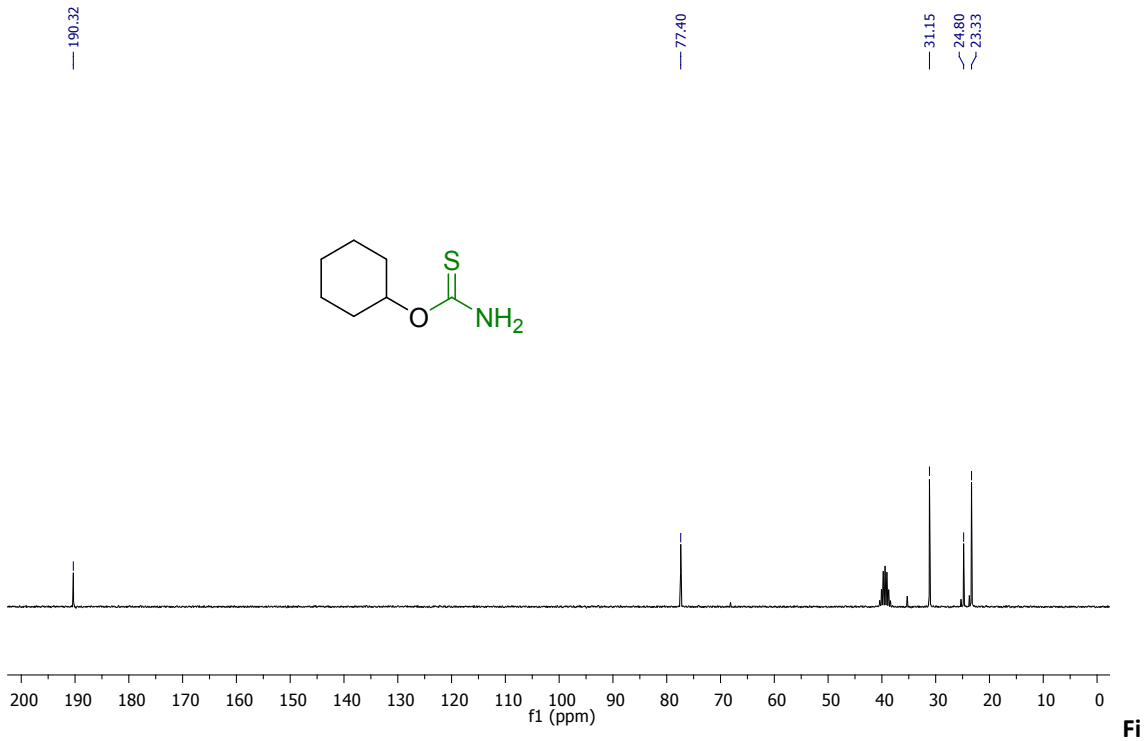


Figure S62. ^{13}C NMR spectrum of 5c in DMSO-d_6 (63MHz)

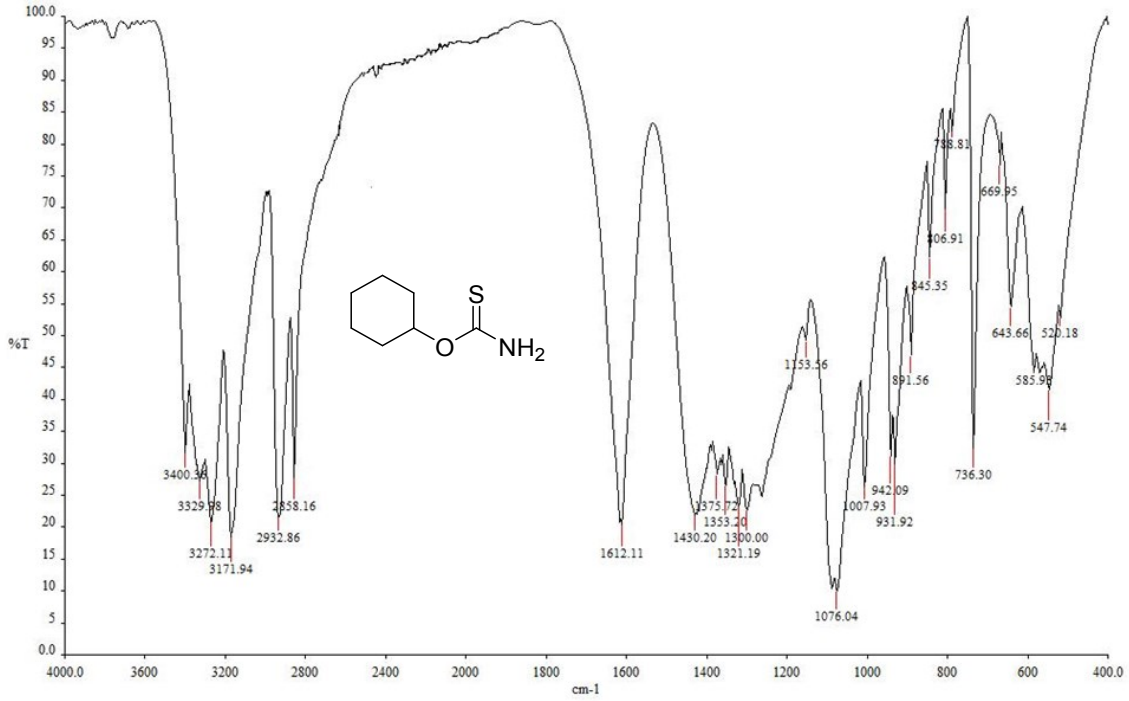


Figure S63. FT-IR spectrum of 5c in KBr

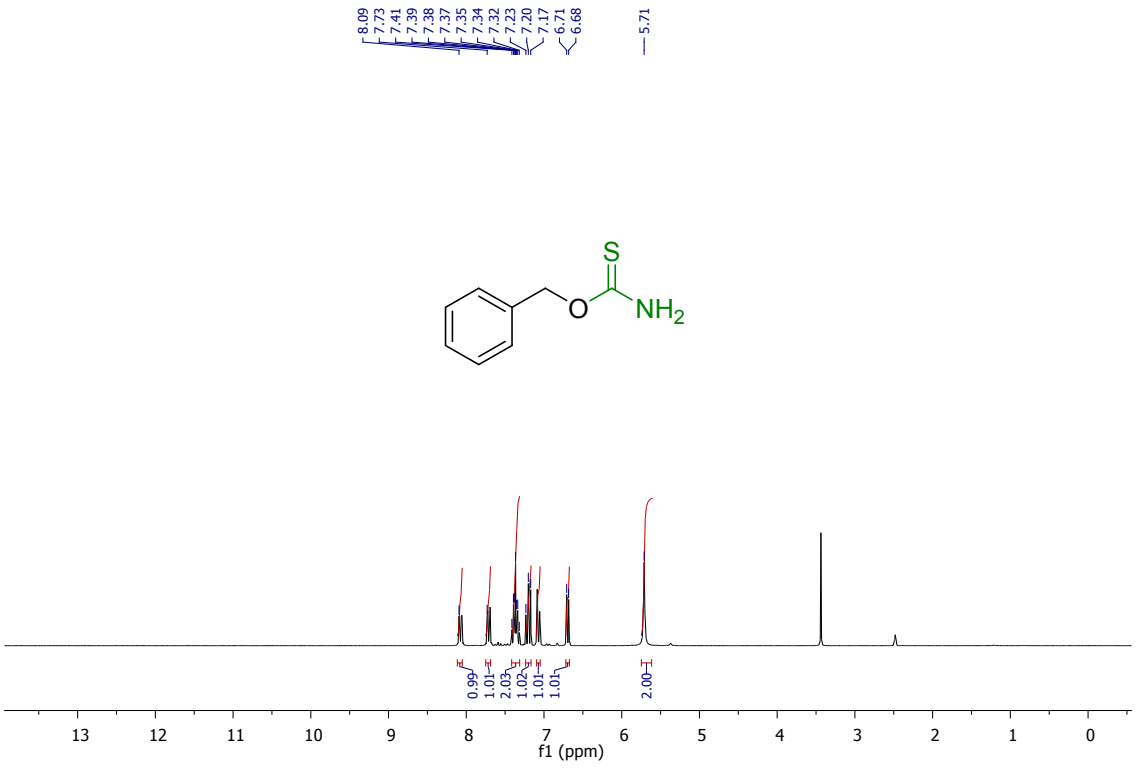


Figure S64. ^{1}H NMR spectrum of 5d in DMSO-d_6 (250MHz)

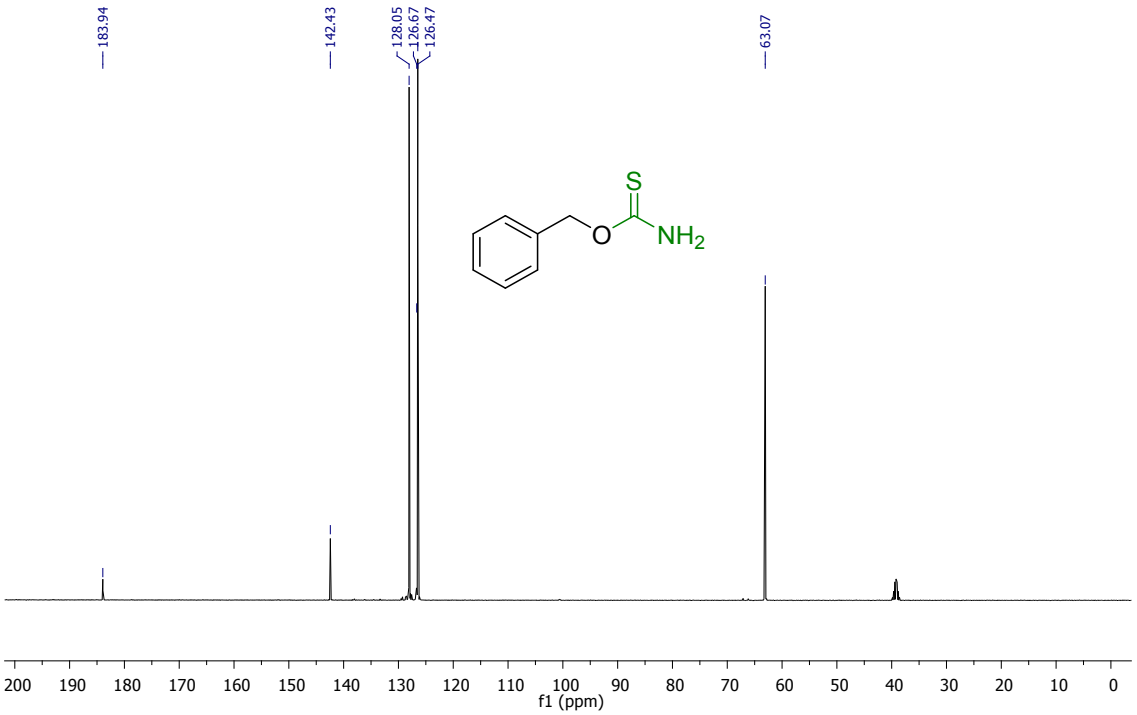


Figure S65. ^{13}C NMR spectrum of 5d in DMSO (101MHz)

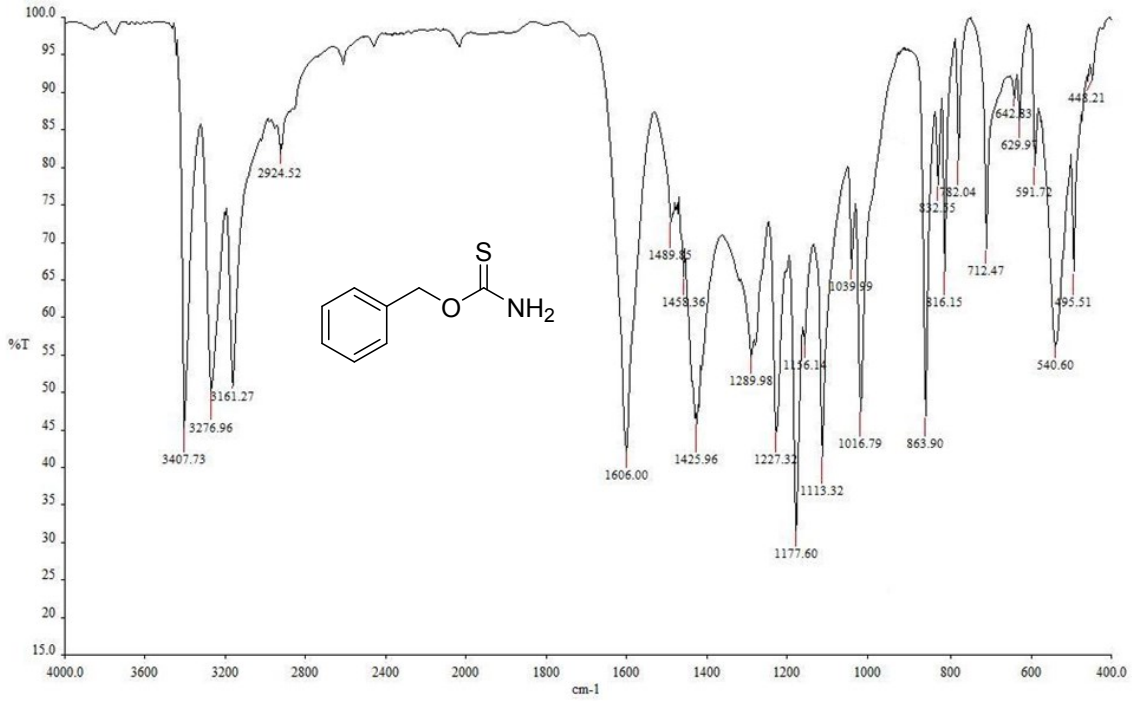


Figure S66. FT-IR spectrum of 5d in KBr

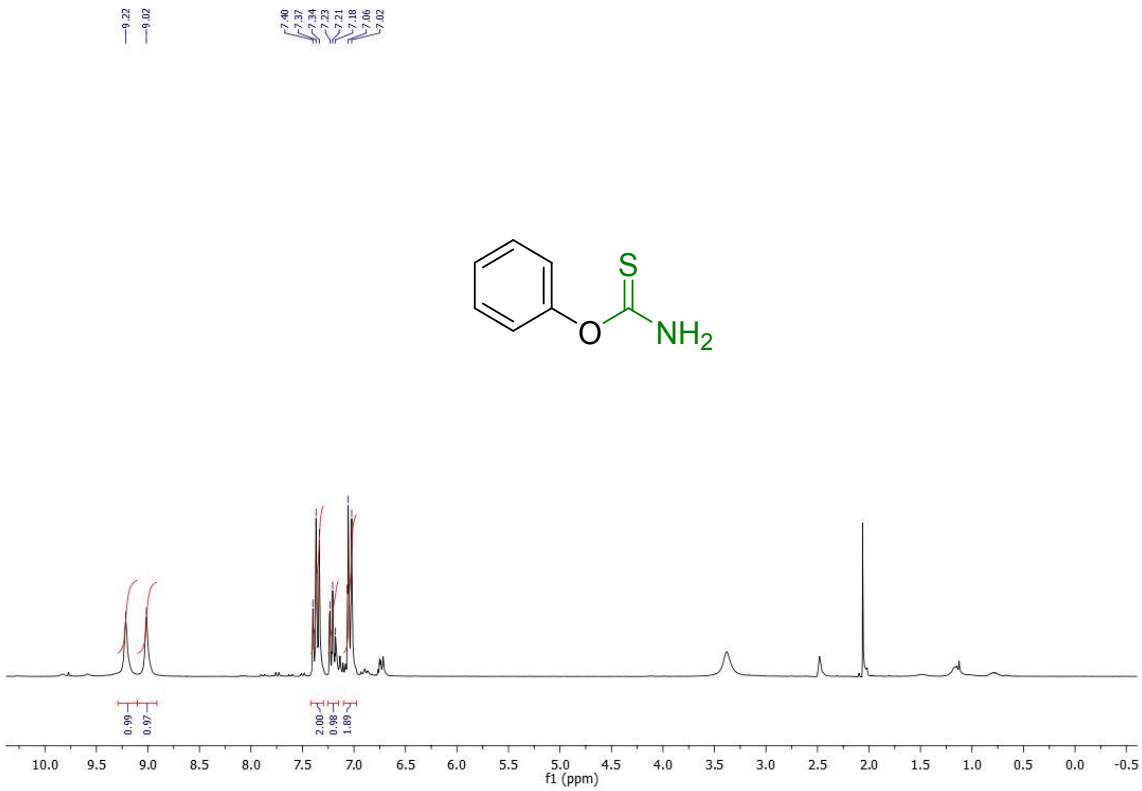


Figure S67. ^{1}H NMR spectrum of 5e in DMSO-d_6 (250MHz).

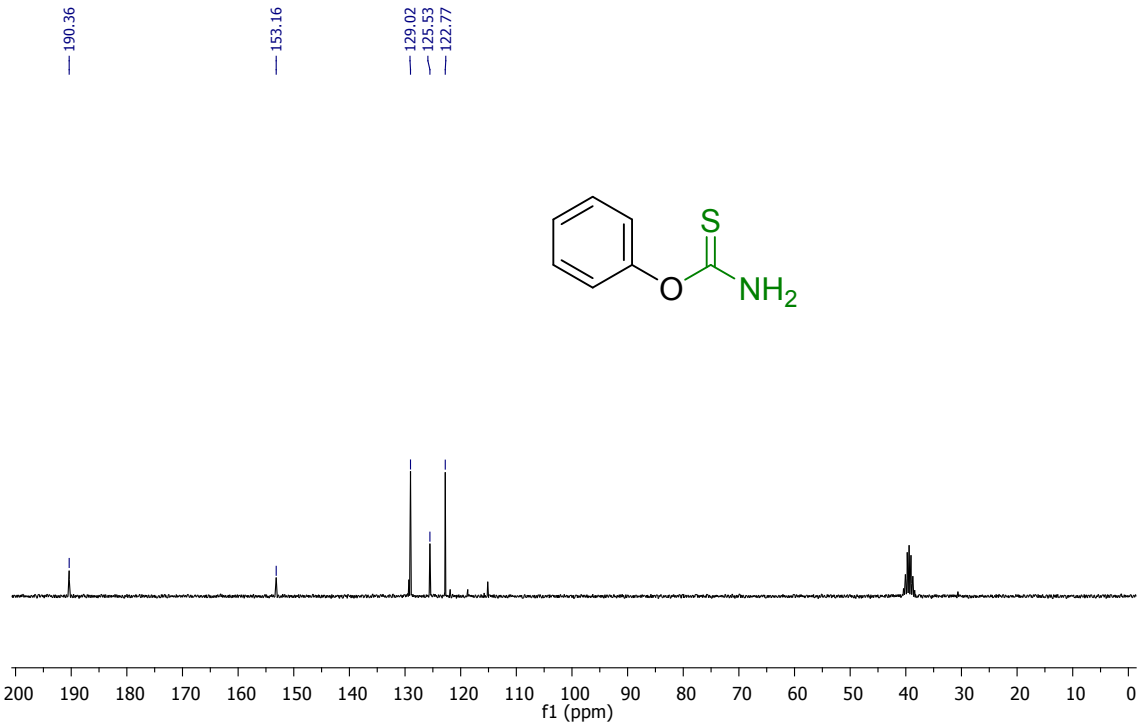


Figure S68. ^{13}C NMR spectrum of 5e in DMSO-d_6 (63MHz)

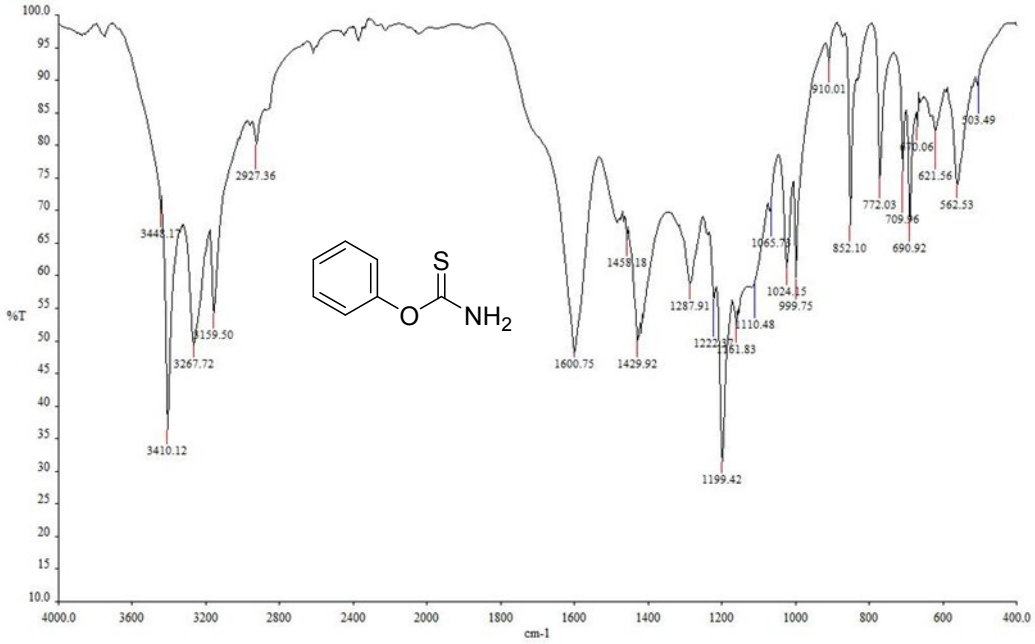


Figure S69. FT-IR spectrum of 5e in kBr

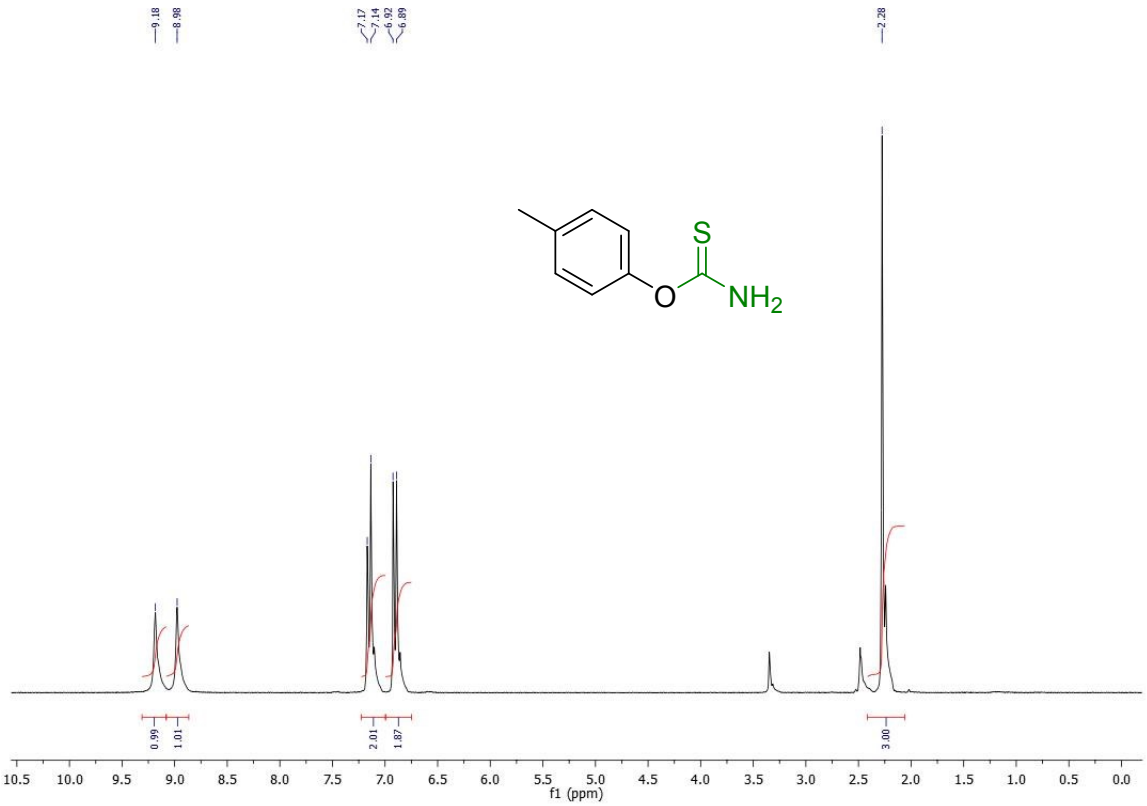


Figure S70. ^{1}H NMR spectrum of 5f in DMSO-d_6 (250MHz)

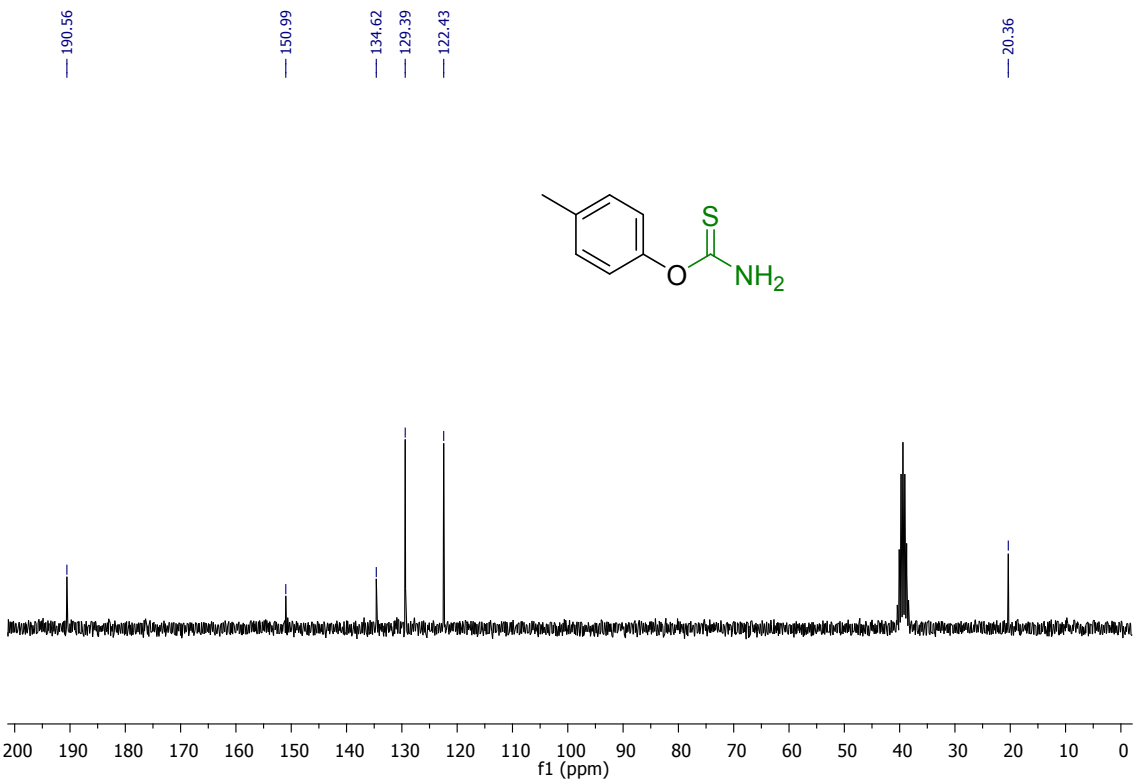


Figure S71. ^{13}C NMR spectrum of 5f in DMSO-d_6 (63MHz)

