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Identification of Parallel Medicinal Chemistry Protocols to Expand Branched Amine Design Space

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Supporting Information

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General Information

All reagents were obtained from commercial suppliers and used without further purification, unless otherwise noted. All solvents used were purchased anhydrous and transferred by nitrogen-purged syringe. Silica gel chromatography was performed using medium pressure Biotage or ISCO systems employing columns pre-packaged by various commercial vendors including Biotage and ISCO. ^{1}H and ^{13}C NMR characterization data were collected at 300 K on a Bruker AS-400 spectrometer operating at 400 and 100 MHz (respectively) with chemical shifts reported in parts per million relative to $CDCl_3$ (^{1}H NMR: 7.26 ppm; ^{13}C NMR: 77.2 ppm) or DMSO-d6 (^{1}H NMR: 2.50 ppm; ^{13}C NMR: 39.5 ppm). LC-MS were acquired using a Waters Acquity UPLC equipped with a Waters Acquity HSS T3 column, water/MeCN gradient and 0.1% v/v formic acid as modifier. Redox-active esters **1** were prepared and reacted in-situ as described in General Library Protocol A or isolated by the procedure of Baran and coworkers.[1] Imines **2** were prepared and reacted in-situ as described in General Library Protocol D or prepared by the procedure of DeBoef and coworkers[2] and used without purification. All reactions were performed on the benchtop under N_2 or air atmosphere, with the exception of the high-throughput conditions screen, which was performed in a glove-box.

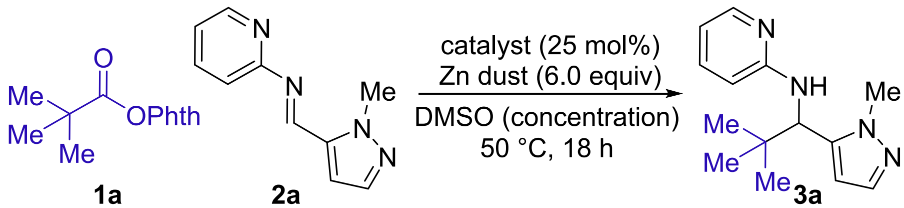
1. Cornella, J.; Edwards, J. T.; Qin, T.; Kawamura, S.; Wang, J.; Pan, C.-M.; Gianatassio, R.; Schmidt, M.; Eastgate, M. D.; Baran, P. S., Practical Ni-Catalyzed Aryl–Alkyl Cross-Coupling of Secondary Redox-Active Esters. *J. Am. Chem. Soc.* **2016,** *138* (7), 2174-2177.

2. Sirois, J. J.; Davis, R.; DeBoef, B., Iron-Catalyzed Arylation of Heterocycles via Directed C–H Bond Activation. *Org. Lett.* **2014,** *16* (3), 868-871.

Experimental Procedures for High Throughput Experimentation (HTE)

A HTE screen was completed on a miniature scale (0.001mmol) examining the key variables of reductant and catalyst. In total 53 catalysts were screened against 4 reductant sources in a total matrix of 212 combinations. The remaining variables were held constant according to the protocol described below.

A. Micromole scale optimization of decarboxylative imine addition



Scale: 0.001 mmol **2a**. Concentration: 0.01 M

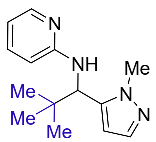
Variables List - Catalysts

No.	Identifier	Base	No.	Identifier	Solvent
1	MFCD00011004	FeCl2	23	None	_Blank
2	MFCD00011005	FeCl3	24	None	(BPhen)NiCl2.DMA2
3	MFCD00149709	FeCl2·4H2O	25	2230140-51-7	NHC-Ni-1
4	MFCD00016082	FeBr3	26	2067359-93-5	C4F12N2NiO8S4·xH2O
5	MFCD00000020	Fe(acac)3	27	MFCD00009592	Ni(P(Ph)3)2Cl2
6	MFCD15144785	Fe(OTf)3	28	MFCD25563227	Ni(P(Cy2Ph)2Cl2
7	MFCD00066973	Ni(OAc)2.4H2O	29	MFCD00270284	Ni(dppf)Cl2
8	MFCD00013481	NiCl2.DME	30	MFCD11973802	Ni(P(Cy)3)2Cl2
9	MFCD00150259	Ni(BF4)2·6H2O	31	MFCD28144558	Ni(P(Ph)3)2TolCl
10	MFCD00149809	NiCl2.6H2O	32	MFCD27978415	Ni(P(Cy2Ph)2TolCl
11	MFCD00066973	Ni(OAc)2.4H2O	33	2049086-34-0	SK-J002-1n
12	MFCD00000024	Ni(acac)2	34	MFCD28411349	(dppf)Ni(o-tolyl)Cl
13	MFCD00149058	Ni(acac)2.xH2O	35	MFCD00015865	Ni(P(Ph)3)2Br2
14	MFCD00058902	Ni(COD)2	36	MFCD06800434	ClNi(Nap)(PPh3)2
15	MFCD00149805	Ni(NO3)2.6H2O	37	MFCD28100473	[(dppf)Ni(cinnamyl)Cl]
16	MFCD29037017	NiCl(o-tolyl)(TMEDA)	38	2049086-37-3	SK-J014-1n
17	MFCD00016264	NiI2	39	2049086-36-2	SK-J004-1n
18	MFCD17015253	Nickamine	40	2091838-72-9	Strem 28-1040
19	MFCD00274339	NiBr2.2MEE	41	None	[(dppf)Ni(cinnamyl)]ZnCl3
20	MFCD00192348	Ni(TMHD)2	42	MFCD00010011	Ni(PPh3)4
21	MFCD00013313	Ni(dppe)Cl2	43	2091838-72-9	NHC-Ni-1
22	MFCD00015318	Ni(dppp)Cl2			

Variables List - Reductants

No.	Identifier	Reductant
1	MFCD00011291	Zn Dust
2	MFCD00011291	Zn Nano
3	MFCD00009601	TDAE
4	MFCD00005951	Hantzsch ester

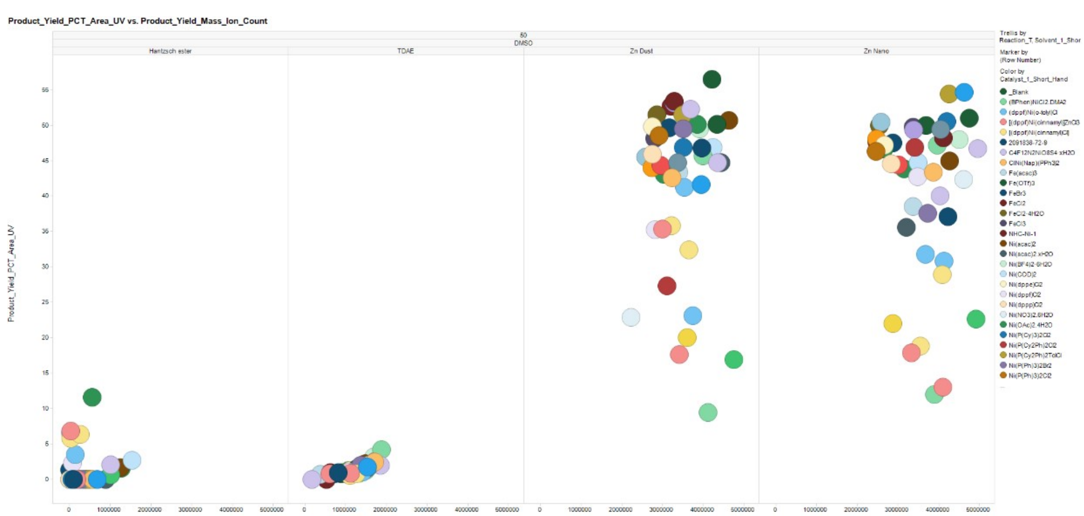
The reactions were set-up in a two 96-well arrays using miniature 8x20mm 0.2ml glass vials conditions following the procedure:



3a

N-(2,2-dimethyl-1-(1-methyl-1H-pyrazol-5-yl)propyl)pyridin-2-amine. To a 8x20mm 0.2mL glass vial pre-equipped with stir bar was dispensed DMSO (50uL, 0.02M) was first dispensed before the **imine, 2a** (5uL, 1eq., as 0.2M solution in DMSO) and **redox active ester**, **1a** (5uL, 2eq., as 0.4M solution in DMSO) added. The reaction was stirred before **catalyst** (10uL, 0.25eq., added as a 0.025M suspension in DMSO) and **reductant** (50uL, 6eq., added as a 0.12M suspension in DMSO) dosed. The reaction was crimp sealed to the glove-box environment before being stirred overnight at 50C for 18hrs. After this period the reaction was cooled, centrifuged, diluted with ACN (200uL) and directly analyzed.