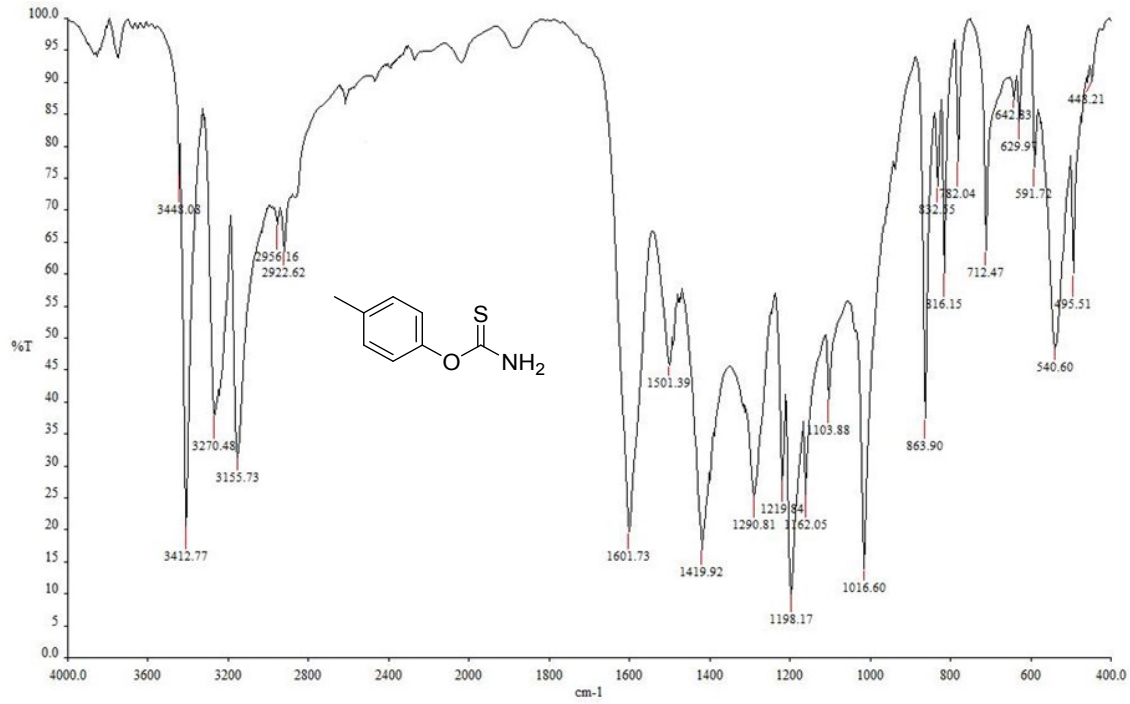


Figure S72. FT-IR spectrum of 5f in KBr

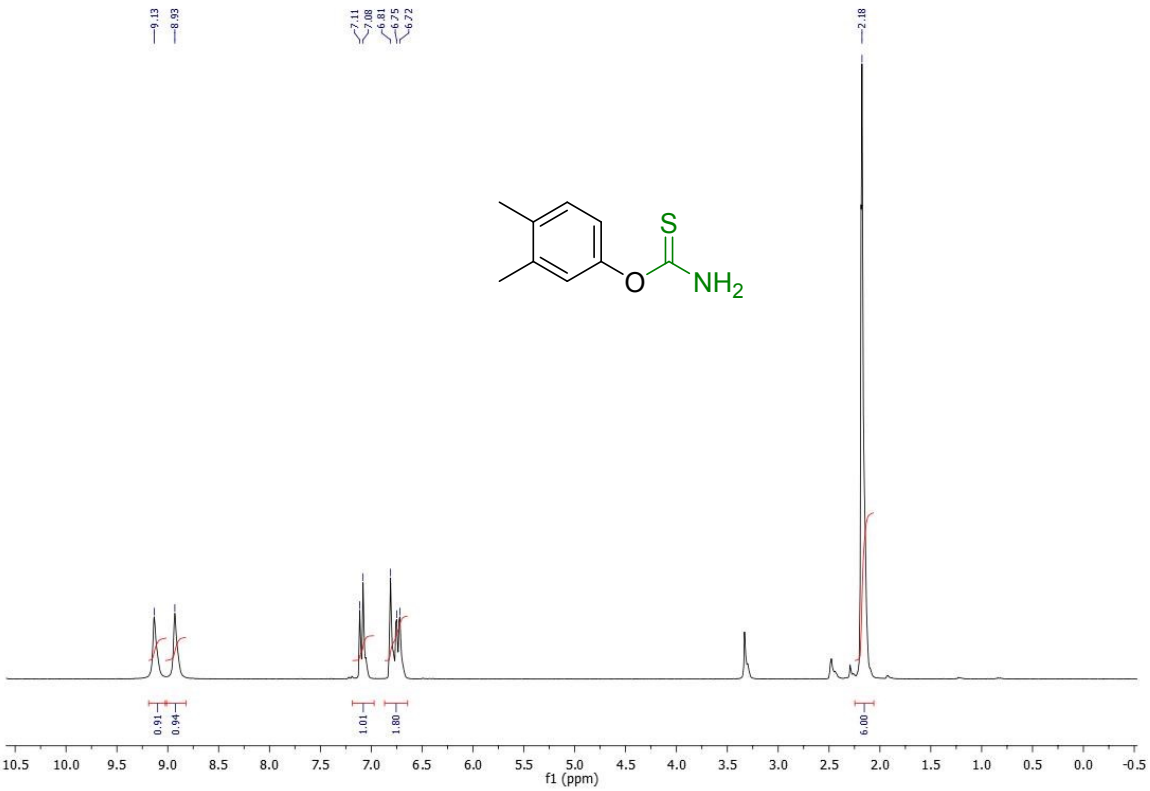


Figure S73. ^{1}H NMR spectrum of 5g in DMSO-d_6 (250MHz)

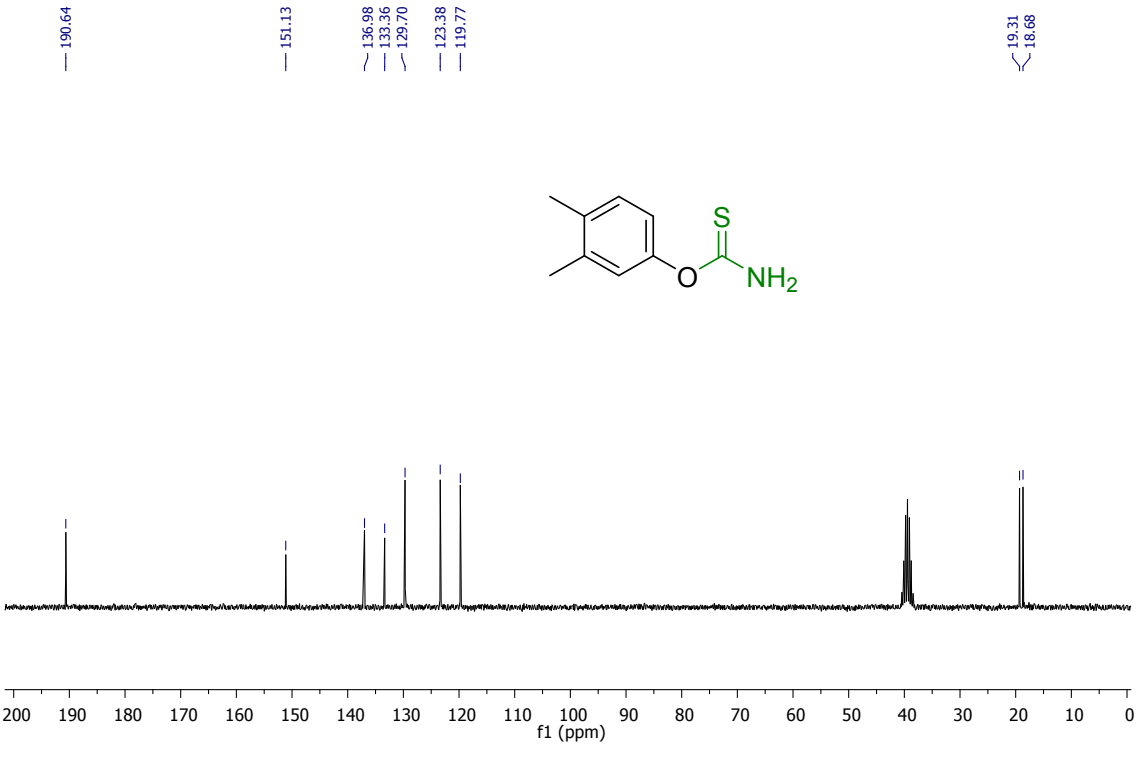


Figure S74. ^{13}C NMR spectrum of 5g in DMSO-d_6 (63MHz)

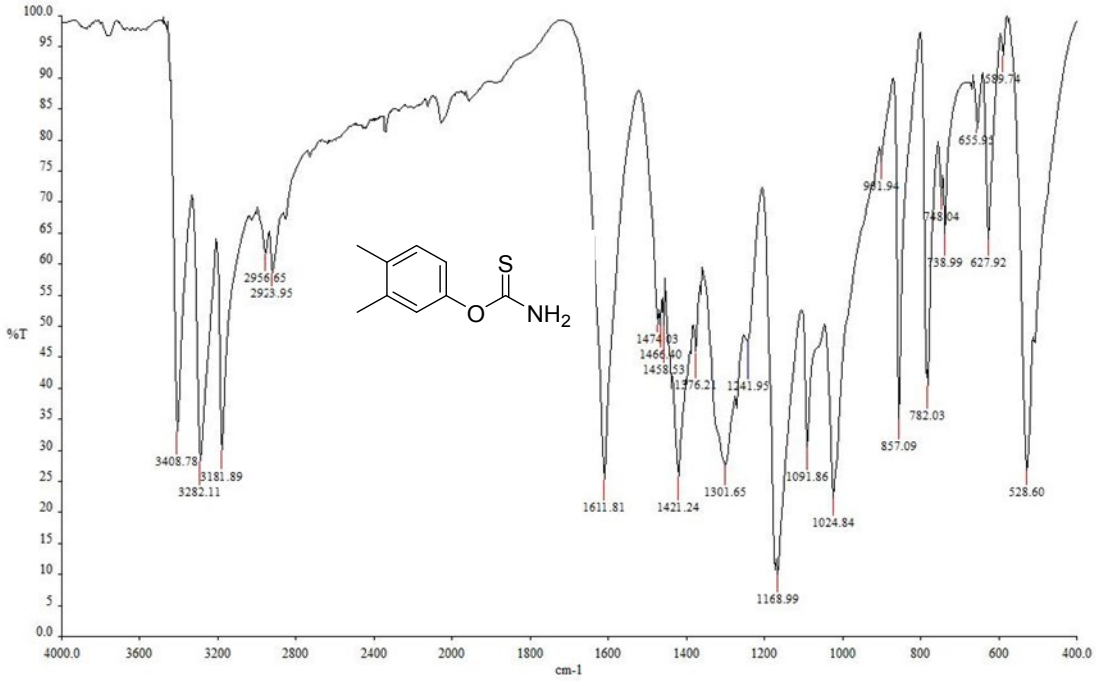


Figure S75. FT-IR spectrum of 5g in KBr

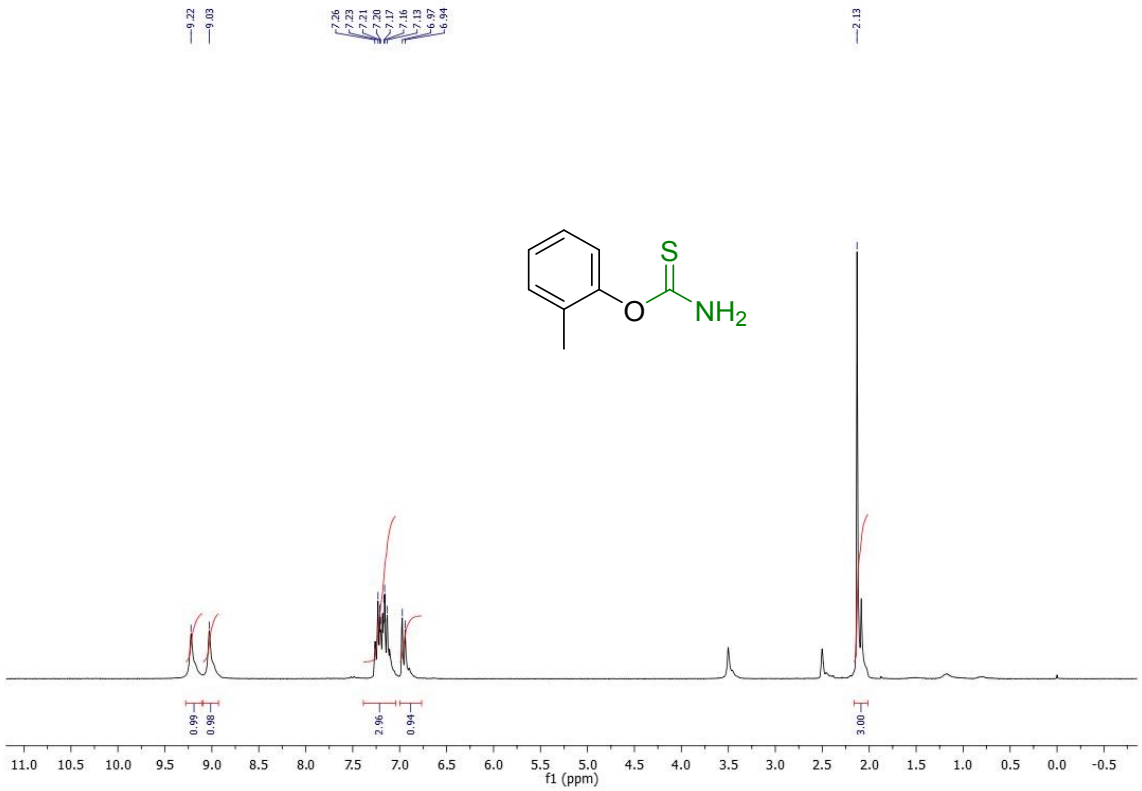


Figure S76. ^{1}H NMR spectrum of 5h in DMSO-d_6 (250MHz)

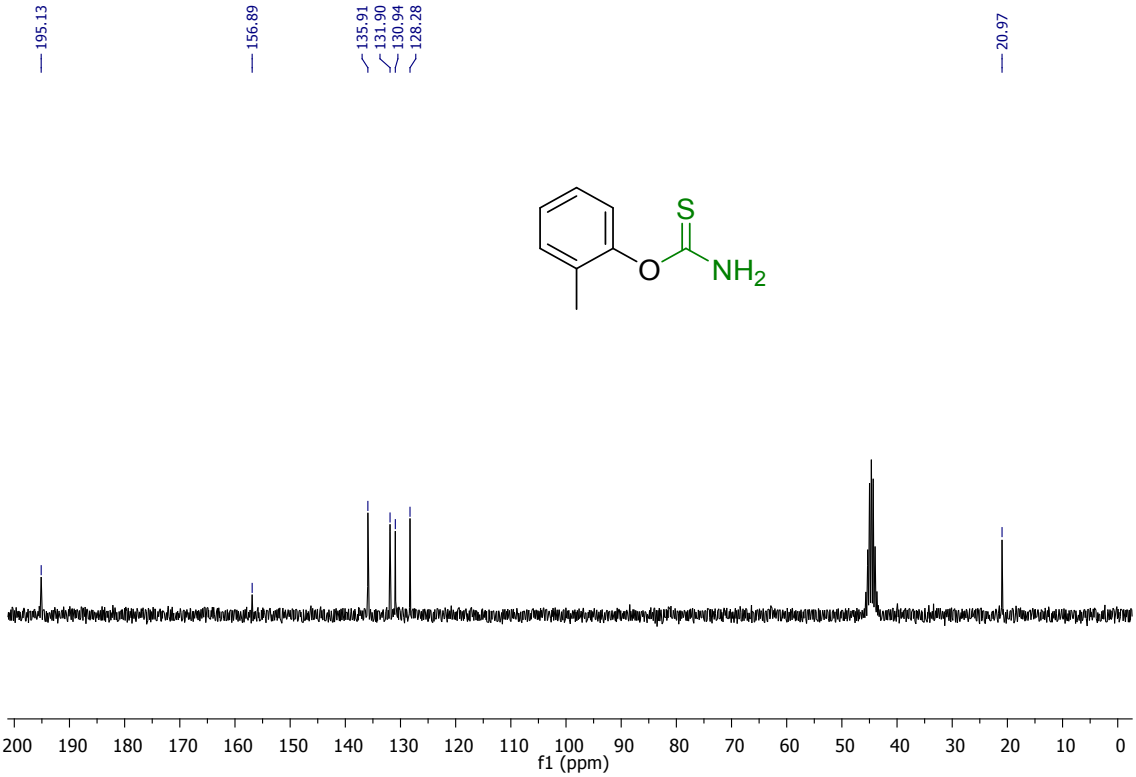


Figure S77. ^{13}C NMR spectrum of 5h in DMSO-d_6 (63MHz)

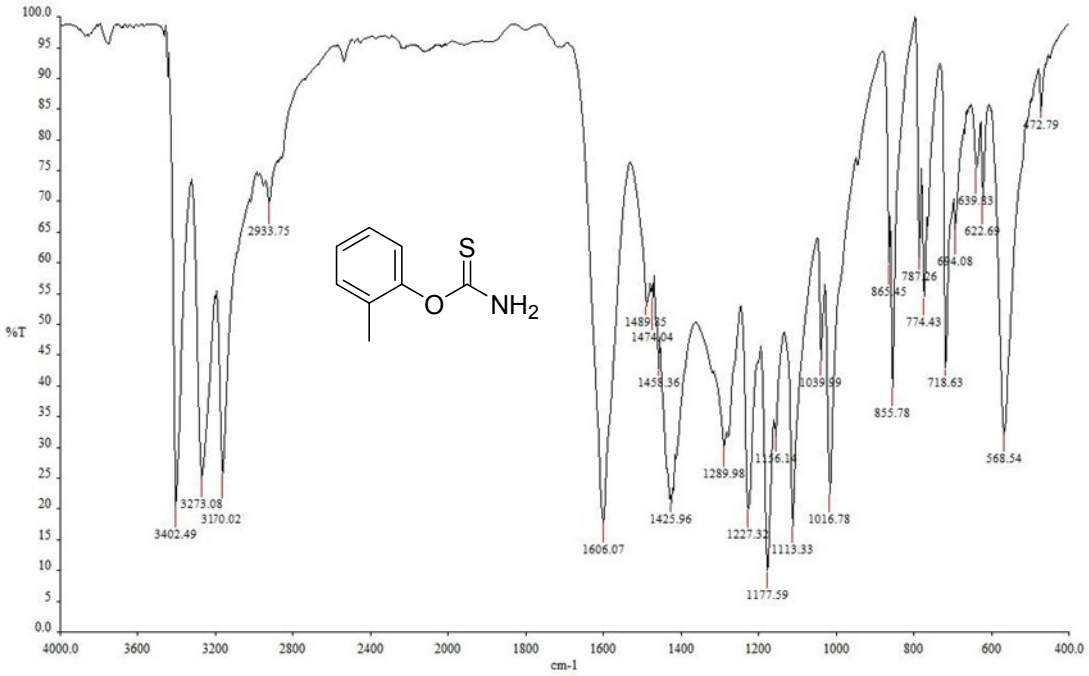


Figure S78. FT-IR spectrum of 5h in KBr

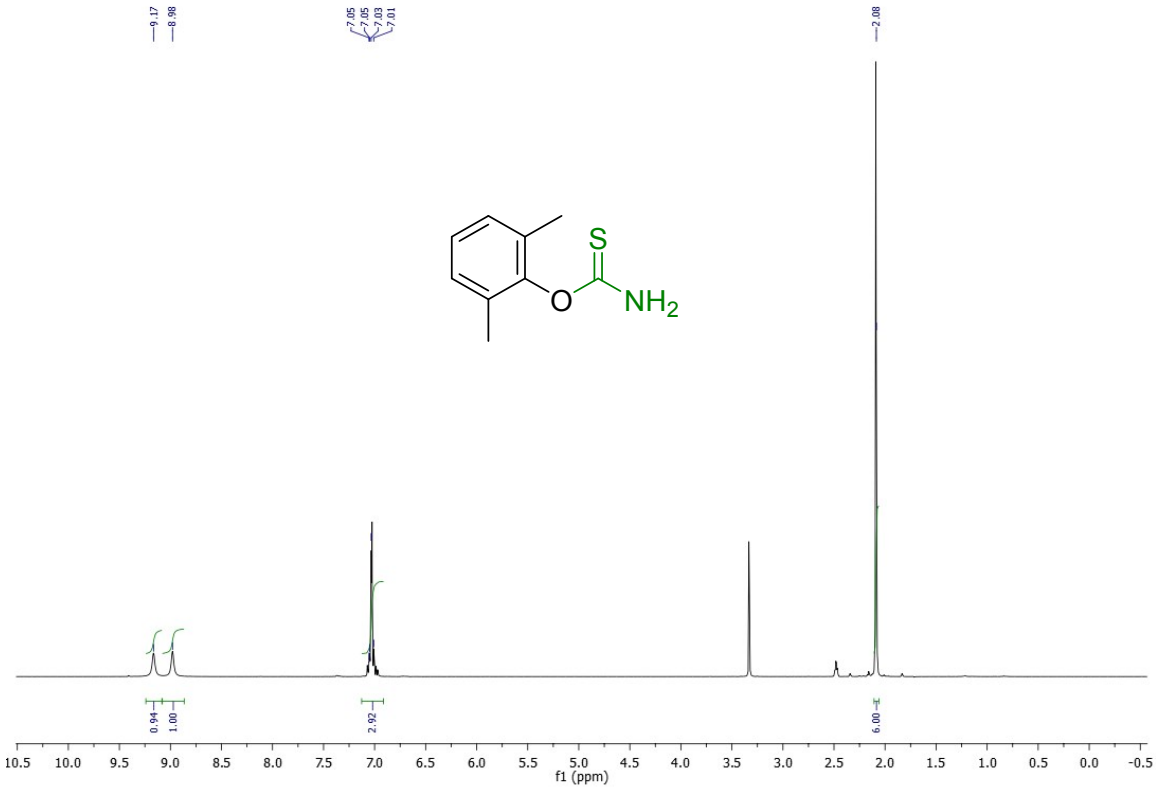


Figure S79. ^{1}H NMR spectrum of 5i in DMSO-d_6 (250MHz)

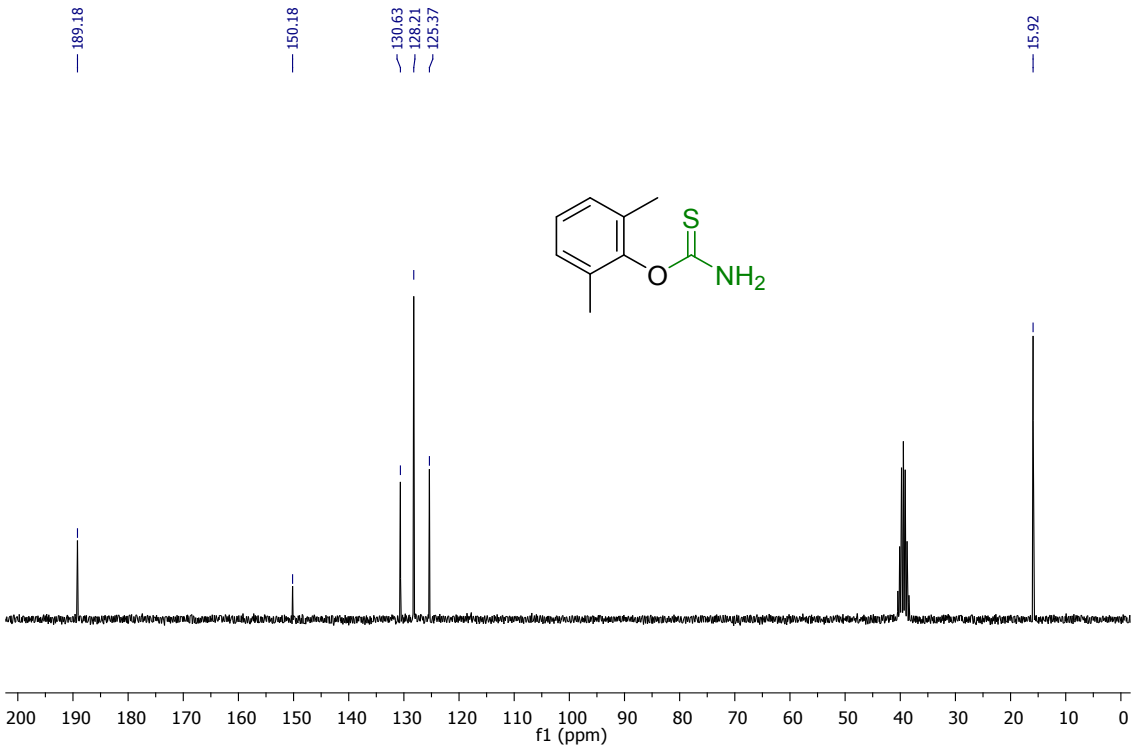


Figure S80. ^{13}C NMR spectrum of 5i in DMSO-d_6 (63MHz)