The TIBCO Spotfire® Analysis below presents product by %Area UV (vertical axis), product by mass ion count (horizontal axis, in good correlation), catalyst (color-see legend), reductant (trellis-see title), temperature (trellis-see title) and solvent (trellis-see title). The highest vertical spots represent the preferred conditions.



Visualization of variables effects in the formation of N-(2,2-dimethyl-1-(1-methyl-1H-pyrazol-5-yl)propyl)pyridin-2-amine.

General Library Procedure A: Synthesis of branched amines from the aliphatic carboxylic acid diversity set

Stage 1 (redox-active ester formation): To a dried round bottom flask under nitrogen atmosphere was added NHPI (2 equiv per reaction, 33 mg, 0.20 mmol) and DMAP (20 mol% per reaction, 2.4 mg, 0.020 mmol). The flask was purged with nitrogen for 5 min, then CH_2Cl_2 (1.0 mL per reaction) was added. The resulting mixture was stirred rapidly for 10 min to provide a suspension. A plate of 1-dram vials with septum caps under air atmosphere were each charged with a unique carboxylic acid and stir bar. Using an 18-gauge needle to prevent clogging, the NHPI/DMAP/CH_2Cl_2 suspension was added (1.0 mL per vial). The vials were stirred at 23 °C for 5 min, then DIC (2.2 equiv per reaction, 34 µL, 0.22 mmol) was added via syringe. The resulting mixture was stirred at ambient temperature for 24 h, then each vial was concentrated in parallel under a stream of nitrogen to provide the redox-active ester intermediates.

Stage 2 (decarboxylative imine addition): To a dried round bottom flask under nitrogen atmosphere was added imine **2a** (1 equiv per reaction, 19 mg, 0.1 mmol) and NiI_2 (25 mol% per reaction, 7.8 mg, 0.025 mmol). The flask was purged with N_2 and DMSO was added (0.2 mL per reaction). The flask was stirred at 23 °C for 10 min to provide a suspension. To 1-dram vials containing redox-active esters (from Stage 1) was added Zn powder (approximately 6 equiv per reaction, 39 mg, 0.6 mmol) via calibrated scoop. Using one vacuum line fitted with a 20 gauge needle and one N_2 line fitted with a 20 gauge needle, each vial was evacuated for ~10 seconds, then backfilled with N_2 (repeated the purging/backfill sequence once). The imine/NiI_2/DMSO suspension was then added to each vial (0.2 mL per reaction). The vials were then stirred at 50 °C for 48 h. The vials were cooled to 23 °C and diluted with CH_2Cl_2 (2 mL) and brine (1 mL). The organic phase was filtered through a prepacked Na_2SO_4 plug and concentrated via genevac. The resulting crude branched amines were dissolved in 1 mL DMSO and submitted for high-throughput purification (column: Waters Sunfire C18 19x100, 5µ; Mobile phase A: 0.05% TFA in water (v/v); Mobile phase B: 0.05% TFA in acetonitrile (v/v).

General Procedure B: Aryl/alkyl branched amine synthesis from pre-isolated redox-active esters (3a, 3u-3y)

To a 1-dram vial with a stir bar and septum cap was added imine **2** (0.25 mmol, 1.0 equiv), redox-active ester **1** (0.50 mmol, 2.0 equiv), NiI_2 (20 mg, 0.0625 mmol, 0.25 equiv), and Zn powder (98 mg, 1.5 mmol, 6 equiv). The vial was placed under vacuum and backfilled with N_2 (3 cycles). DMSO (0.5 mL, 0.5 M) was added via syringe. The septum cap was replaced with an unpunctured septum cap. The vial was stirred and heated to 50 °C. After 24 h the reaction was cooled to 23 °C. The solution was concentrated in vacuo via Genevac vacuum centrifuge and purified by flash column chromatography using the solvent system indicated. *Alternative (non-Genevac) workup:* After 24 h the reaction was cooled to 23 °C and diluted with EtOAc (20 mL). The solution was washed with saturated LiCl (aq) (2 X 20 mL). The combined aqueous phases were extracted with EtOAc (20 mL). The combined organic phases were dried over Na_2SO_4, filtered, and concentrated in vacuo. The crude compounds were purified by flash column chromatography using the solvent system indicated.