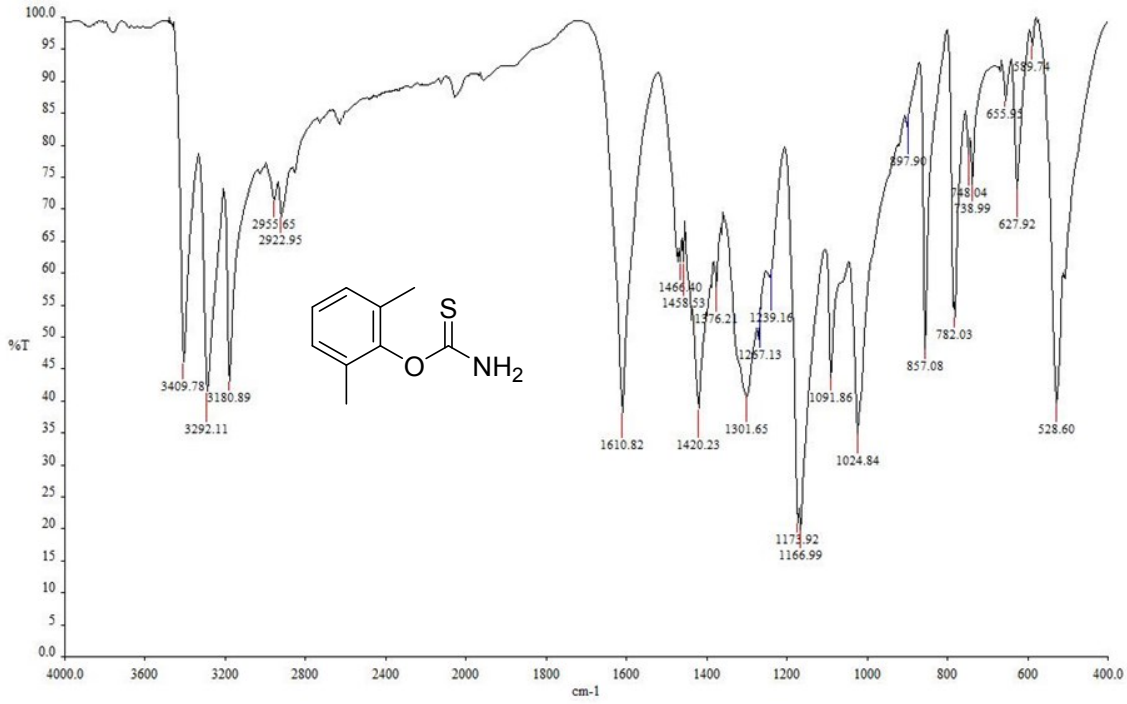


Figure S81. FT-IR spectrum of 5i in KBr

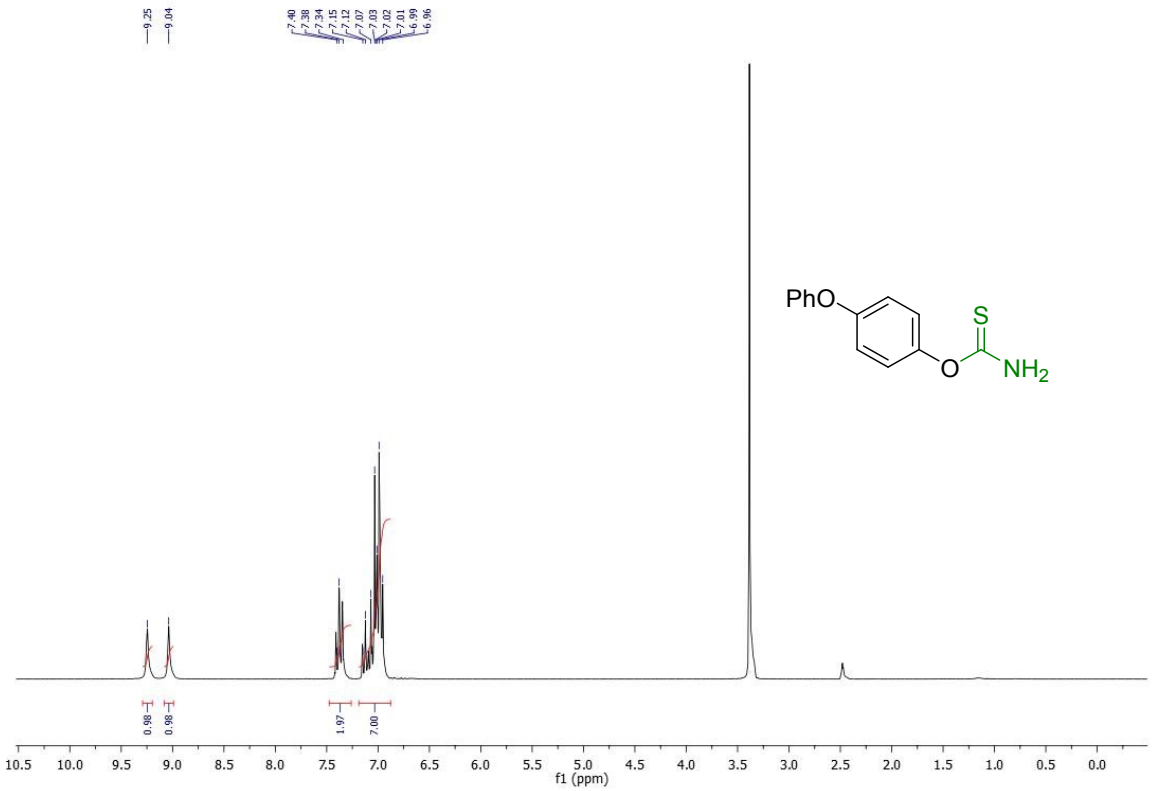


Figure S82. ^{1}H NMR spectrum of 5j in DMSO-d_6 (250MHz)

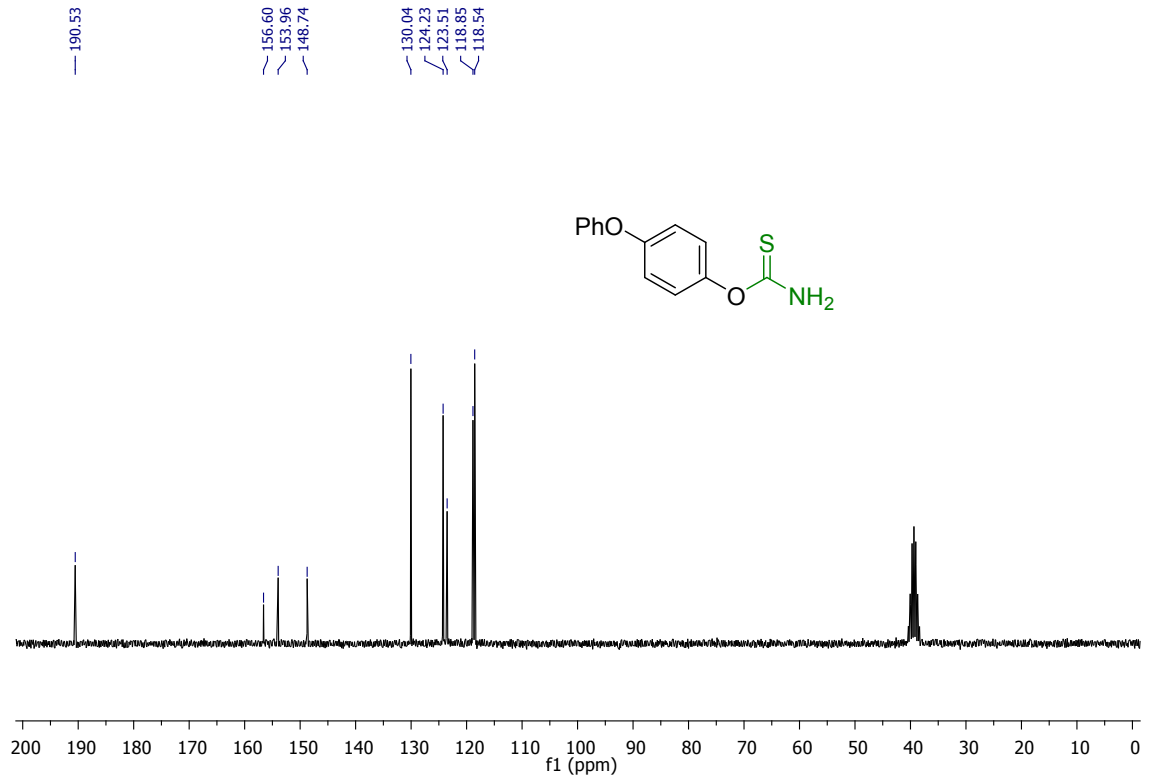


Figure S83. ^{13}C NMR spectrum of 5j in DMSO-d_6 (63MHz)

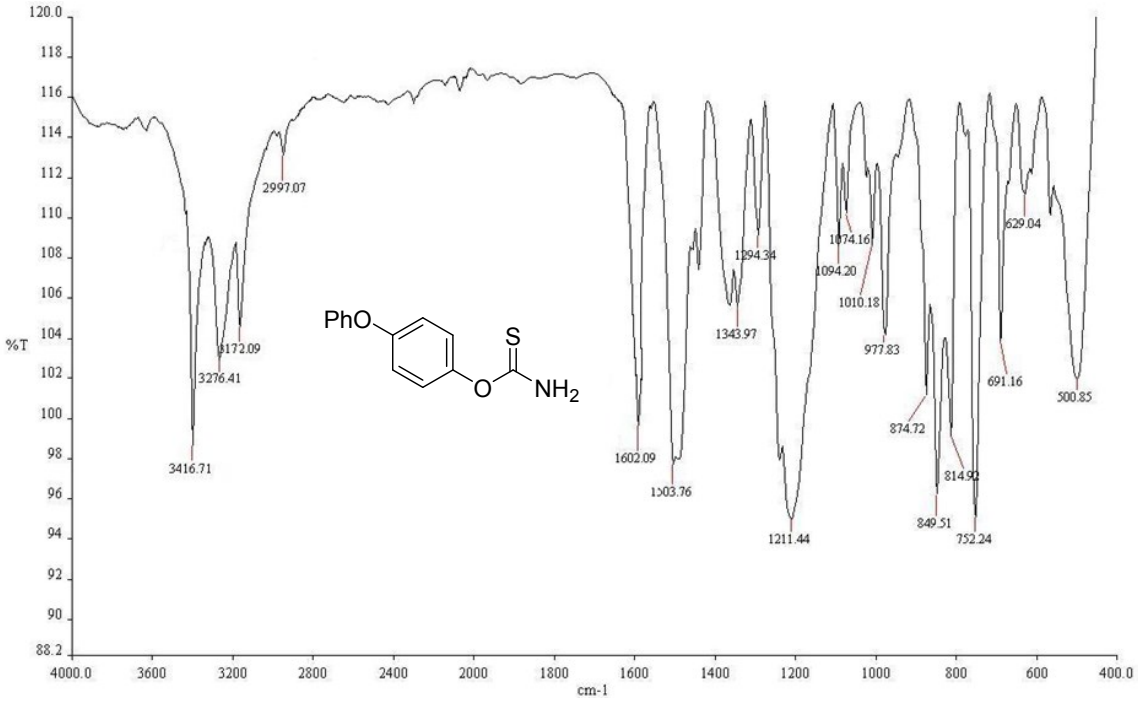


Figure S84. FT-IR spectrum of 5j in KBr

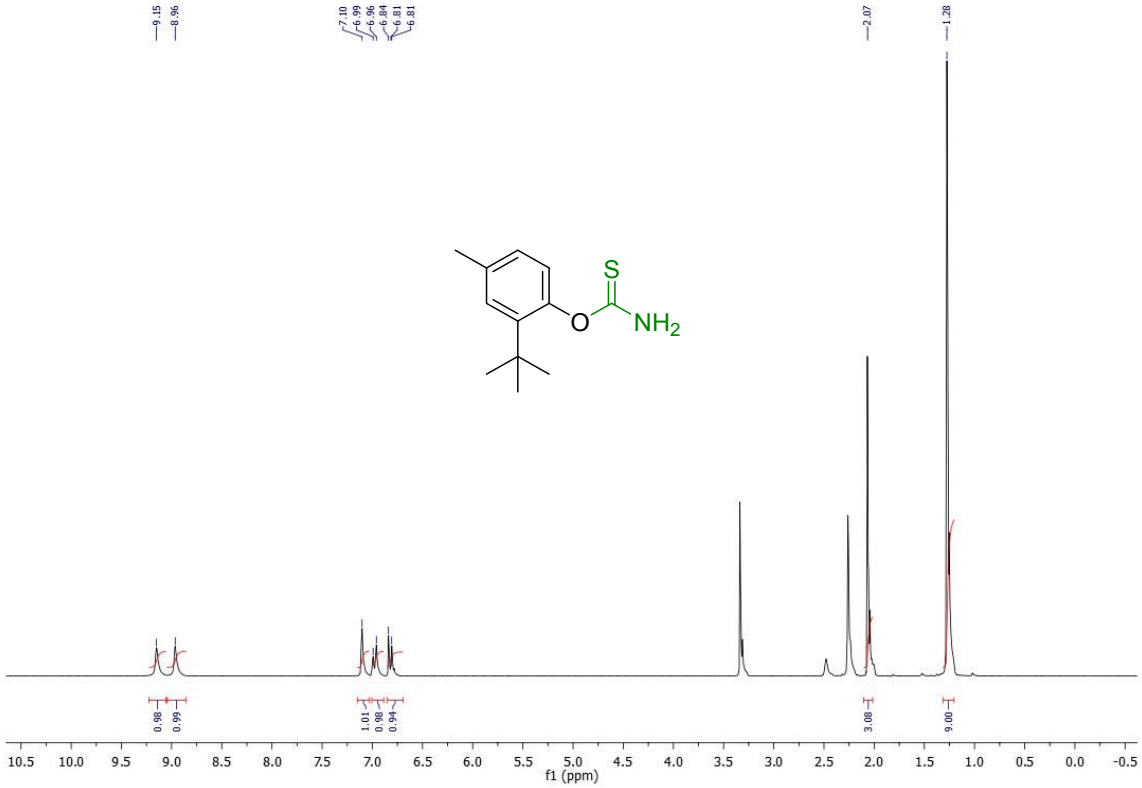


Figure S85. ^{1}H NMR spectrum of 5k in DMSO-d_6 (250MHz)

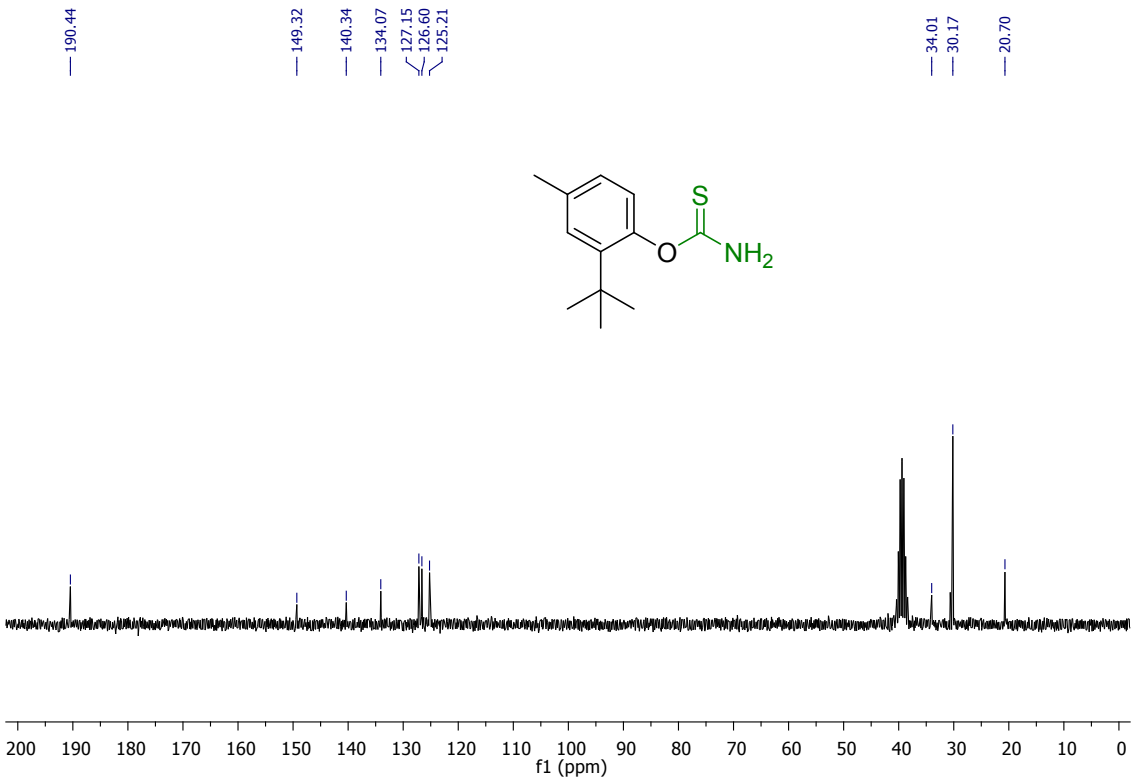


Figure S86. ^{13}C NMR spectrum of 5k in DMSO-d_6 (63MHz)

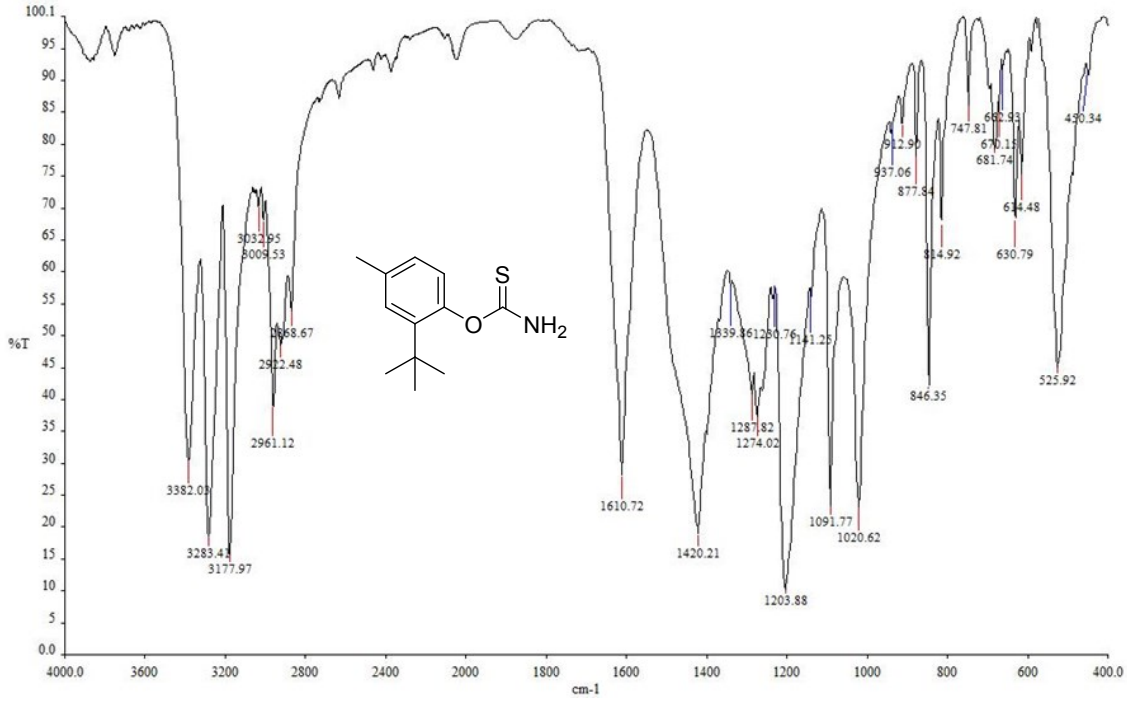


Figure S87. FT-IR spectrum of 5k in KBr

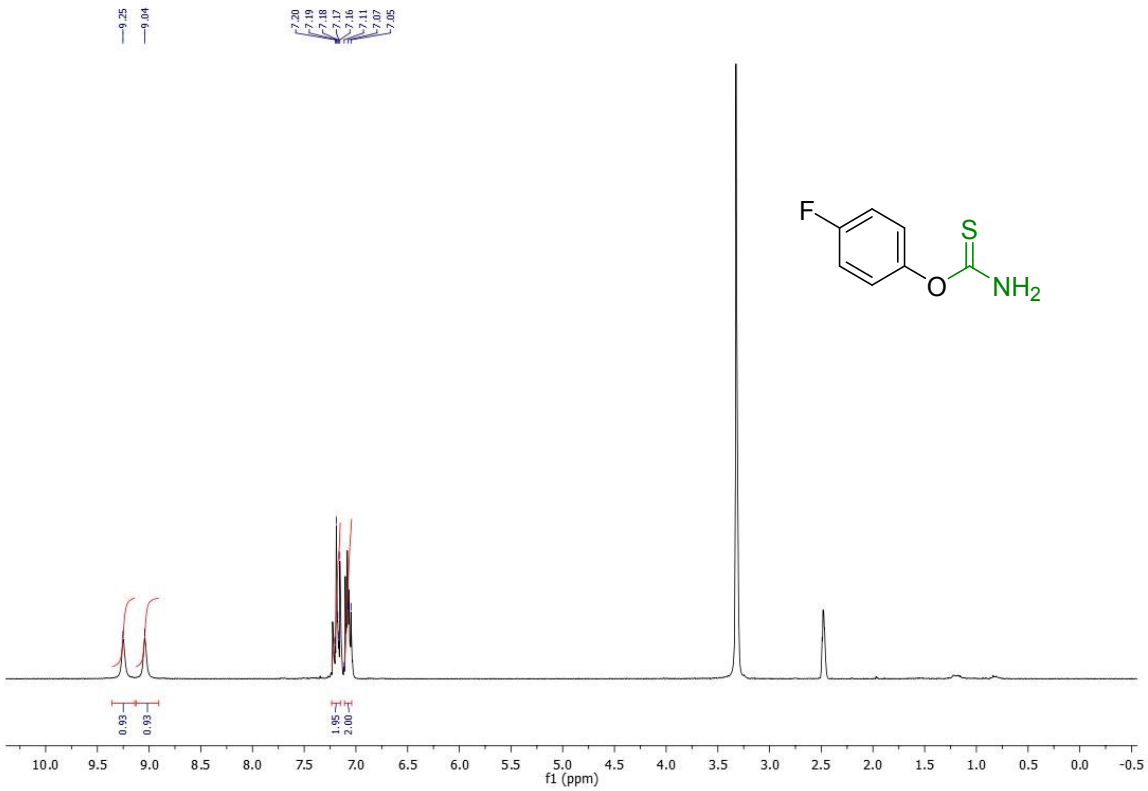


Figure S88. ^{1}H NMR spectrum of 5l in DMSO-d_6 (250MHz)

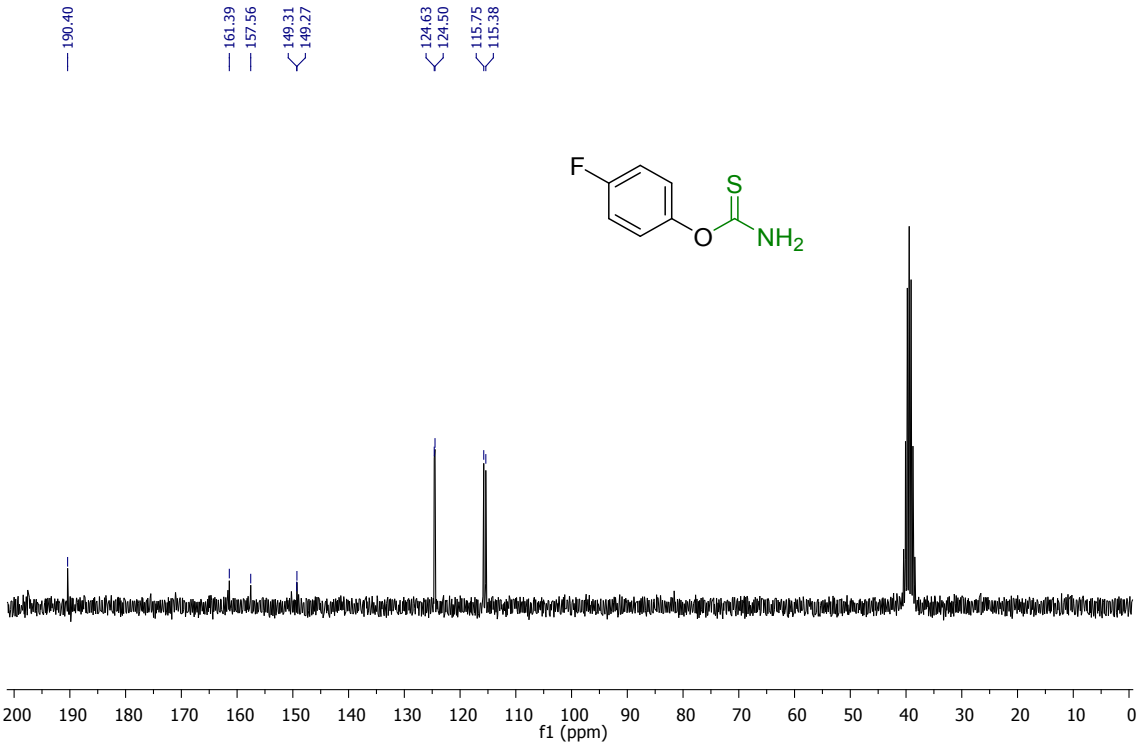


Figure S89. ^{13}C NMR spectrum of 5l in DMSO-d_6 (63MHz)

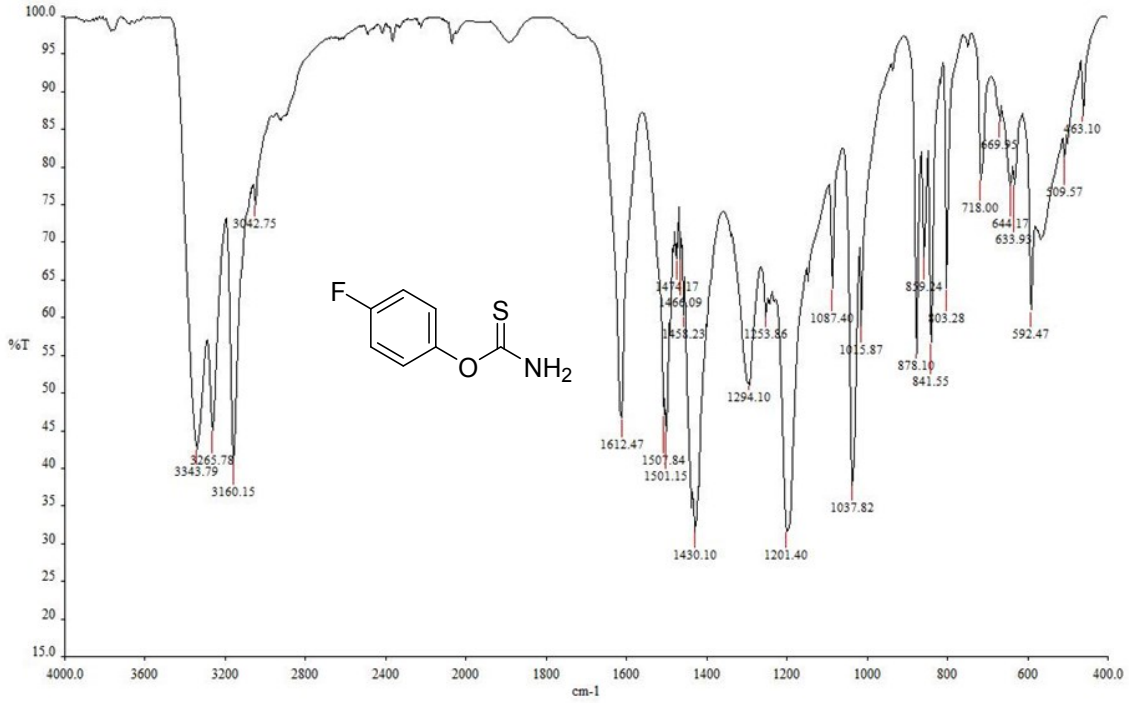


Figure S90. FT-IR spectrum of 5l in KBr

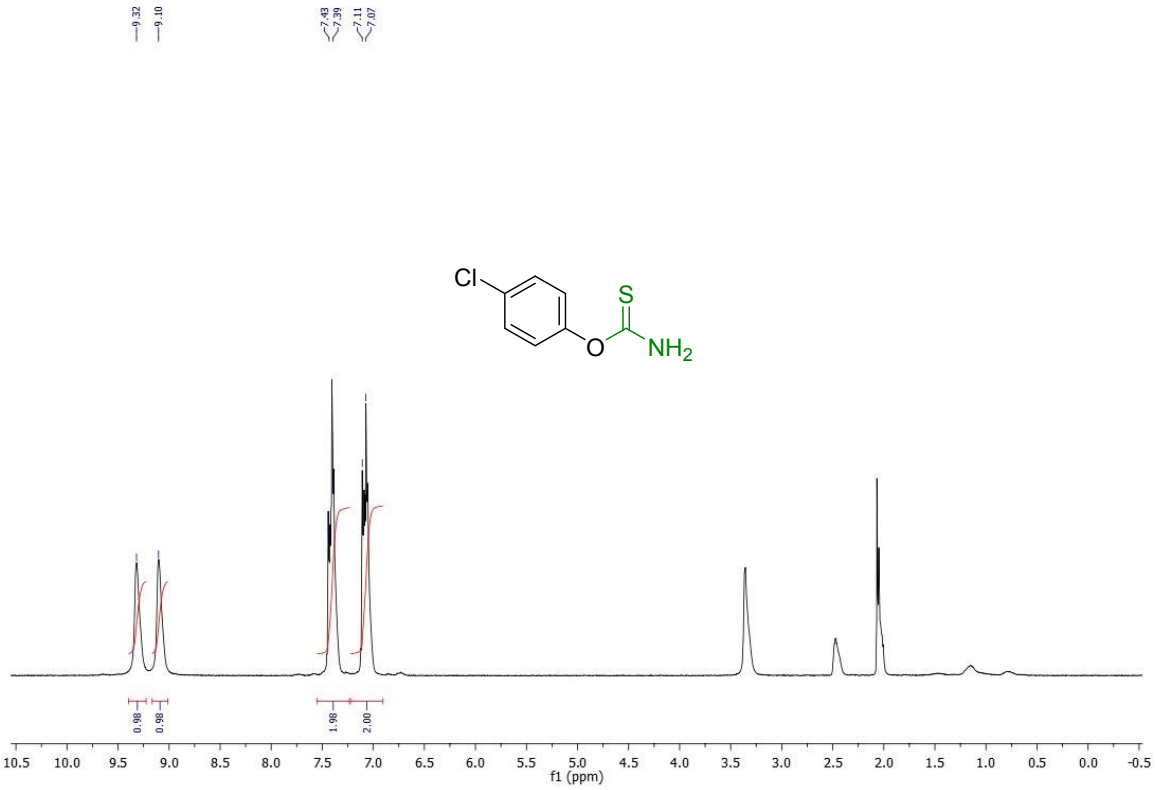


Figure S91. ^{1}H NMR spectrum of 5m in DMSO-d_6 (250MHz)

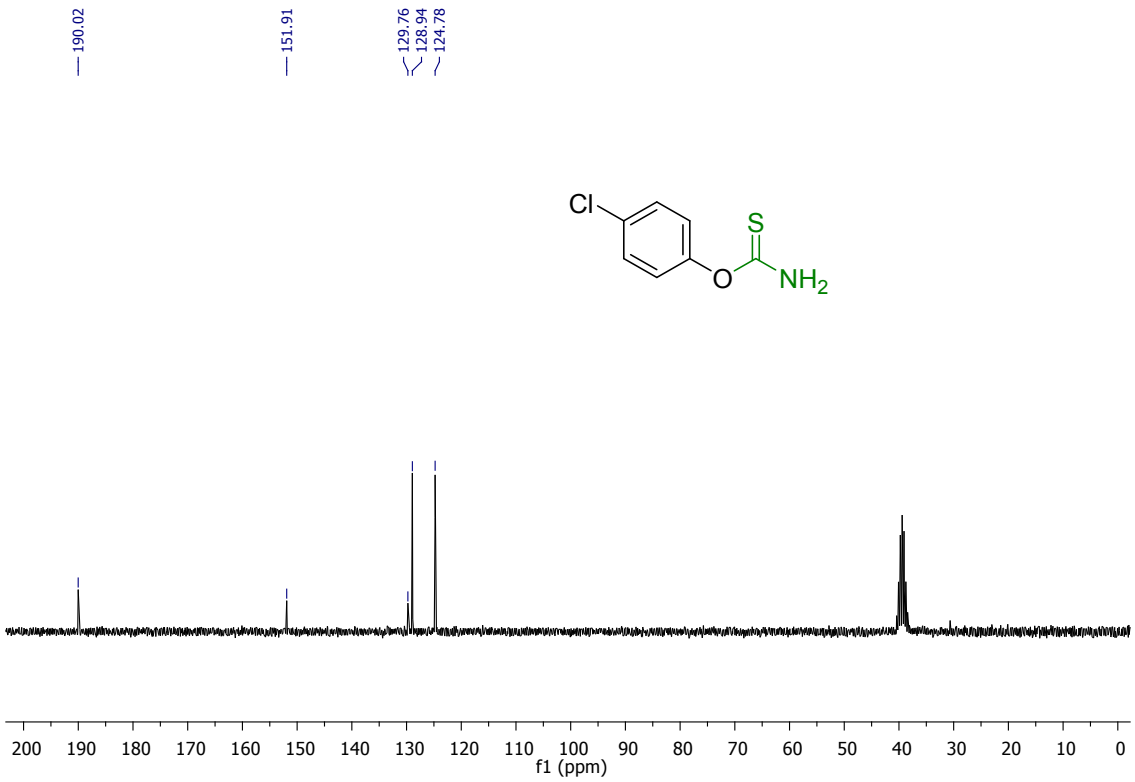


Figure S92. ^{13}C NMR spectrum of 5m in DMSO-d_6 (63MHz)

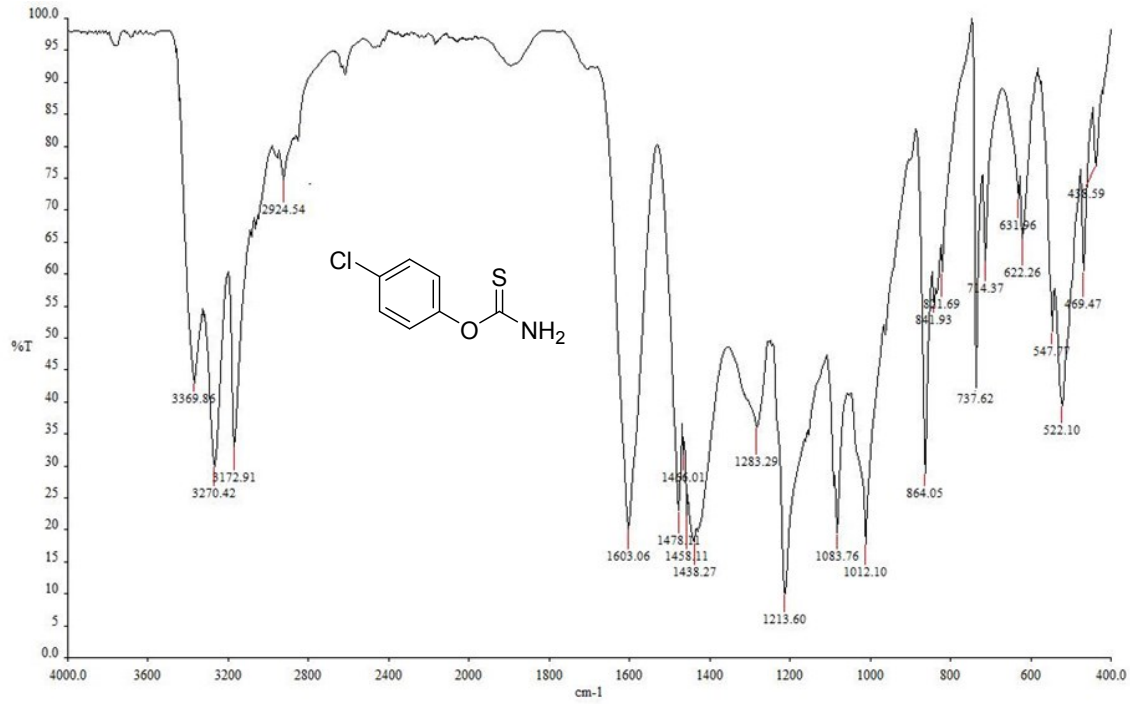


Figure S93. FT-IR spectrum of 5m in KBr

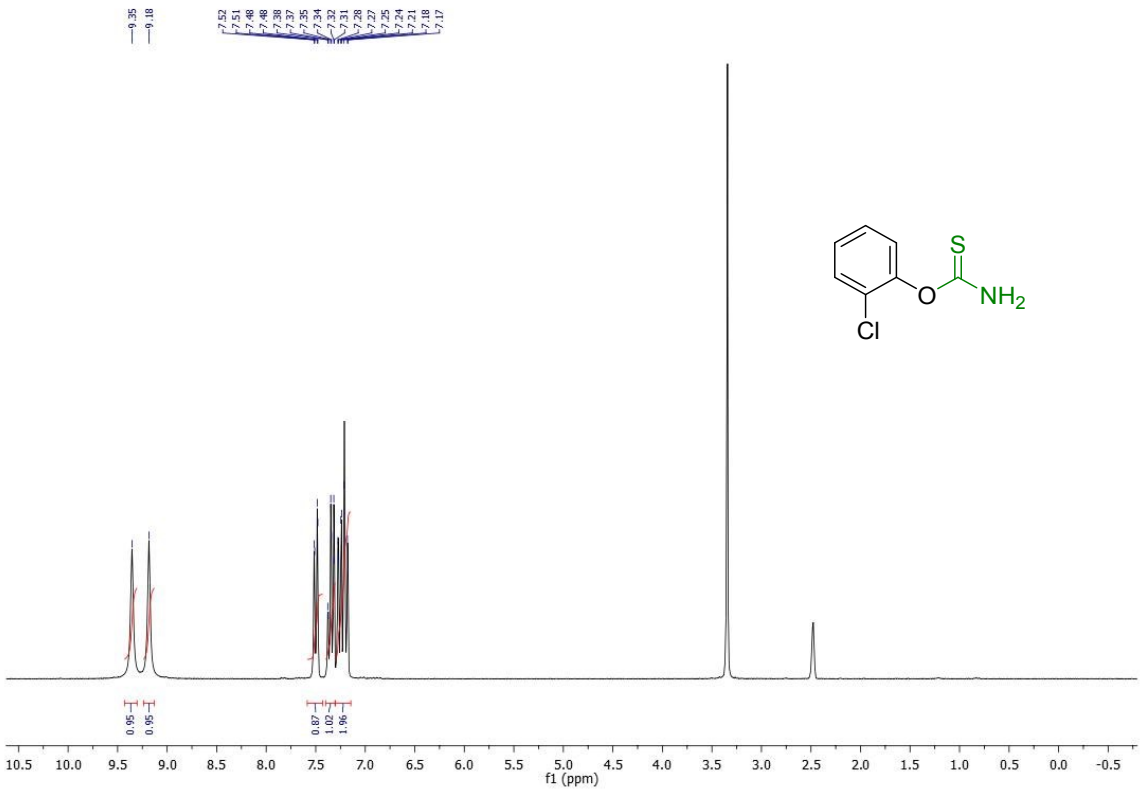


Figure S94. ^{1}H NMR spectrum of 5n in DMSO-d_6 (250MHz)

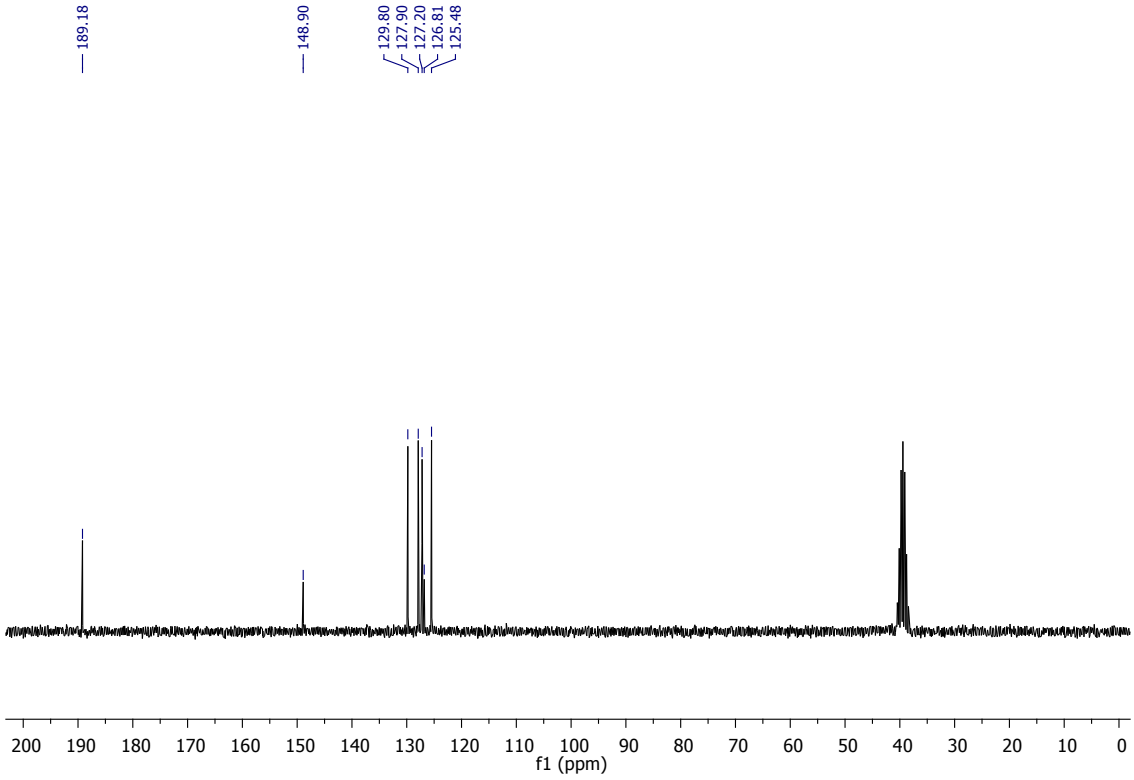


Figure S95. ^{13}C NMR spectrum of 5n in DMSO-d_6 (63MHz)

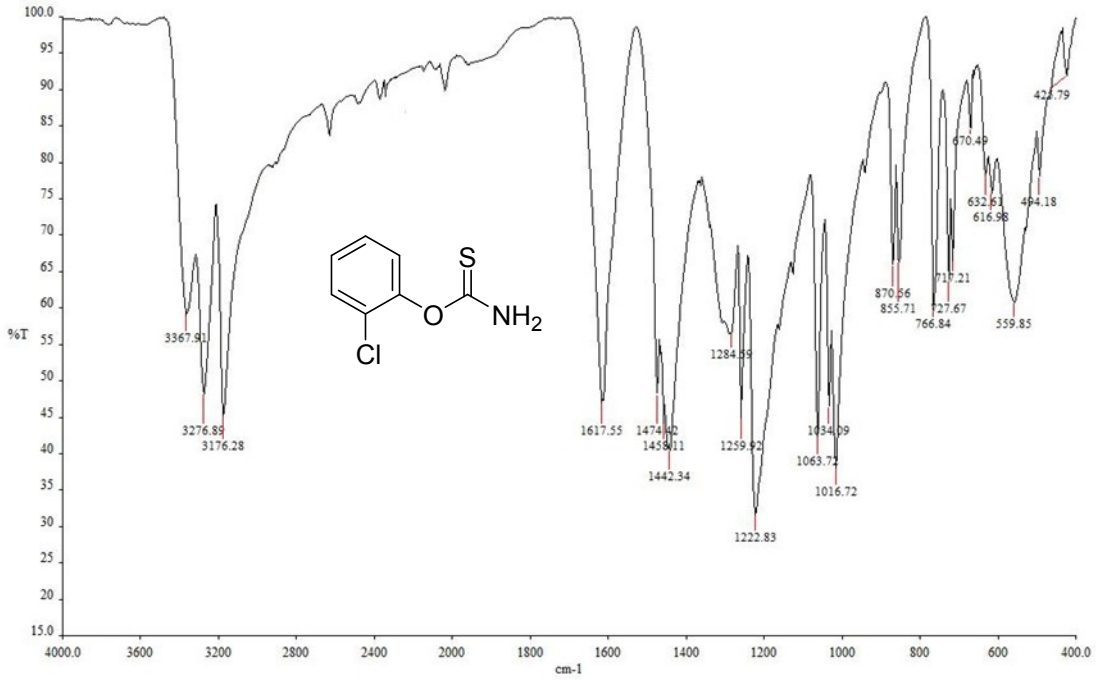


Figure S96. FT-IR spectrum of 5n in KBr

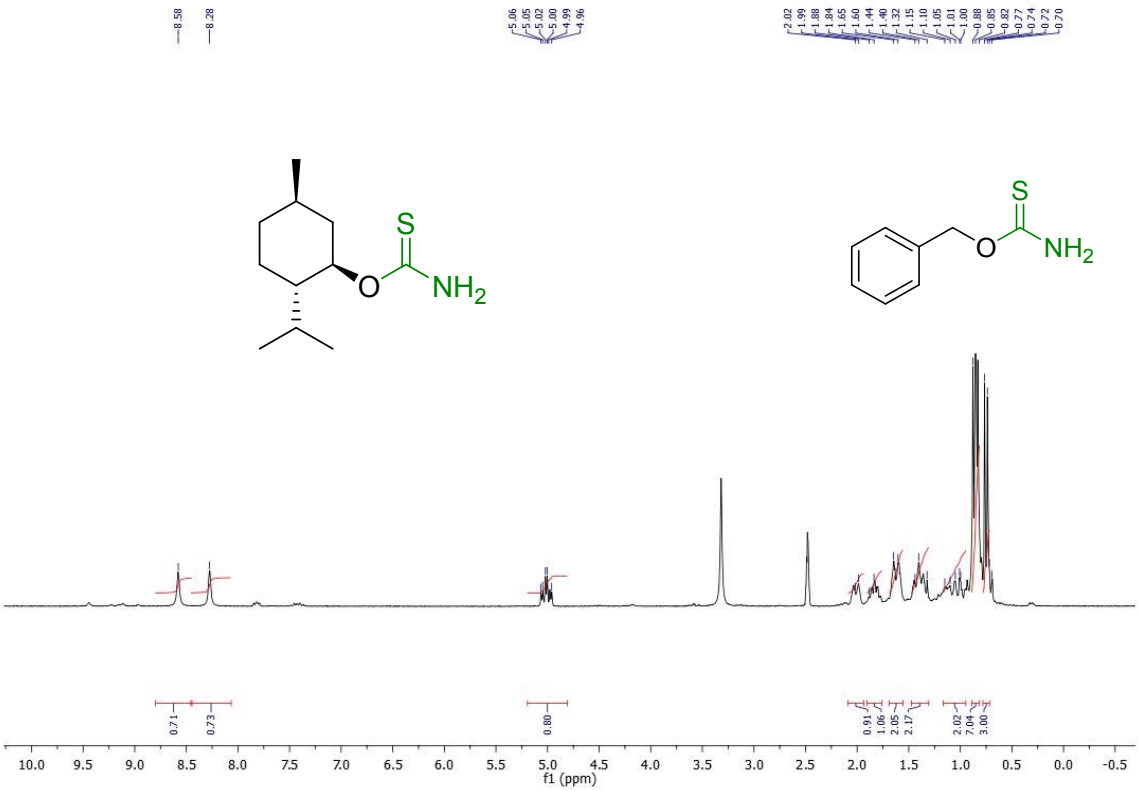


Figure S97. ^{1}H NMR spectrum of 5o in DMSO-d_6 (250MHz)

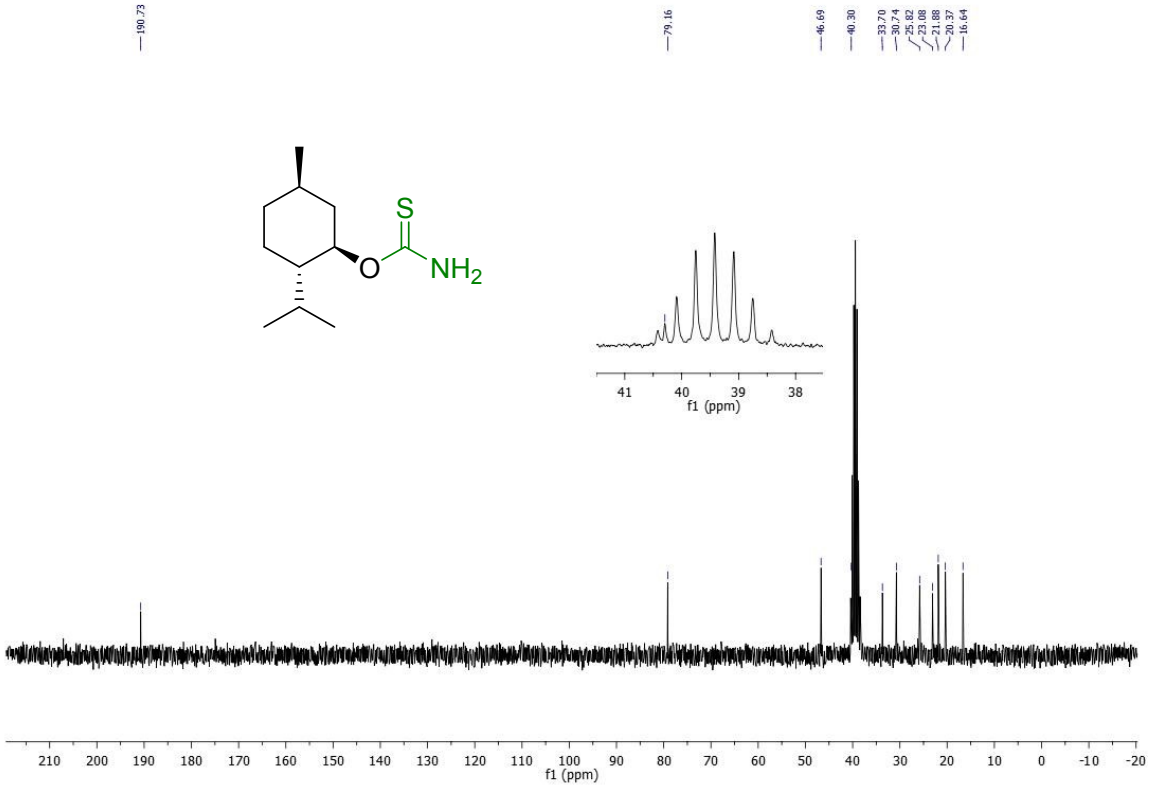


Figure S98. ^{13}C NMR spectrum of 5o in DMSO-d_6 (63MHz)