General Library Procedure C: Synthesis of branched amines from the heteroaryl bromide diversity set

Stage 1 (aryl lithium formation): 2-dram vials with septum caps and stir bars in a 6X4 rack were charged with aryl bromide (0.45 mmol per reaction, 1.5 equiv). The vials were sequentially evacuated for 10 seconds and backfilled with N_2. THF (1.4 mL per reaction) was added. The vial rack was submerged in a Tupperware container on a stir plate containing dry ice / acetone at -78 °C. Upon cooling, each vial was evacuated/backfilled with N_2 two more times. n-BuLi (2.5 M in hexanes) (0.18 mL per reaction, 0.45 mmol, 1.5 equiv) was added via syringe. The vials were stirred at -78 °C for 30 min.

Stage 2 (imine addition): In a separate round bottom flask under N_2 atmosphere, the crude imine (0.30 mmol per reaction) was dissolved in THF (2 mL per reaction). The imine solution in THF was added to each vial at -78 °C (2 mL per reaction). The vials were slowly warmed to 23 °C over 24 h. The reactions were quenched with 5% AcOH in EtOAc (v/v) (0.5 mL per vial). Brine (1 mL per vial) was added. The organic phase was filtered through a prepacked Na_2SO_4 plug and concentrated using Genevac EZ-2 Elite. The resulting crude branched amines were dissolved in 1 mL DMSO and submitted for high-throughput purification (column: Waters Sunfire C18 19x100, 5μ; Mobile phase A: 0.05% TFA in water (v/v); Mobile phase B: 0.05% TFA in acetonitrile (v/v).

General Library Procedure D: Synthesis of branched amines from the aldehyde & heteroaryl amine diversity sets

Stage 1 (imine formation): To a 2-dram vial containing the aldehyde (0.2 mmol, 1.3 equiv) in a 6X4 vial rack was added a solution of the heteroaryl amine (0.15 mmol, 1.0 equiv) in toluene (1 mL per vial). 3 Å molecular sieves (250 mg per vial) were then added and reaction vials were capped. The vials were heated to 100 °C and shaken on a shaker plate for 16 h. The reaction mixtures were cooled to 23 °C and transferred to new 2-dram vials via pipette. Molecular sieves were rinsed with acetone (2 X 1 mL) via pipette. The combined solvent was removed using a Genevac EZ-2 Elite to give the crude imines.

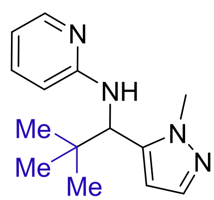
Stage 2 (Grignard addition): The crude imines were dissolved in tetrahydrofuran (1 mL per vial) and the vials were sealed. A solution of phenyl magnesium bromide (3.0 M in Et_2O) (0.2 mL per vial, 0.6 mmol, 4 equiv) was added at 23 °C. The reaction mixtures were then heated to 50 °C and shaken for 16 h. Reactions were cooled to 23 °C then treated with a 5% acetic acid / ethyl acetate mixture (2 mL per vial) followed by a brine solution (2 mL). The organic layers were transferred to separate 2-dram vials and the aqueous layers were extracted with additional ethyl acetate (2 mL). The combined organic phases were filtered through prepacked Na_2SO_4 plugs and concentrated in parallel using Genevac EZ-2 Elite. The resulting crude branched amines were dissolved in 1 mL DMSO and submitted for high-throughput purification (column: Waters Sunfire C18 19x100, 5µ; Mobile phase A: 0.05% TFA in water (v/v); Mobile phase B: 0.05% TFA in acetonitrile (v/v).

Characterization Data: Carboxylic Acid Diversity Set

Characterization Data for Branched Amine Compounds Following precedence for library chemistry,[3,4] compounds generated via library protocols were isolated by HPLC and characterized by low-resolution mass spectrometry; a subset of compounds from each library protocol were fully characterized.