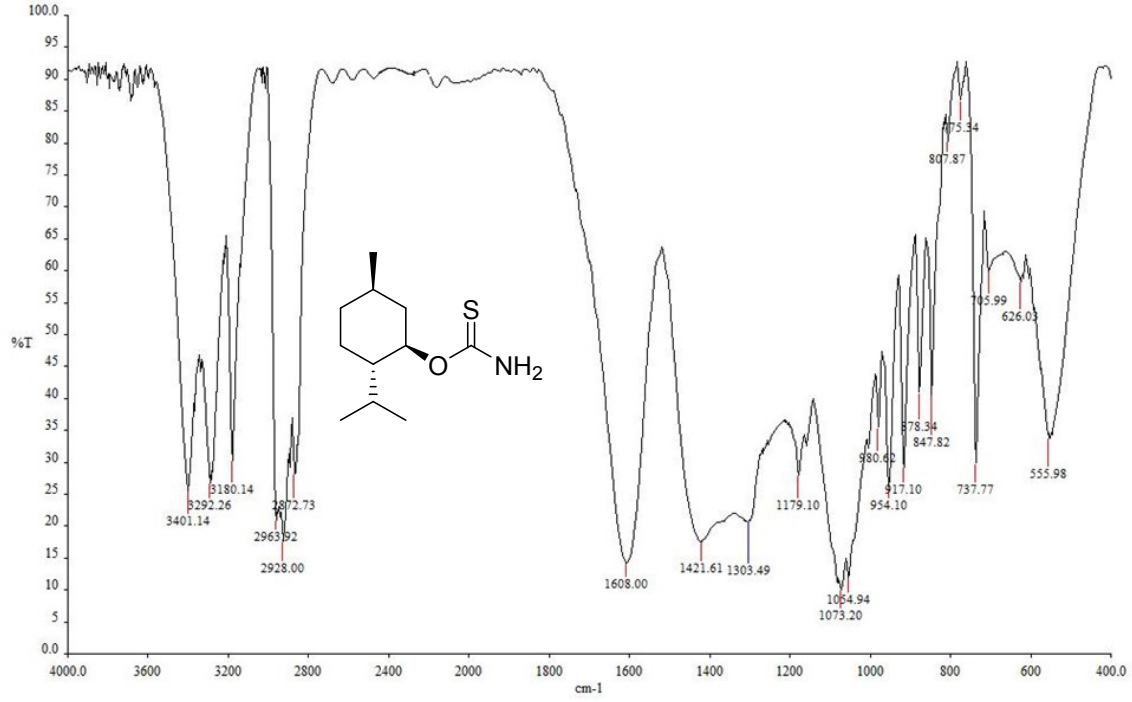
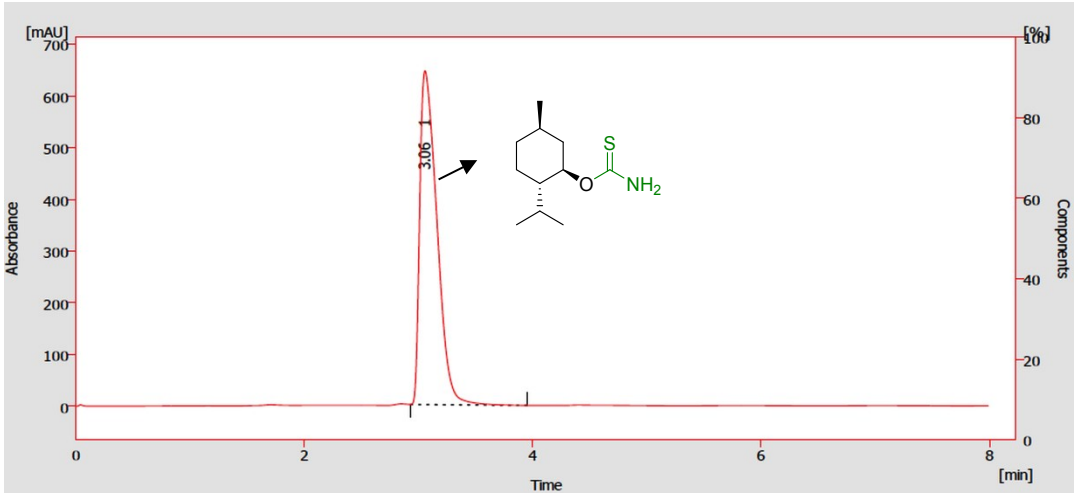


Figure S99. FT-IR spectrum of 5o in KBr



	Reten. Time [min]	Start Time [min]	End Time [min]	Start Value [mAU]	End Value [mAU]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]
1	3.057	2.930	3.953	3.345	1.486	6735.375	645.649	100.0	100.0	0.17
	Total					6735.375	645.649	100.0	100.0	

Figure S100. HPLC spectrum of 5o in H_2O:CH_3CN (30:70%) at 254 (nm).

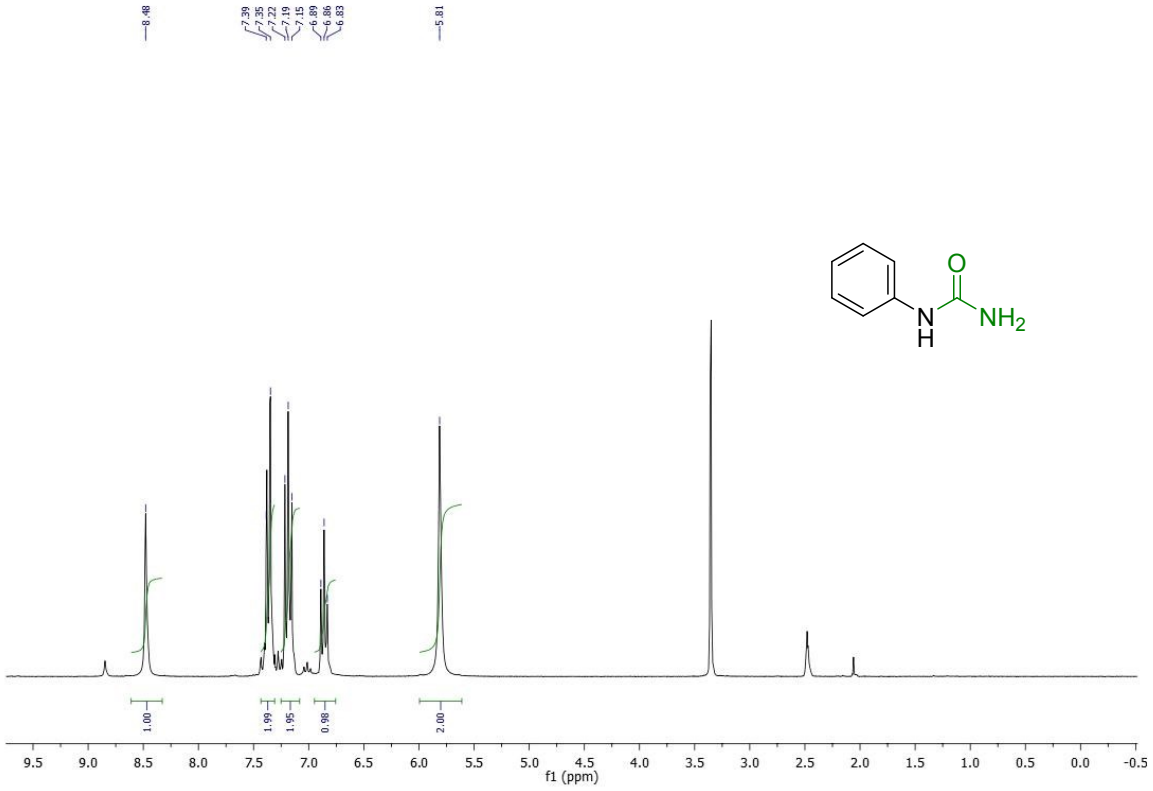


Figure S101. ^{1}H NMR spectrum of 7a in DMSO-d_6 (250MHz)

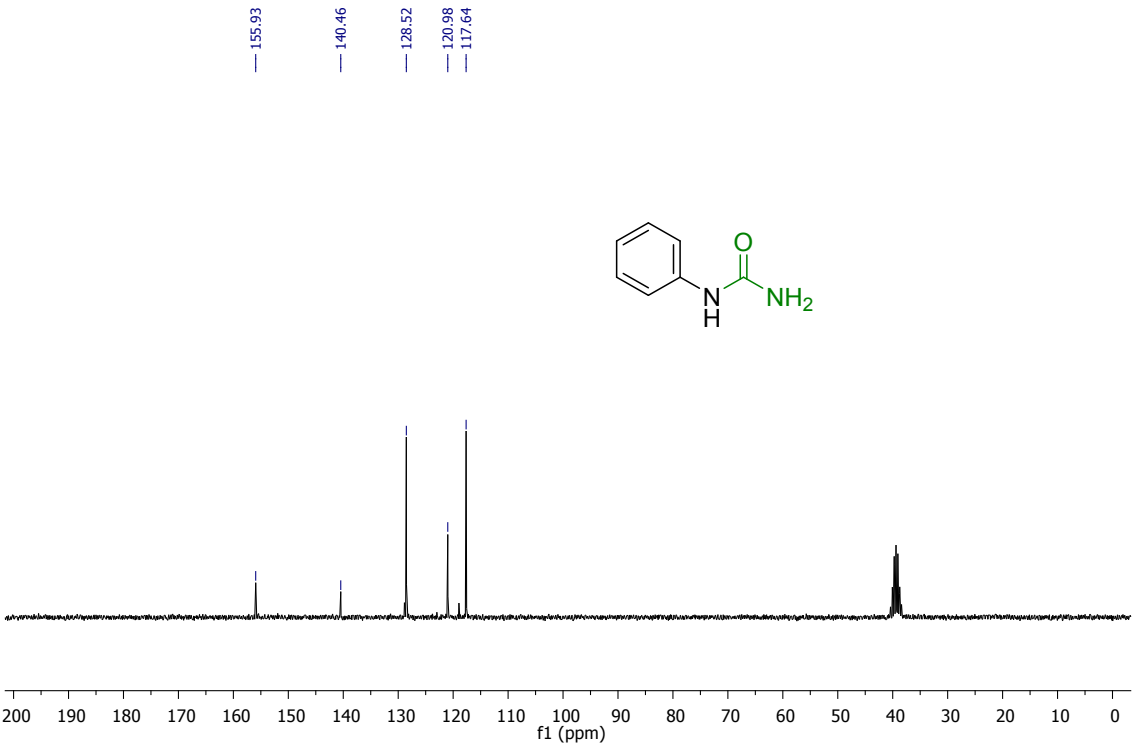


Figure S102. ^{13}C NMR spectrum of 7a in DMSO-d_6 (63MHz)

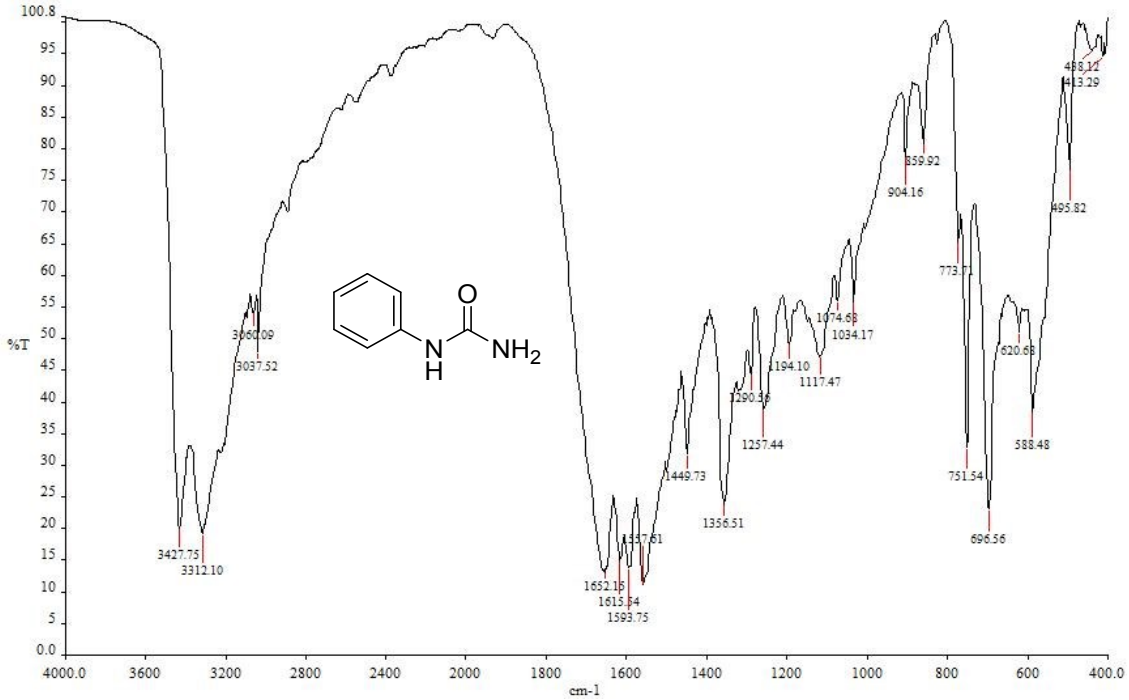


Figure S103. FT-IR spectrum of 7a in KBr

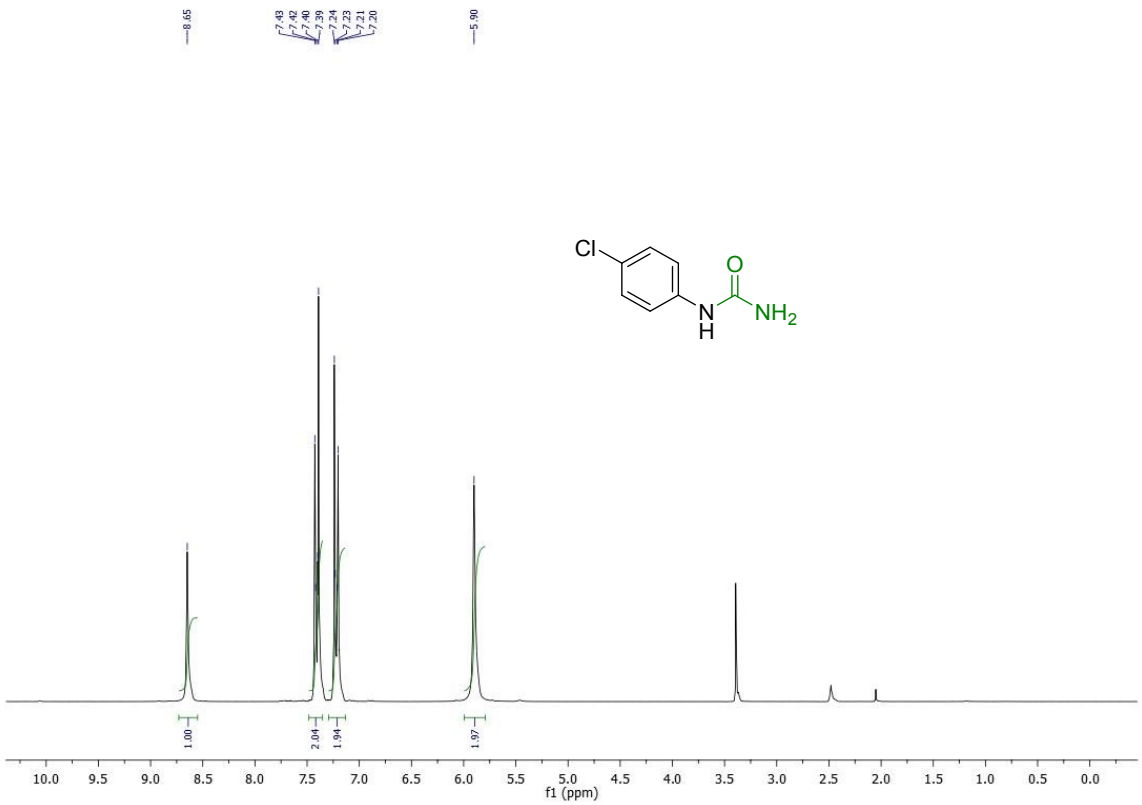


Figure S104. ^{1}H NMR spectrum of 7b in DMSO-d_6 (250MHz)

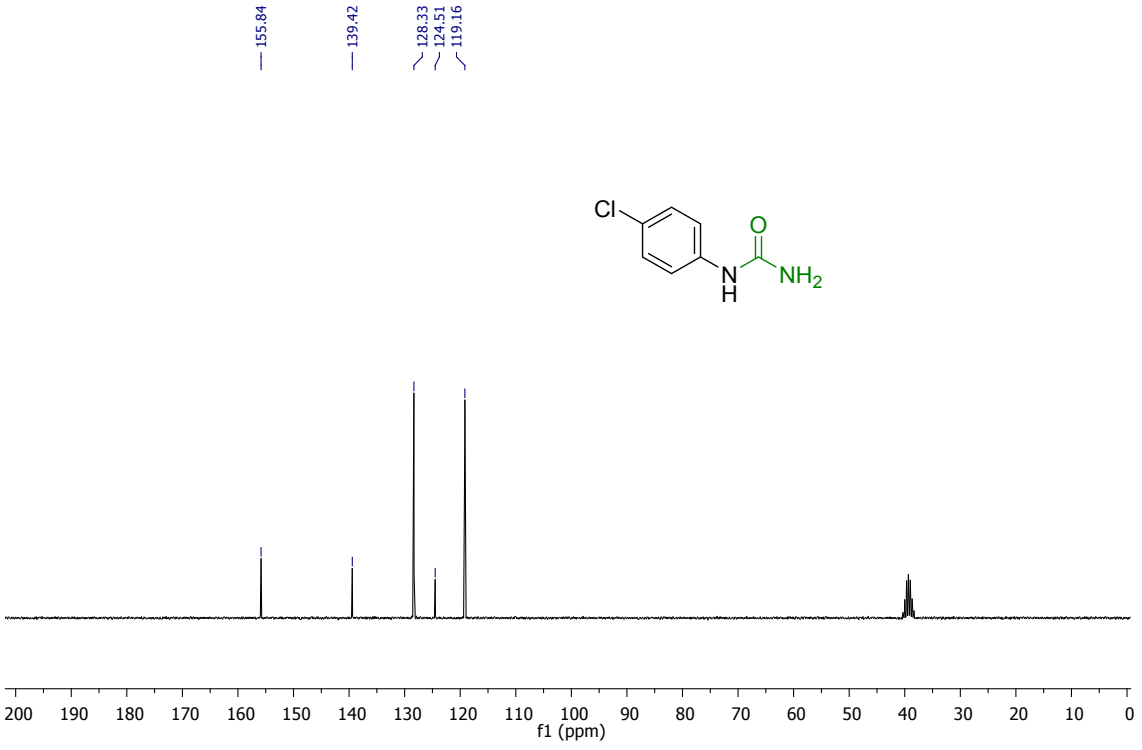


Figure S105. ^{13}C NMR spectrum of 7b in DMSO-d_6 (63MHz)

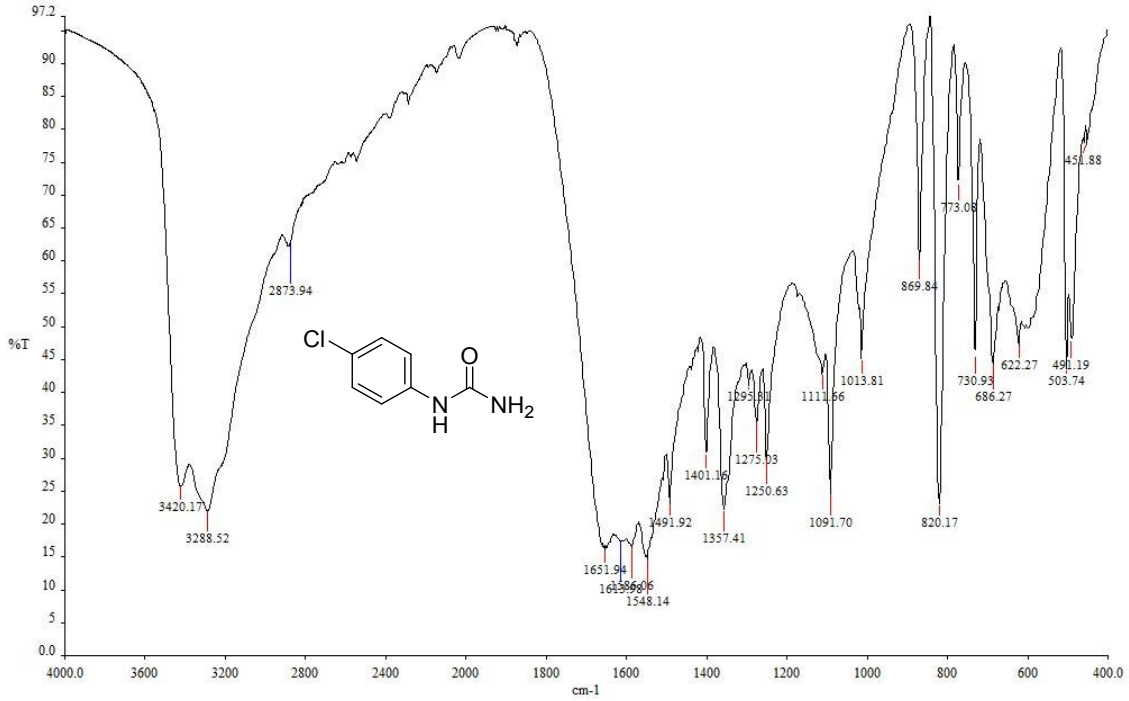


Figure S106. FT-IR spectrum of 7b in KBr

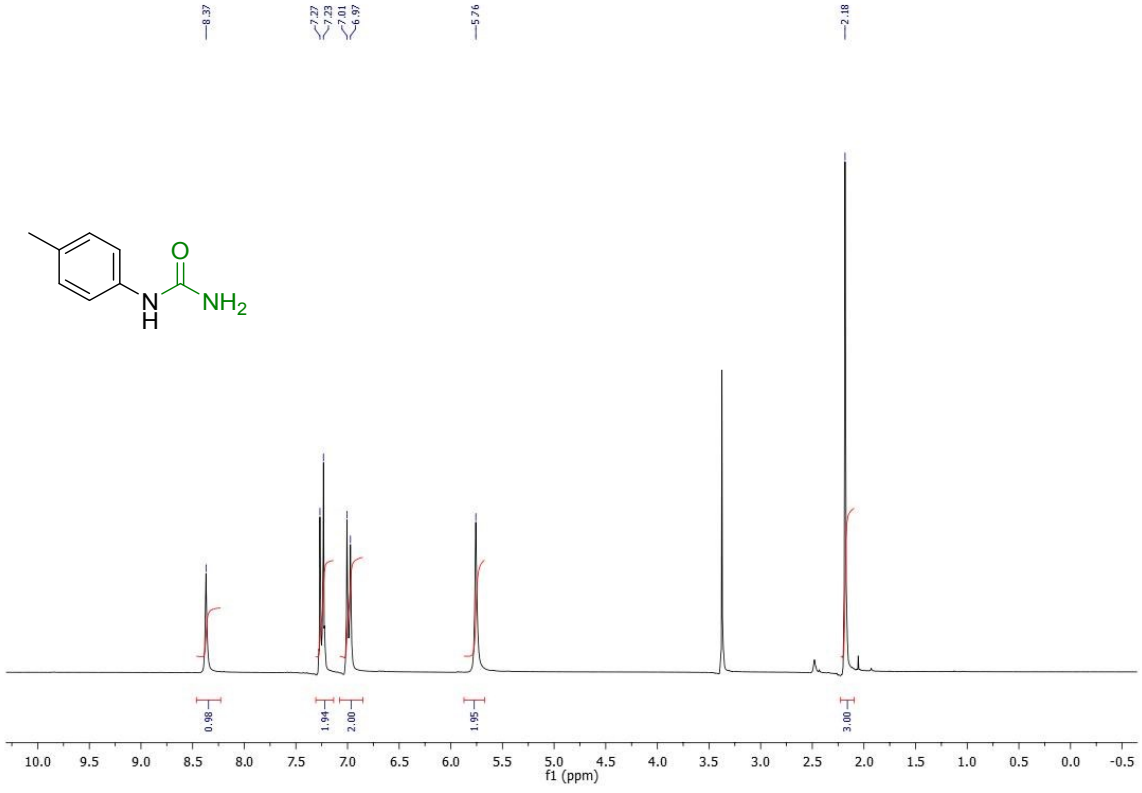


Figure S107. ^{1}H NMR spectrum of 7c in DMSO-d_6 (250MHz)

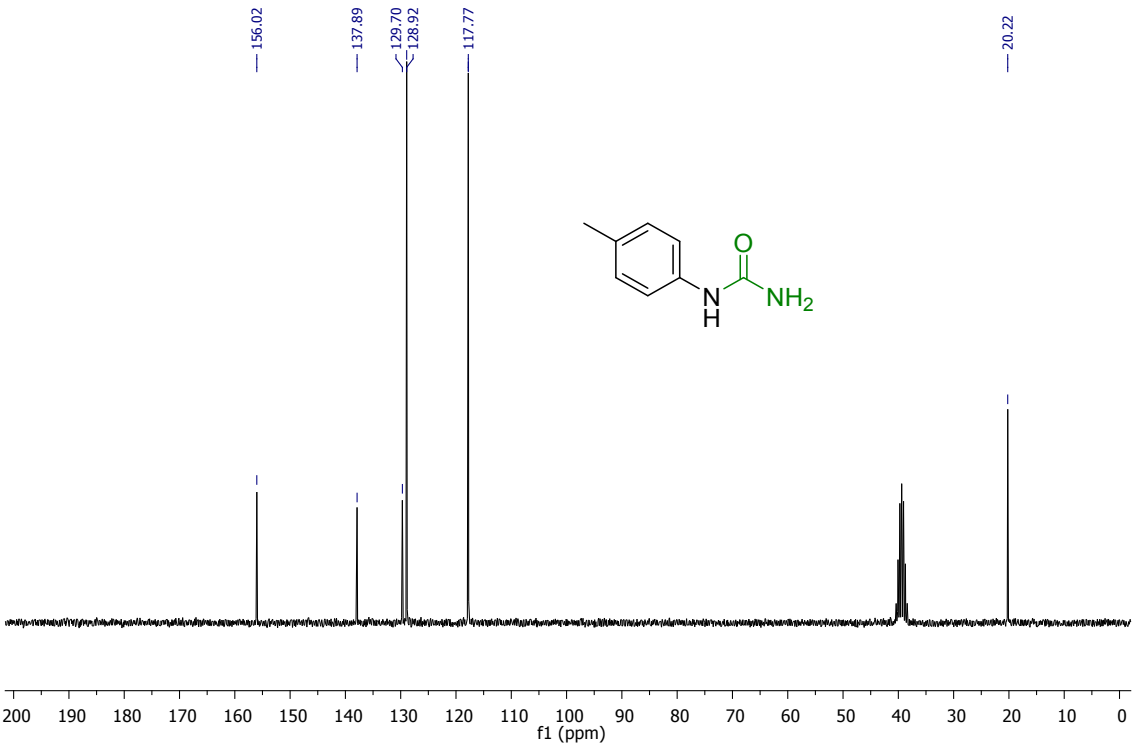


Figure S108. ^{13}C NMR spectrum of 7c in DMSO-d_6 (63MHz)