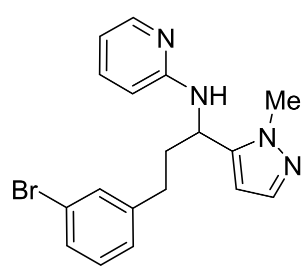
3. Ni, S.; Padial, N. M.; Kingston, C.; Vantourout, J. C.; Schmitt, D. C.; Edwards, J. T.; Kruszyk, M. M.; Merchant, R. R.; Mykhailiuk, P. K.; Sanchez, B. B.; Yang, S.; Perry, M. A.; Gallego, G. M.; Mousseau, J. J.; Collins, M. R.; Cherney, R. J.; Lebed, P. S.; Chen, J. S.; Qin, T.; Baran, P. S., A Radical Approach to Anionic Chemistry: Synthesis of Ketones, Alcohols, and Amines. *J. Am. Chem. Soc.* **2019,** *141* (16), 6726-6739.
4. Deeming, A. S.; Russell, C. J.; Willis, M. C., Combining Organometallic Reagents, the Sulfur Dioxide Surrogate DABSO, and Amines: A One-Pot Preparation of Sulfonamides, Amenable to Array Synthesis. *Angew. Chem. Int. Ed.* **2015,** *54* (4), 1168-1171.

*N-(2,2-dimethyl-1-(1-methyl-1H-pyrazol-5-yl)propyl)pyridin-2-amine (**3a**)*

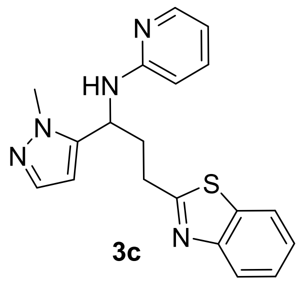


Prepared according to general procedure B (0.10 mmol scale). Purification via flash column chromatography (linear gradient: 1% MeOH / CH_2Cl_2 to 10% MeOH / CH_2Cl_2) provided 12 mg (49% yield); ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 8.00 (d, J = 4.3 Hz, 1H) (m, 1H), 7.77 (br s, 1H), 7.35 (d, *J* = 1.2 Hz, 1H), 7.02 (br s, 1H), 6.77 (br s, 1H), 6.27 (s, 1H), 5.10 (d, *J* = 7.4 Hz, 1H), 3.91 (s, 3H), 0.97 (s, 9H); ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 159.40, 159.14, 158.87, 137.97, 118.18, 115.82, 112.89, 105.09, 55.45, 37.64, 36.83, 26.33; HRMS (ESI) m/z:[M + H]+ calcd for $C_{14}H_{20}N_4$, 245.1761; found, 245.1768.

*N-(3-(3-bromophenyl)-1-(1-methyl-1H-pyrazol-5-yl)propyl)pyridin-2-amine (**3b**)*

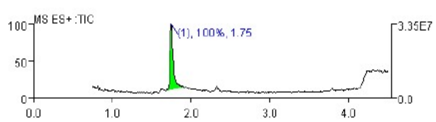


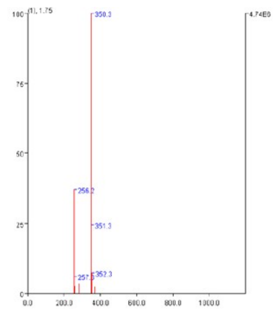
Prepared in parallel format according to Library Procedure A. 6.4 mg isolated; ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 7.97 (d, J = 4.7 Hz, 1H), 7.73 (br s, 1H), 7.44 (s, 1H), 7.40-7.37 (m, 1H), 7.32 (d, *J* = 1.4 Hz, 1H), 7.26-7.22 (m, 2H), 6.88 (br s, 1H), 6.75 (br s, 1H), 6.25 (d, *J* = 1.4 Hz, 1H), 5.09 (d, *J* = 4.7 Hz, 1H), 3.77 (s, 3H), 2.74-2.66 (m, 2H), 2.16-2.10 (m, 2H); ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 157.98, 143.87, 137.46, 131.05, 130.47, 128.85, 127.42, 121.67, 117.74, 115.38, 112.56, 112.50, 103.67, 99.49, 46.64, 36.53, 35.78, 31.23; HRMS (ESI) m/z:[M + H]+ calcd for $C_{18}H_{19}BrN_4$, 371.0866; found, 371.0866.