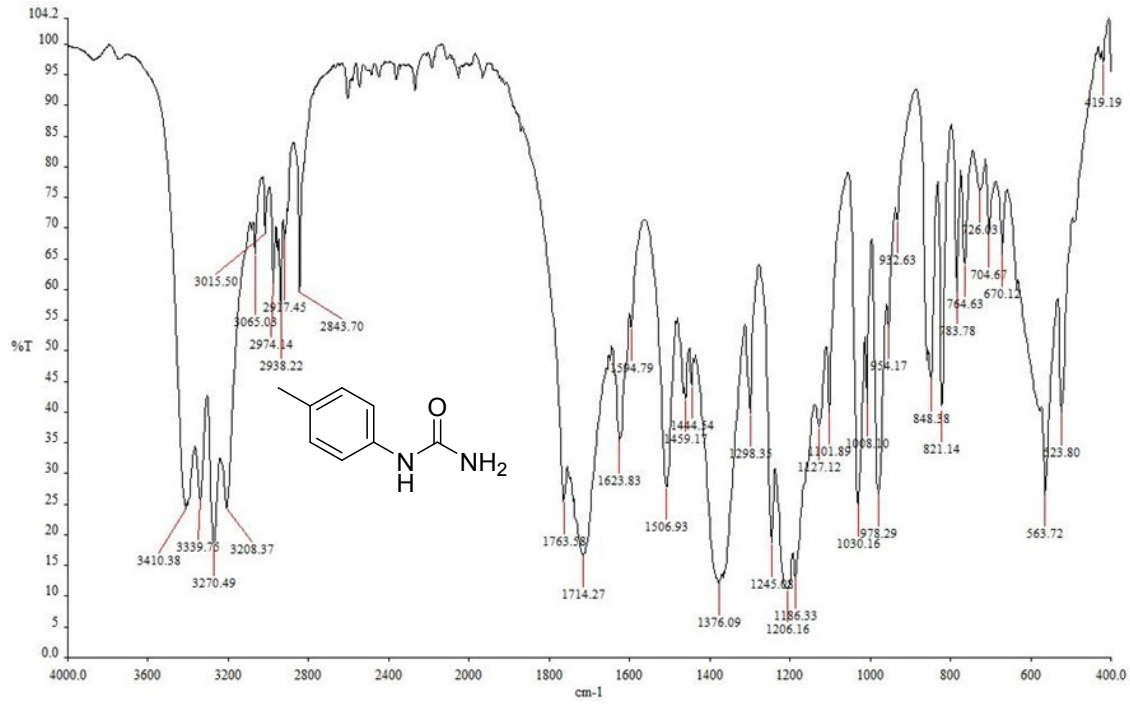


Figure S109. FT-IR spectrum of 7c in KBr

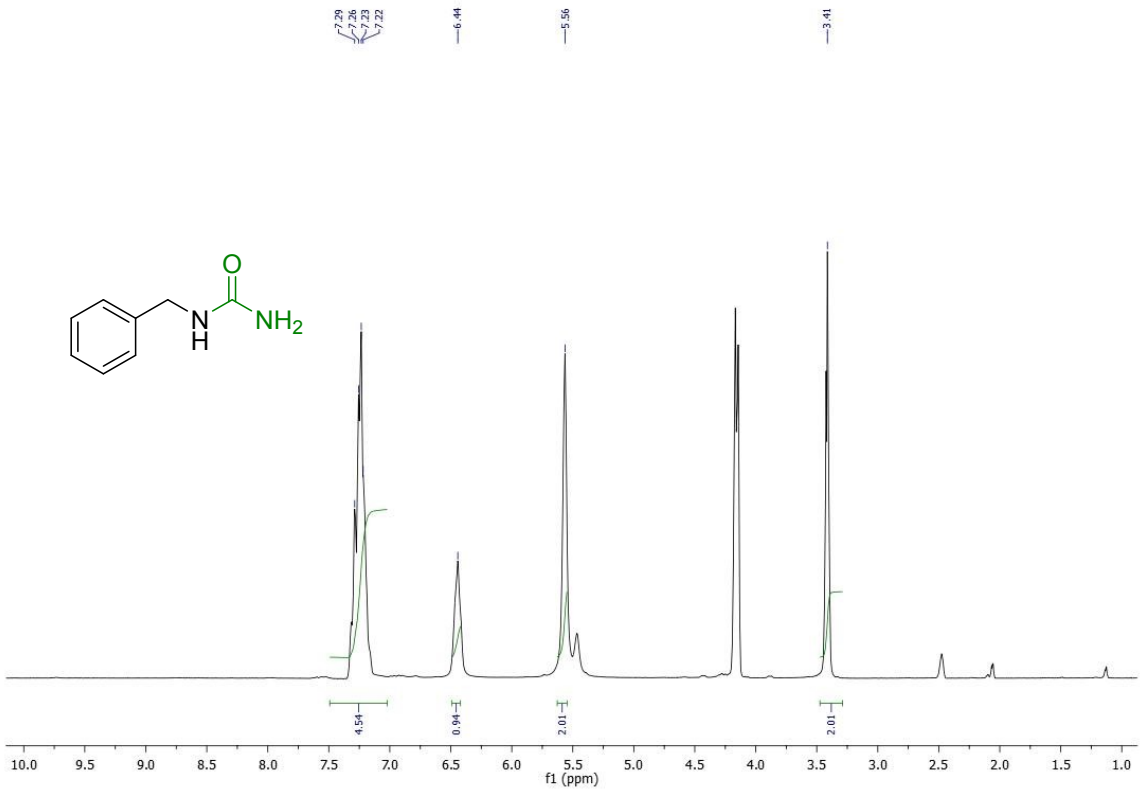


Figure S110. ^{1}H NMR spectrum of 7d in DMSO-d_6 (250MHz)

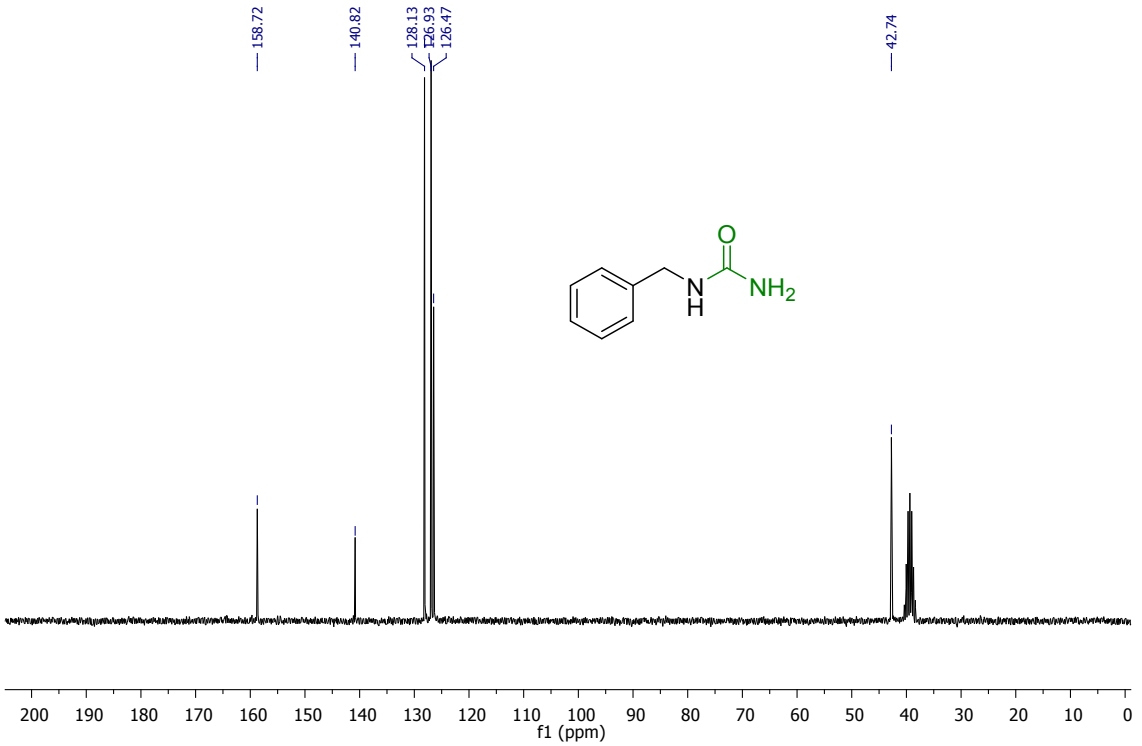


Figure S111. ^{13}C NMR spectrum of 7d in DMSO-d_6 (63MHz)

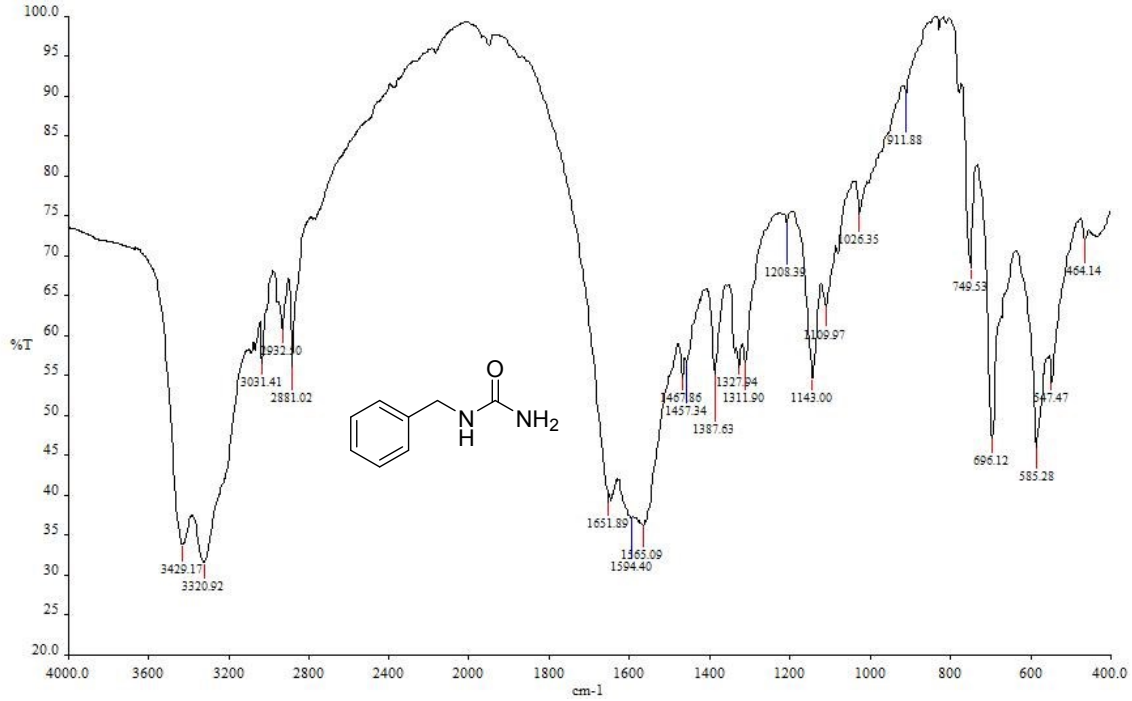


Figure S112. FT-IR spectrum of 7d in KBr

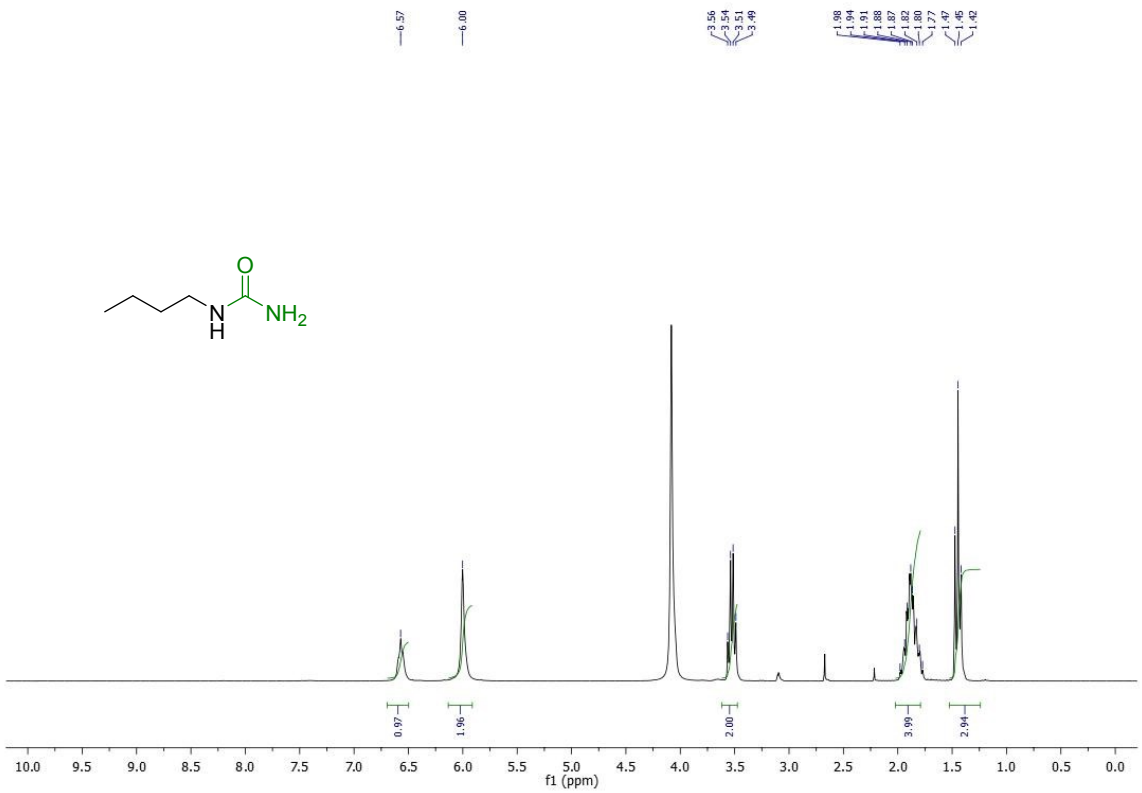


Figure S113. ^{1}H NMR spectrum of 7e in DMSO-d_6 (250MHz)

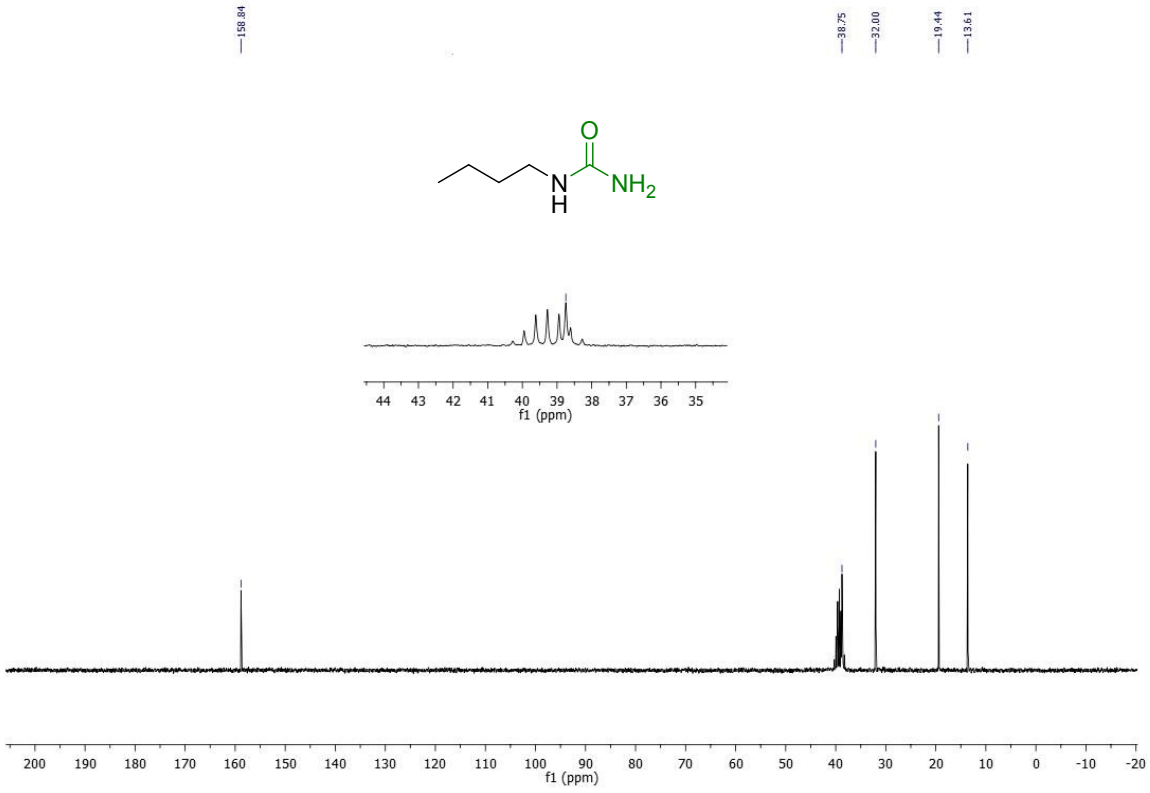


Figure S114. ^{13}C NMR spectrum of 7e in DMSO-d_6 (63MHz)

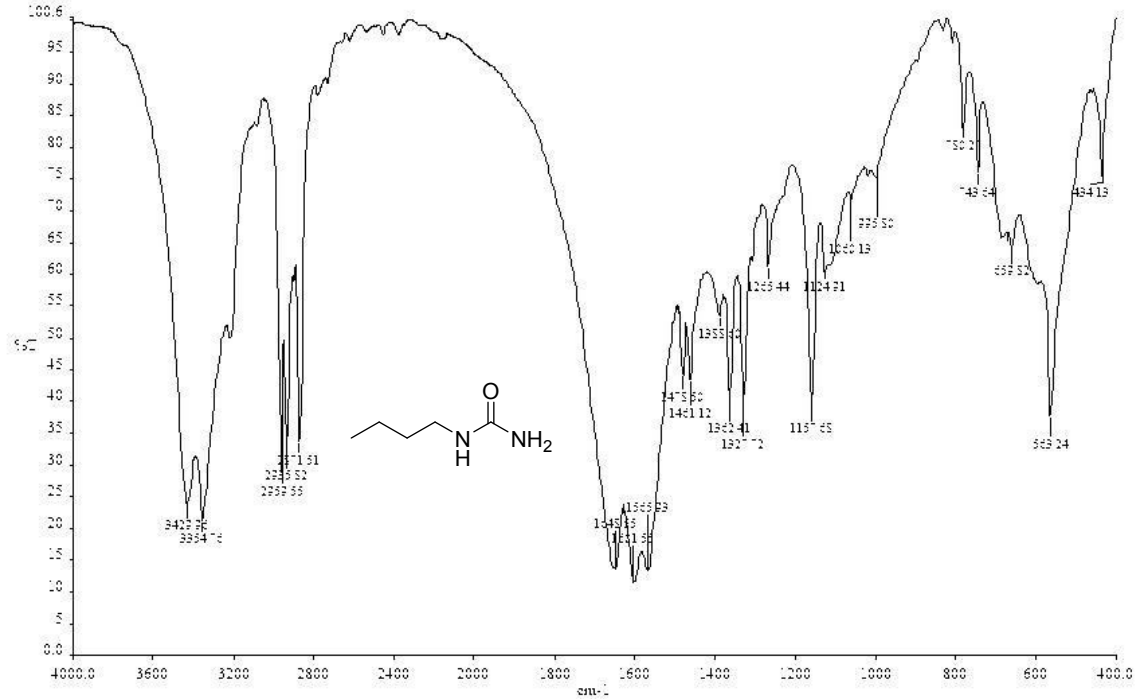


Figure S115. FT-IR spectrum of 7e in KBr

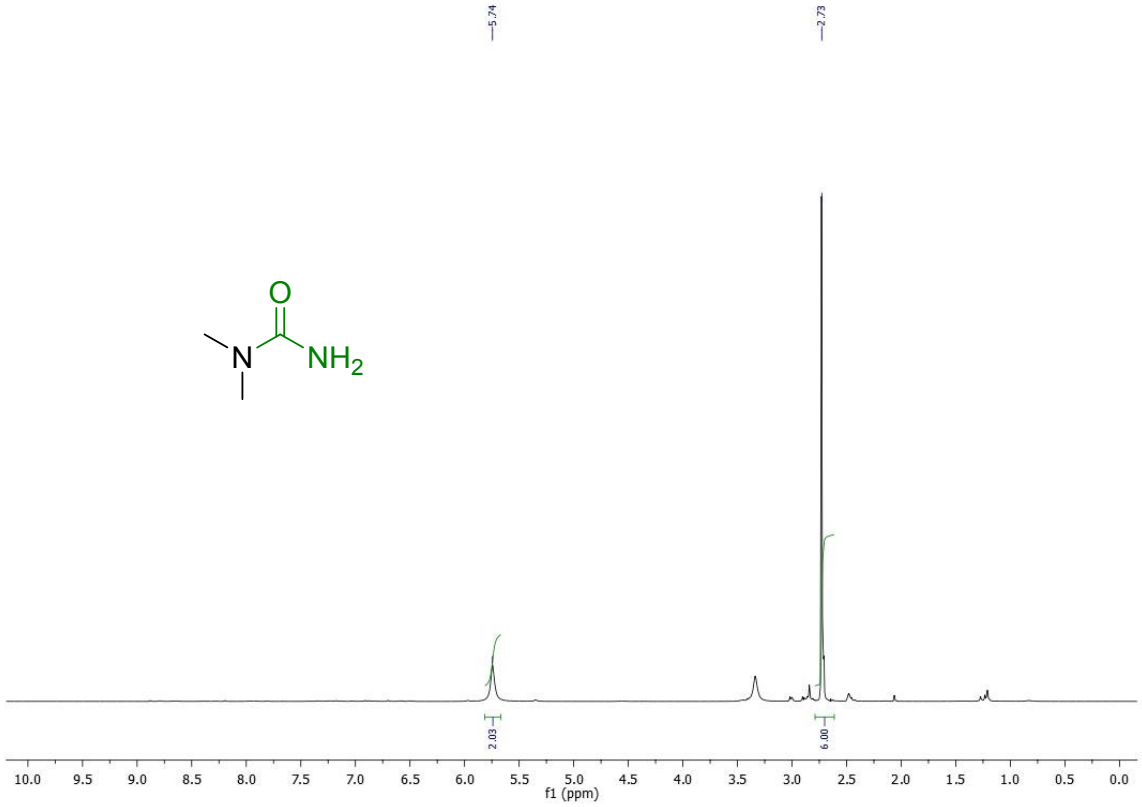


Figure S116. ^{1}H NMR spectrum of 7f in DMSO-d_6 (250MHz)

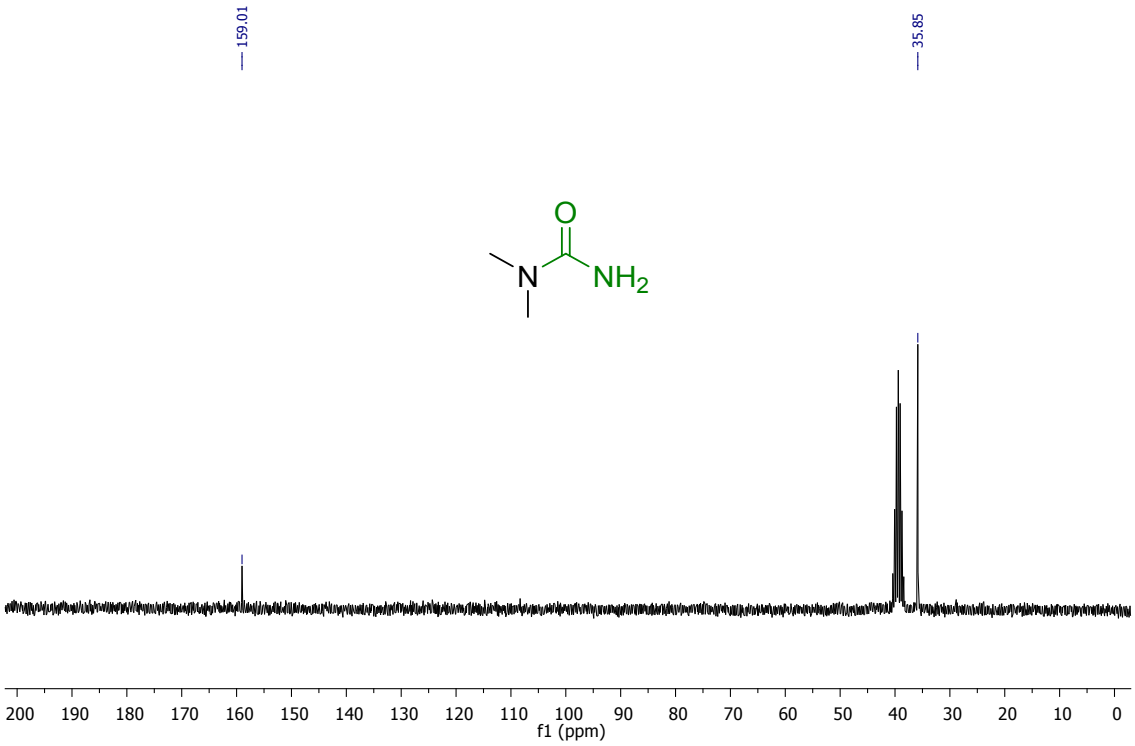


Figure S117. ^{13}C NMR spectrum of 7f in DMSO-d_6 (63MHz)

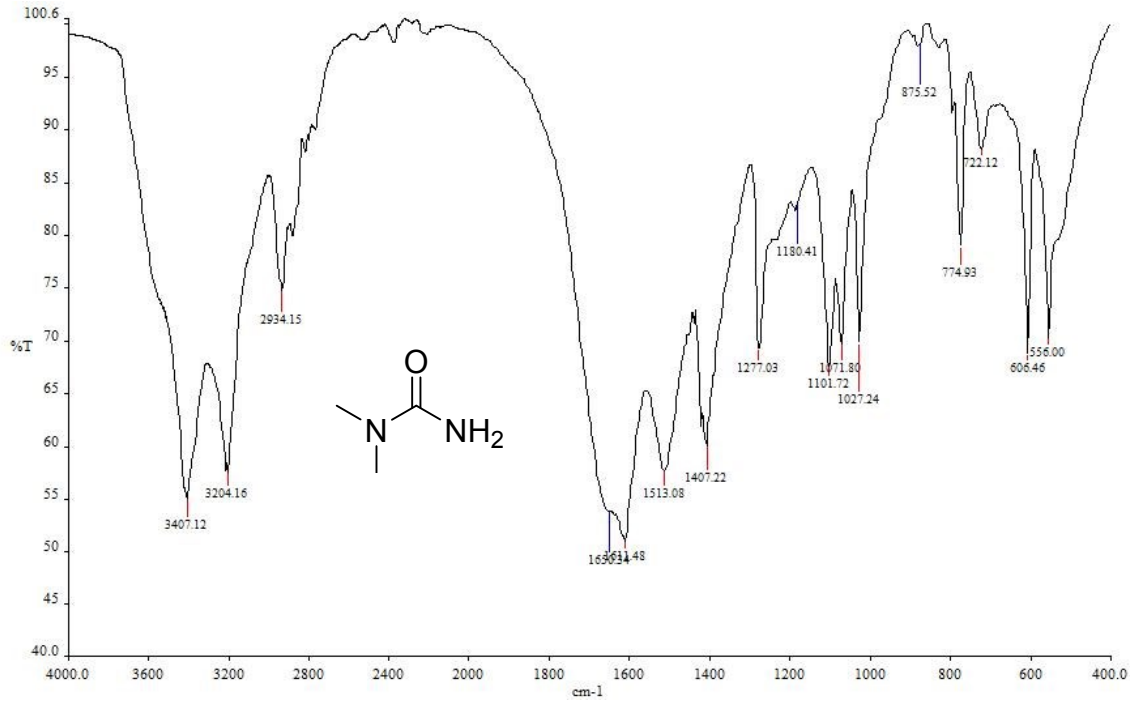


Figure S118. FT-IR spectrum of 7f in KBr

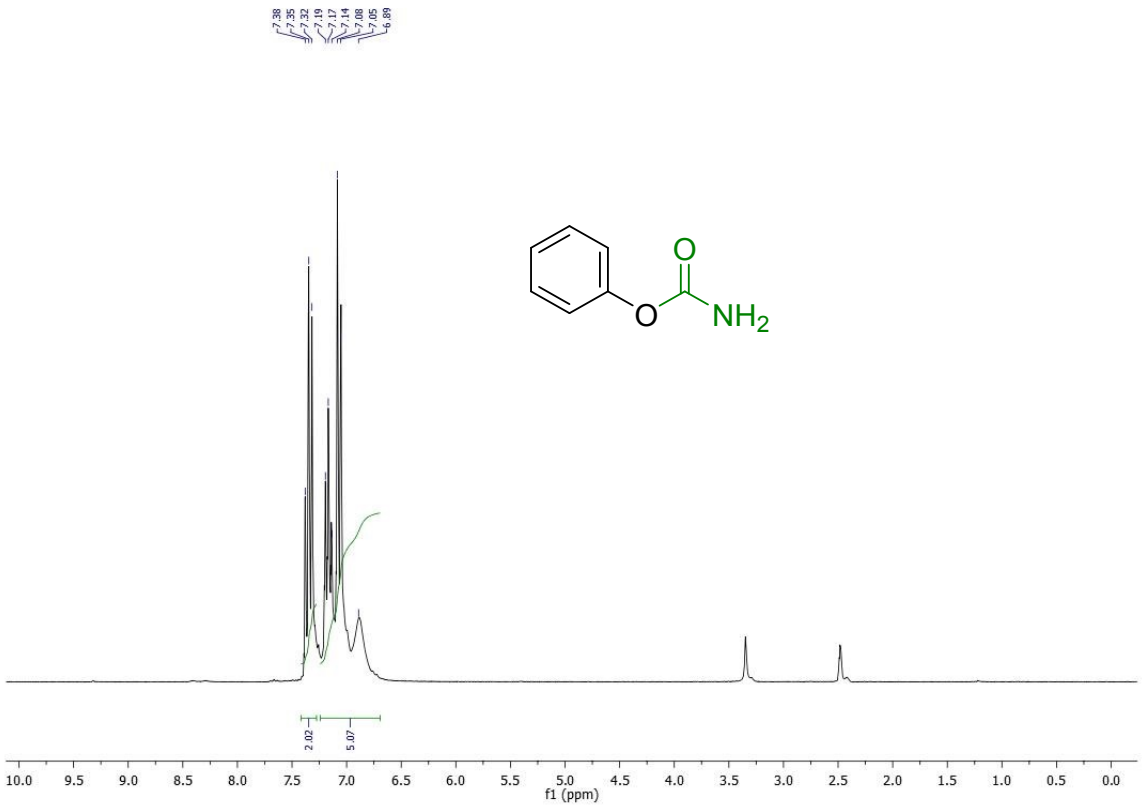


Figure S119. ^{1}H NMR spectrum of 7g in DMSO-d_6 (250MHz)

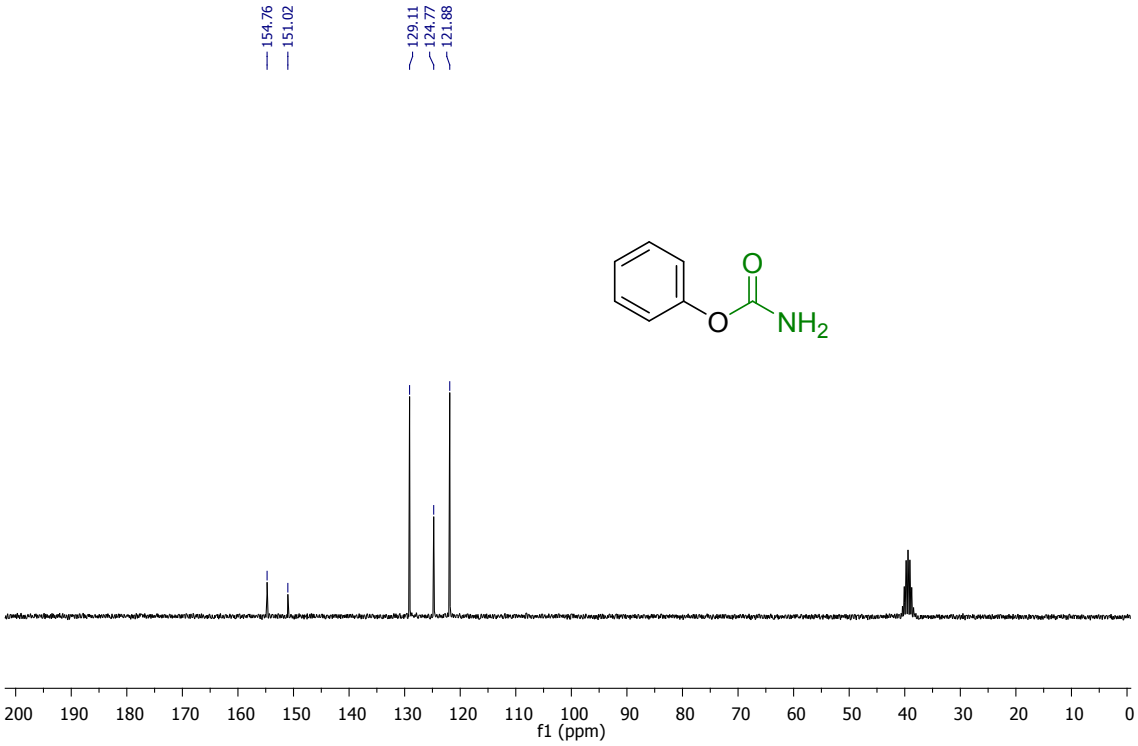


Figure S120. ^{13}C NMR spectrum of 7g in DMSO-d_6 (63MHz)

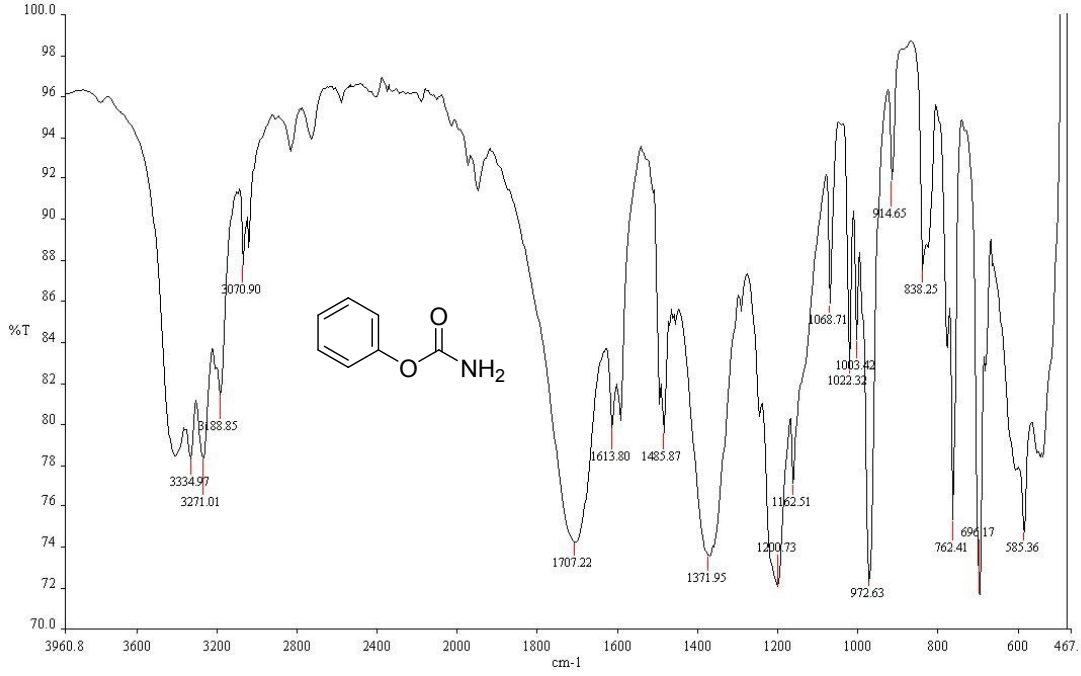


Figure S121. FT-IR spectrum of 7g in KBr

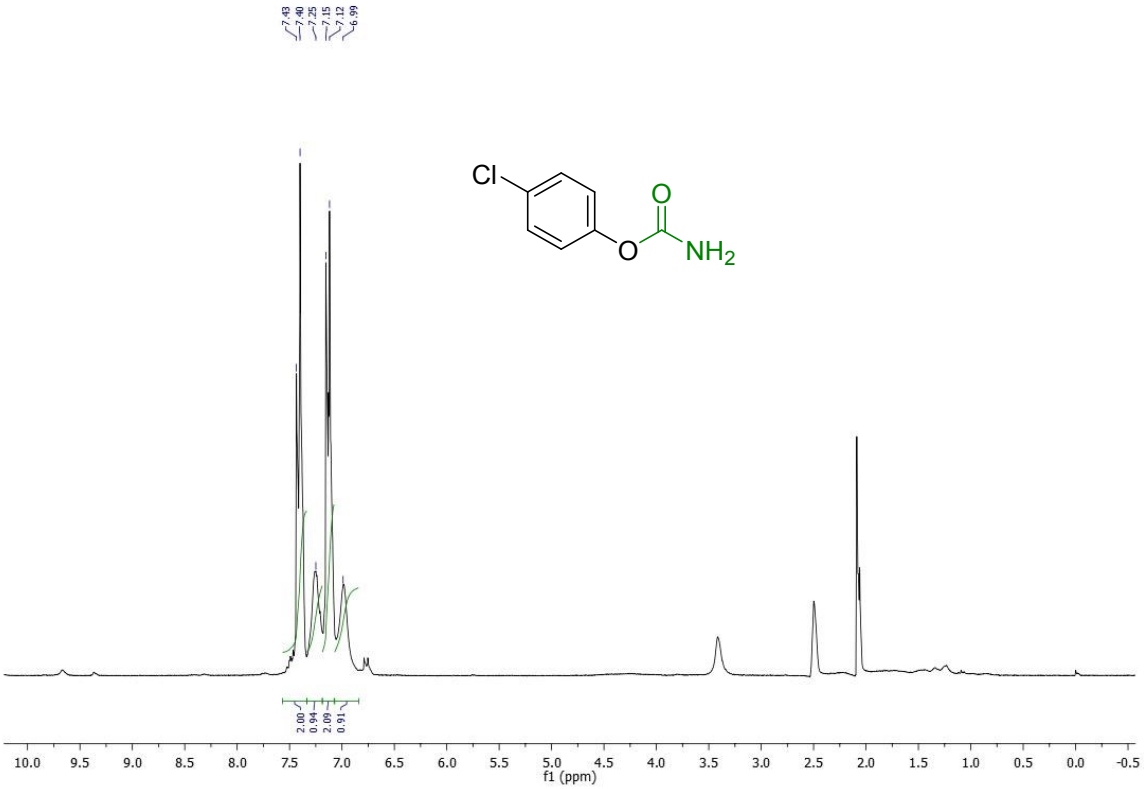


Figure S122. ^{1}H NMR spectrum of 7h in DMSO-d_6 (250MHz)

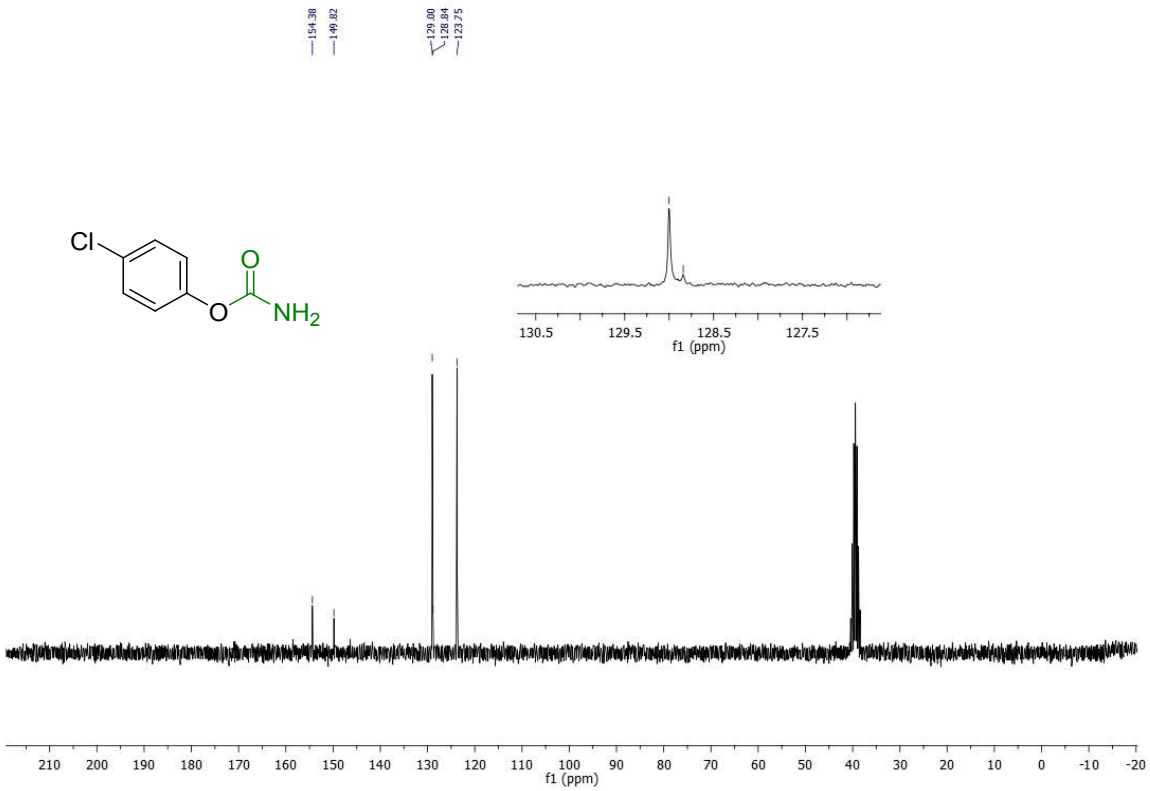


Figure S123. ^{13}C NMR spectrum of 7h in DMSO-d_6 (63MHz)

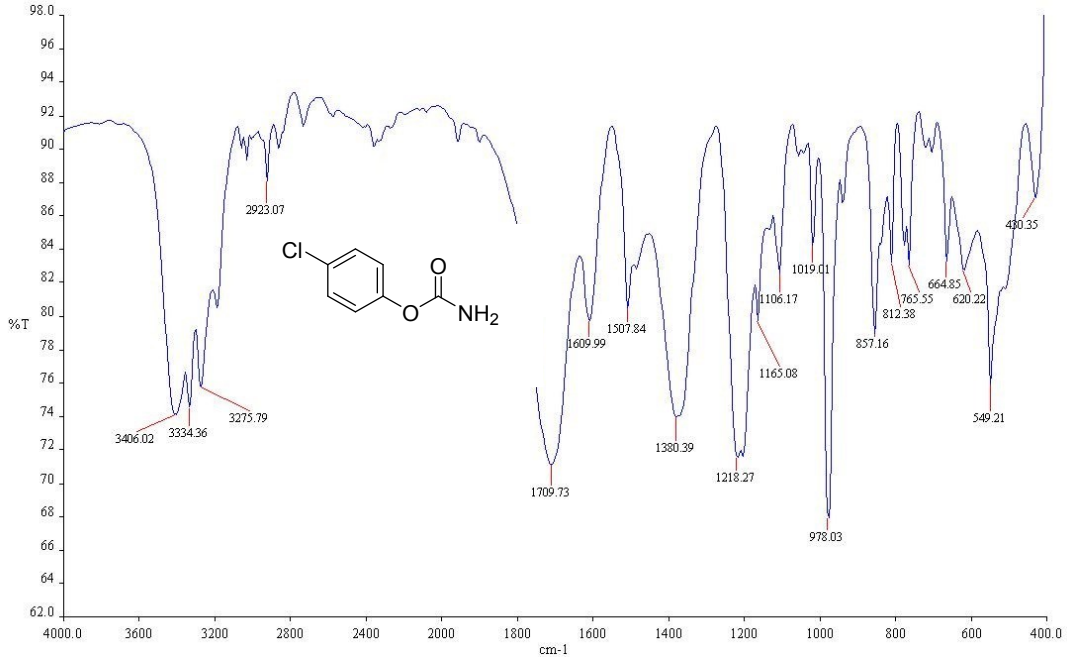


Figure S124. FT-IR spectrum of 7h in KBr

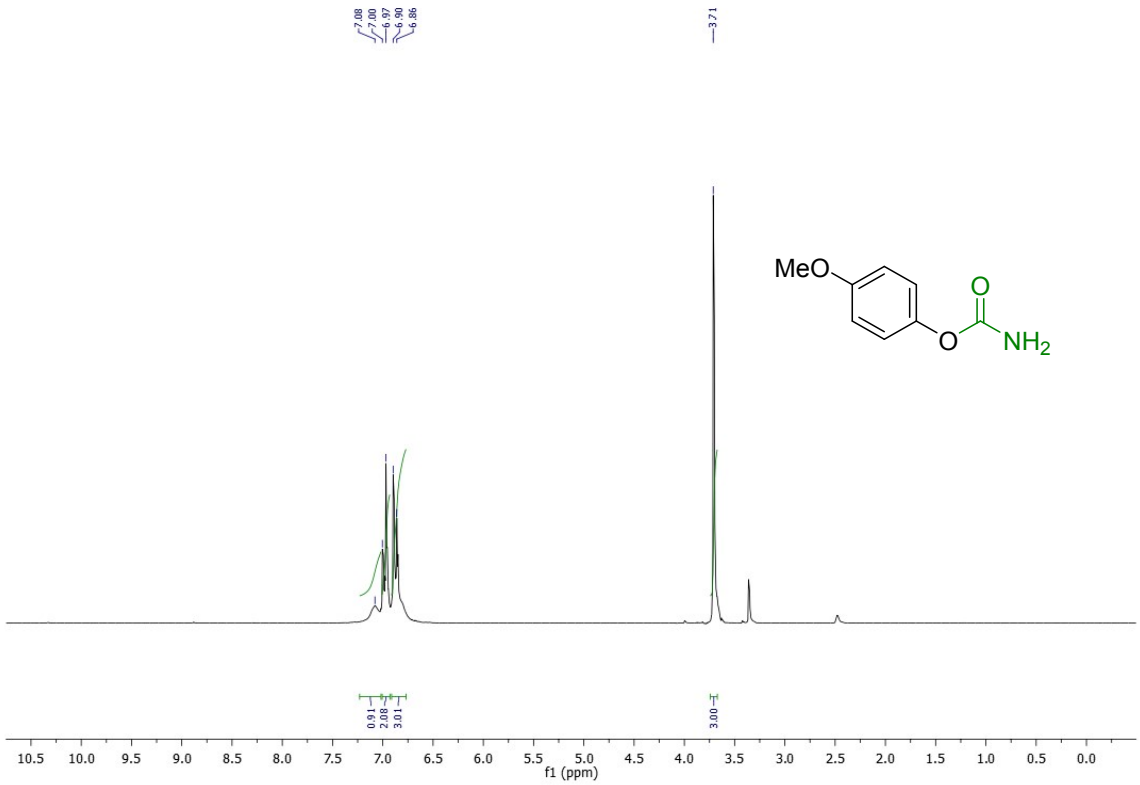


Figure S125. ^{1}H NMR spectrum of 7i in DMSO-d_6 (250MHz)

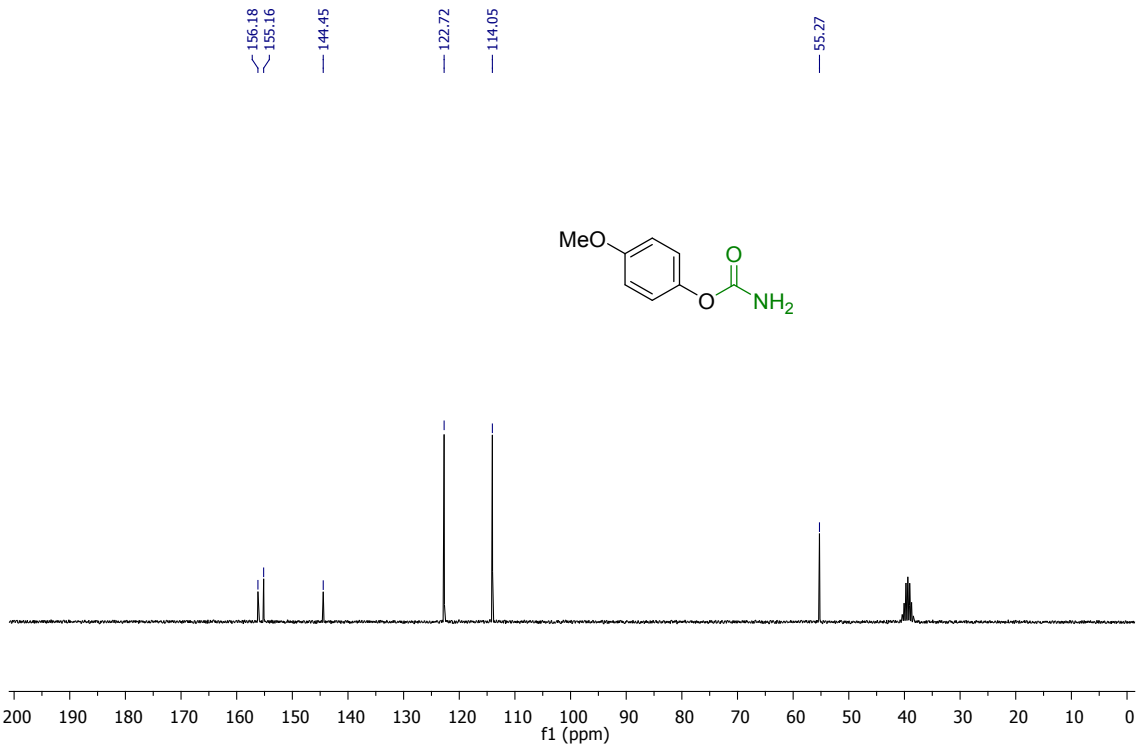


Figure S126. ^{13}C NMR spectrum of 7i in DMSO-d_6 (63MHz)

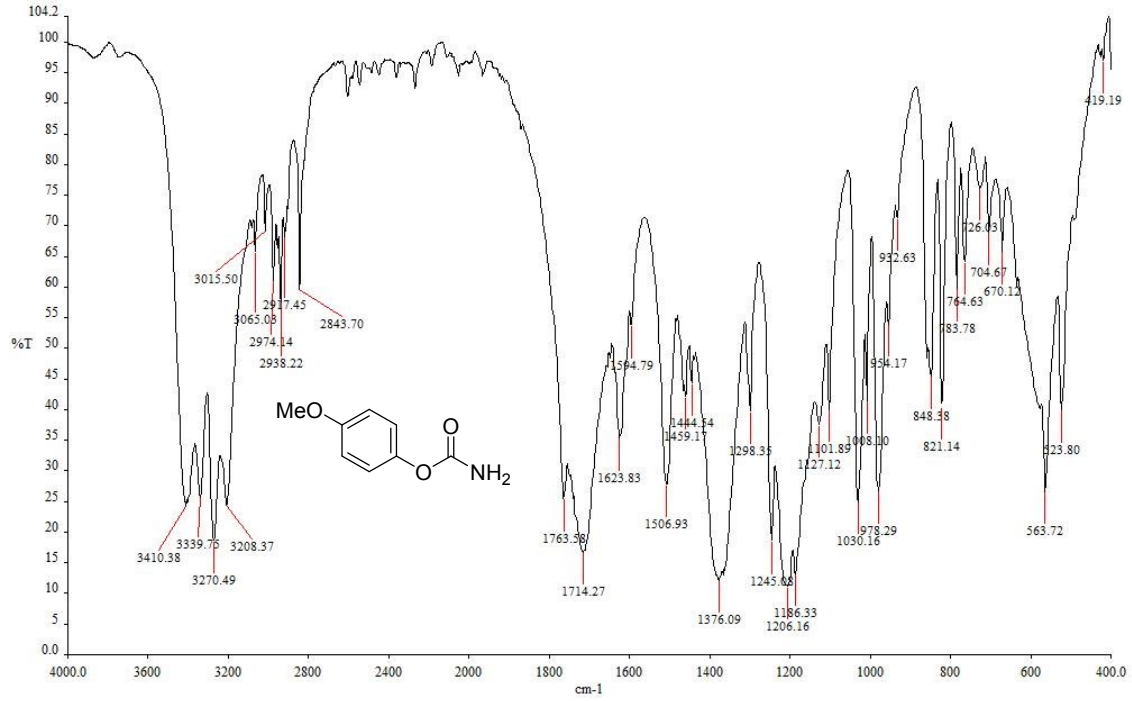


Figure S127. FT-IR spectrum of 7*i* in KBr

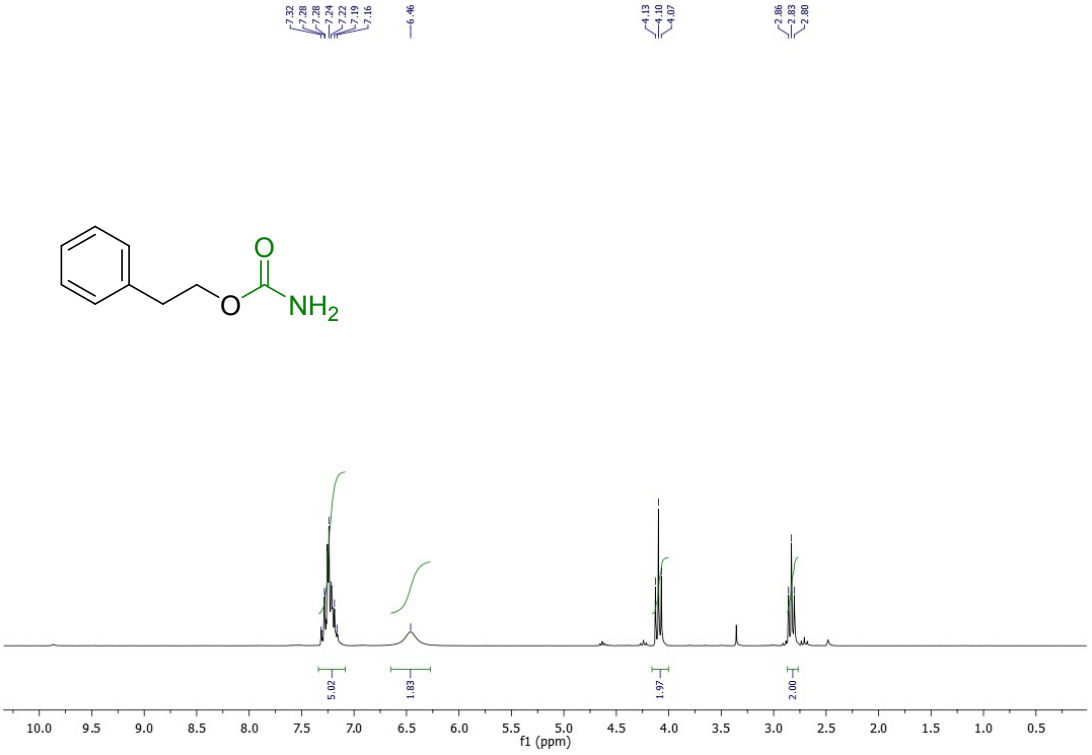


Figure S128. ^{1}H NMR spectrum of 7j in DMSO-d_6 (250MHz)

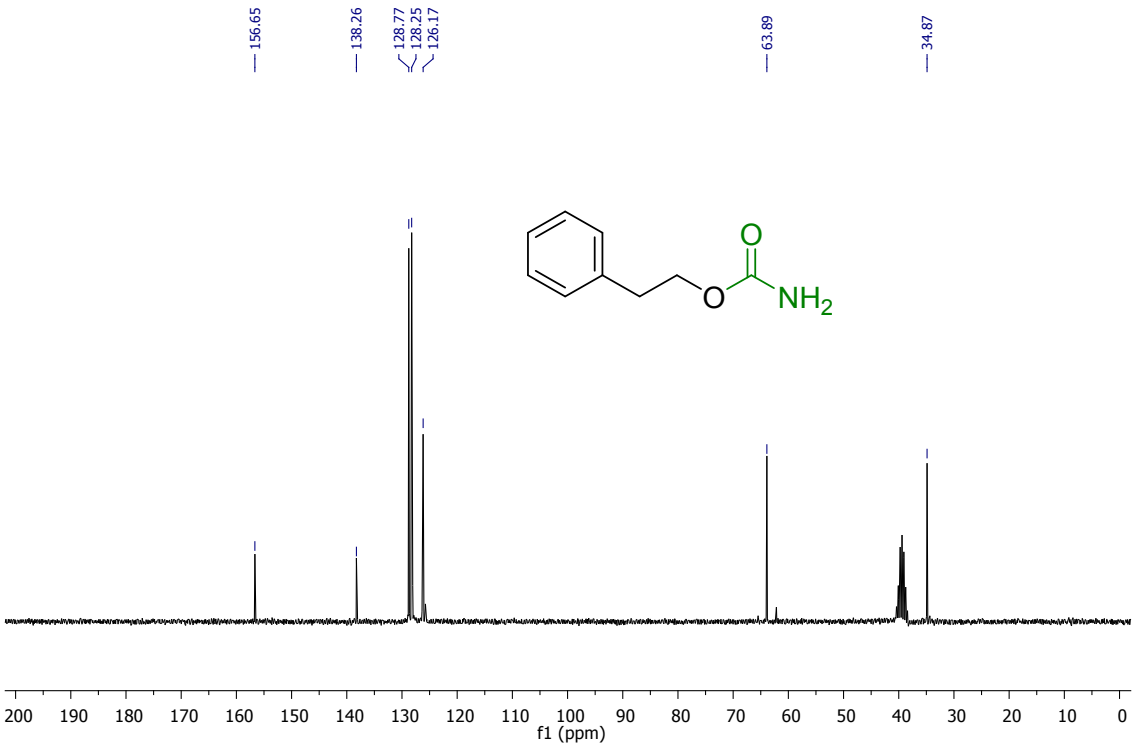


Figure S129. ^{13}C NMR spectrum of 7j in DMSO-d_6 (63MHz)

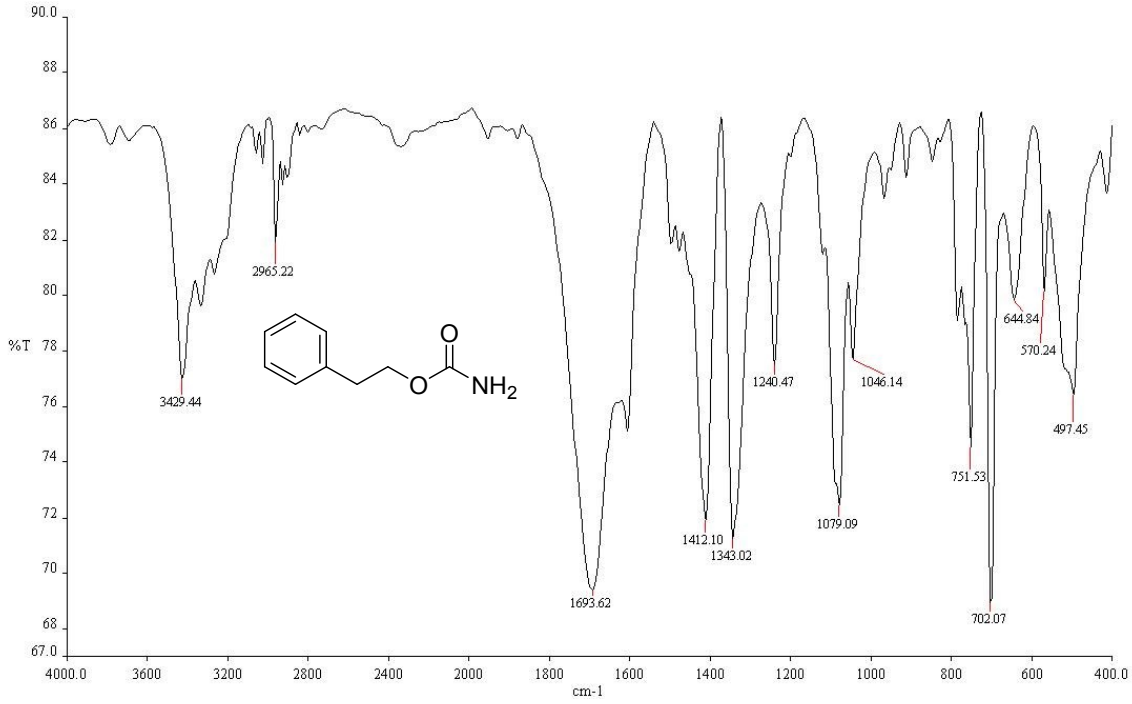


Figure S130. FT.IR spectrum of 7j in KBr

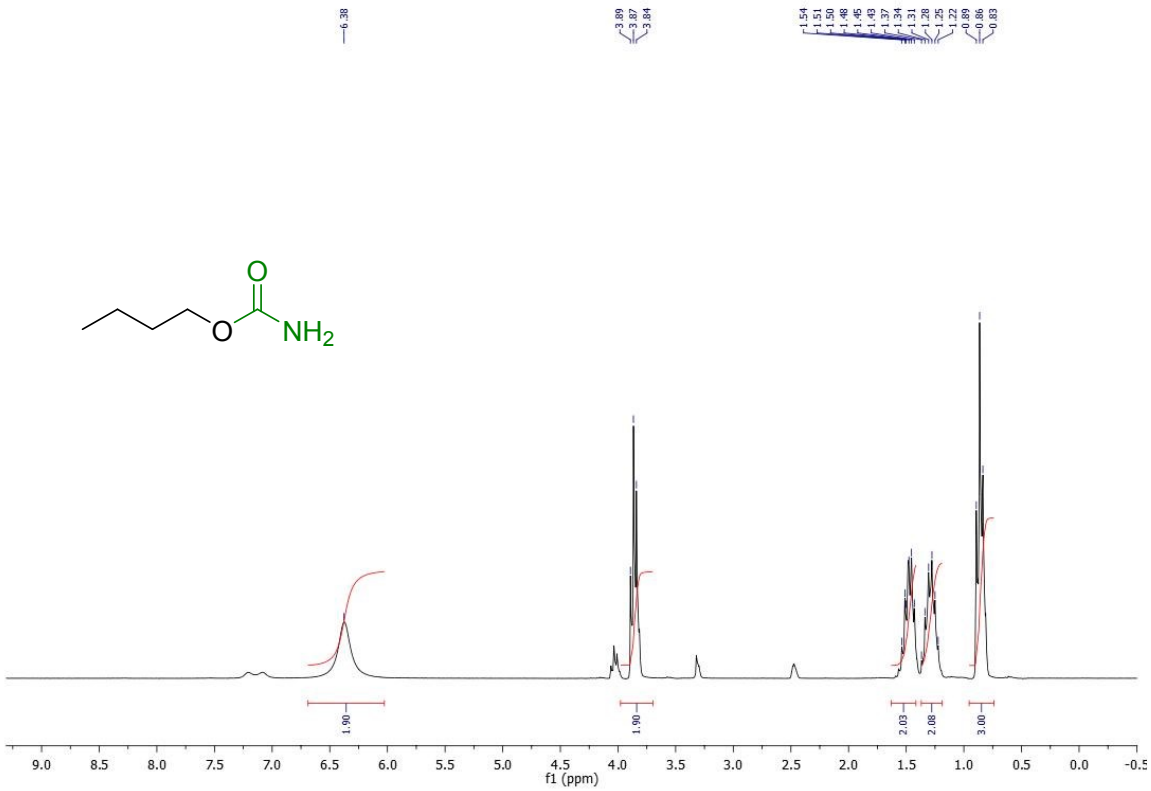


Figure S131. ^{1}H NMR spectrum of 7k in DMSO-d_6 (250MHz)

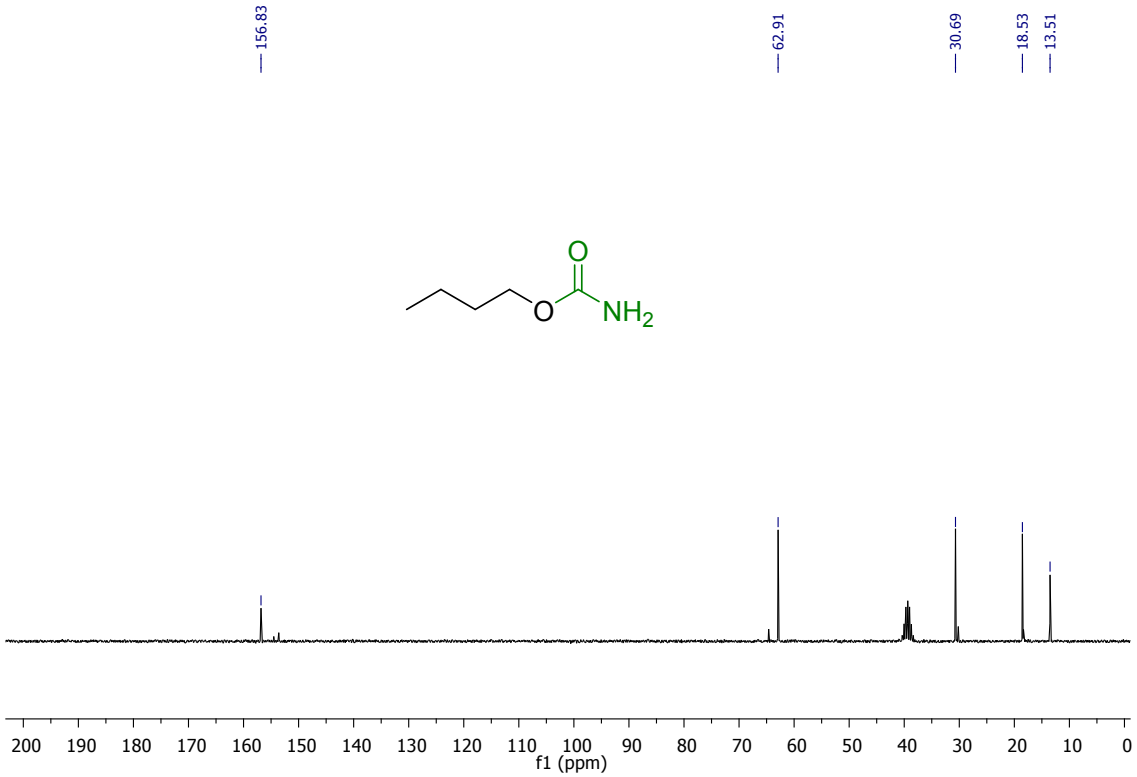


Figure S132. ^{13}C NMR spectrum of 7k in DMSO-d_6 (63MHz)

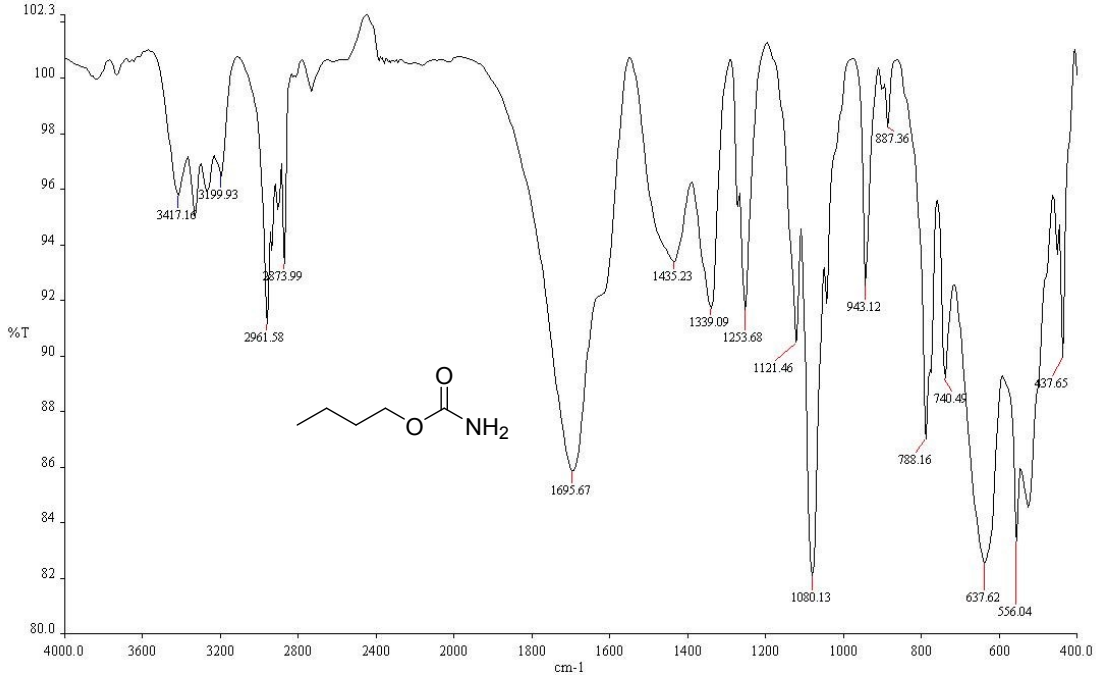


Figure S133. FT-IR spectrum of 7k in KBr

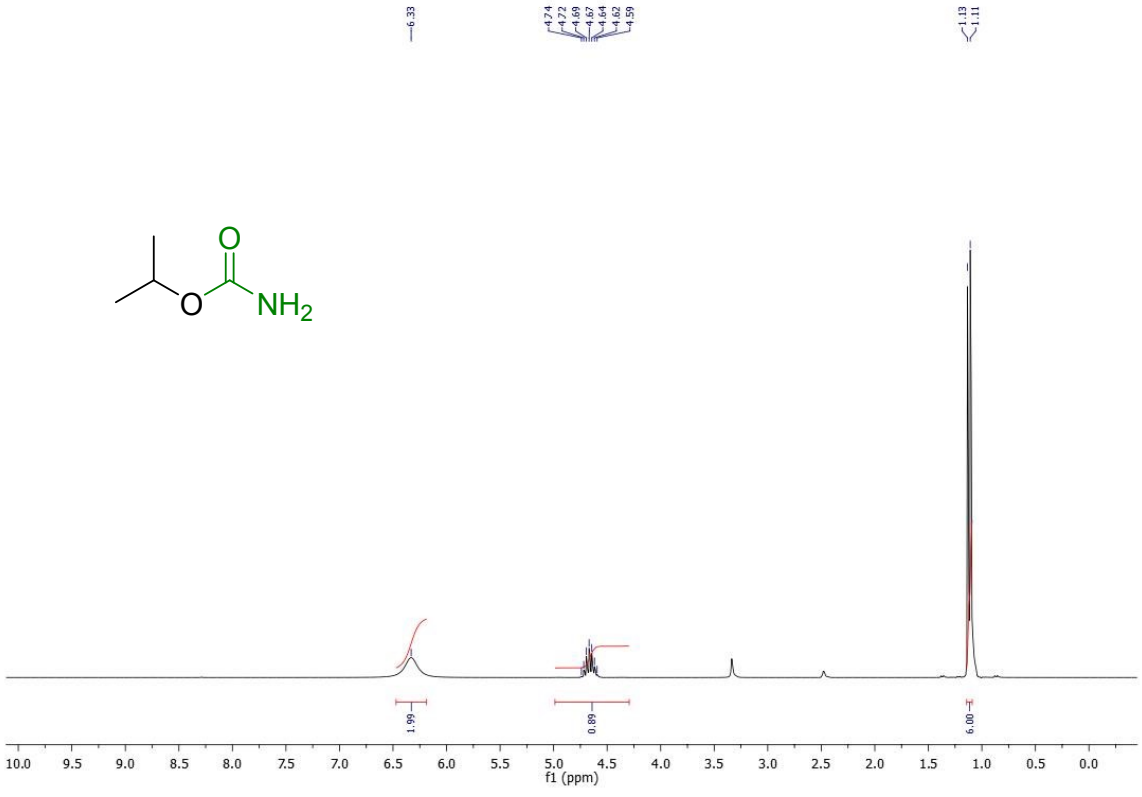


Figure S134. ^{1}H NMR spectrum of 7l in DMSO-d_6 (250MHz)

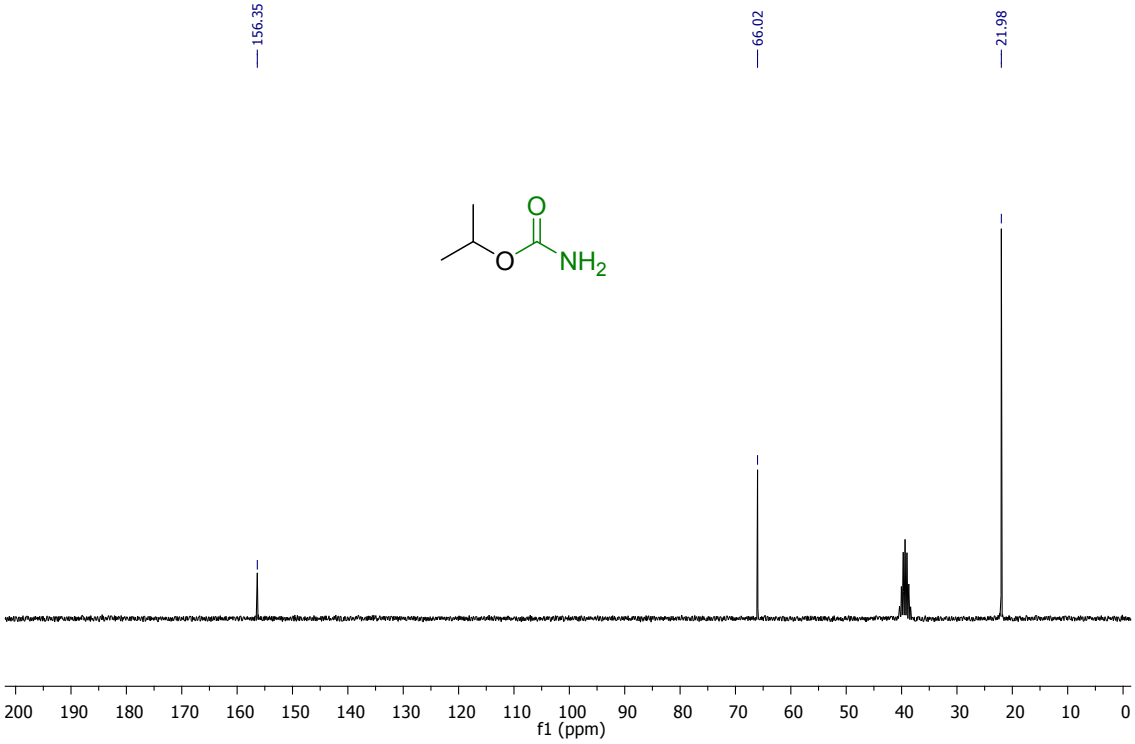


Figure S135. ^{13}C NMR spectrum of 7l in DMSO-d_6 (63MHz)

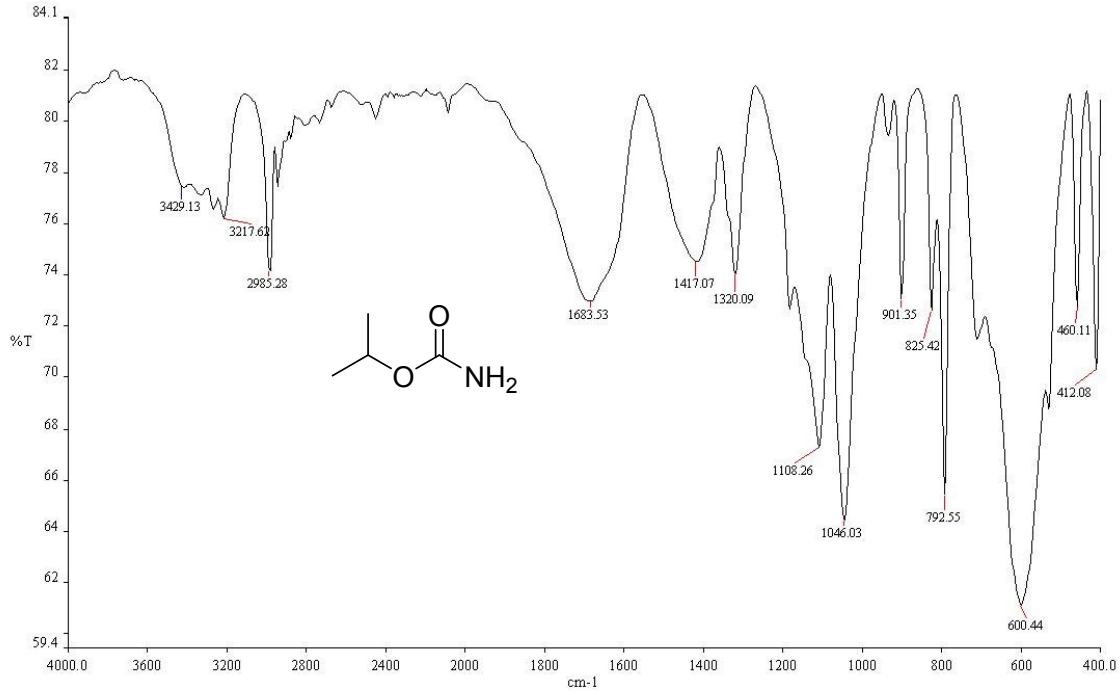


Figure S136. FT-IR spectrum of 7l in KBr