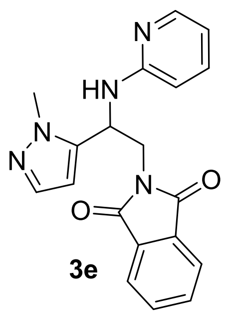


3c

4.0 mg product obtained. LC-MS data – Ret. time 1.7: MS ES+ *m/z* 350 ($[M+H]^+$).

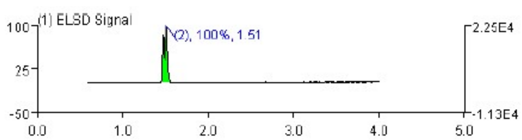


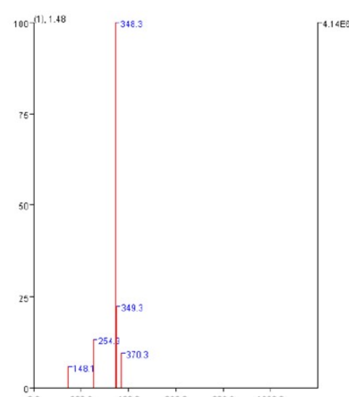




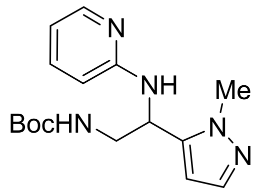
3e

3.8 mg product obtained. LC-MS data – Ret. time 1.48: MS ES+ *m/z* 348 ($[M+H]^+$).

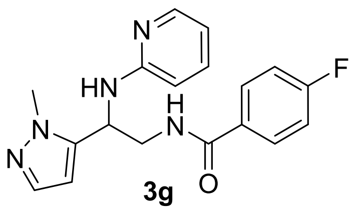




*tert-butyl (2-(1-methyl-1H-pyrazol-5-yl)-2-(pyridin-2-ylamino)ethyl)carbamate (**3f**)*

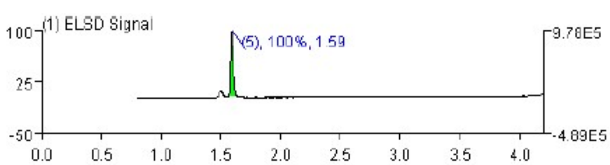


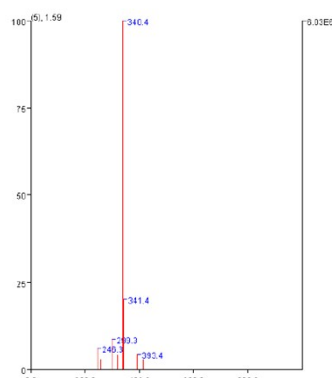
Prepared in parallel format according to Library Procedure A. 10.2 mg isolated; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.89-7.77 (m, 1H), 7.73 (t, *J* = 7.8 Hz , 1H), 7.43 (d, *J* = 1.6 Hz, 1H), 6.79 (t, *J* = 6.6 Hz, 1H), 6.53 (d, *J* = 9.0 Hz , 1H), 6.24 (d, *J* = 1.6 Hz, 1H), 5.58-5.56 (m, 1H), 4.97 (dd, J = 1.6 Hz, 4.7 Hz, 1H), 4.03 (s, 3H), 3.69-3.63 (m, 1H), 3.45-3.38 (m, 1H), 1.43 (s, 9H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 156.26, 154.20, 143.75, 139.11, 139.01, 134.29, 112.49, 110.23, 104.84, 80.05, 50.01, 44.60, 37.00, 28.31; HRMS (ESI) m/z:[M + H]+ calcd for $C_{16}H_{23}N_5O_2$, 318.1925; found, 318.1932.

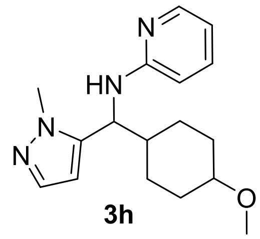


3g

2.7 mg product obtained. LC-MS data – Ret. time 1.54: MS ES+ *m/z* 340 ([M+H]$^+$).

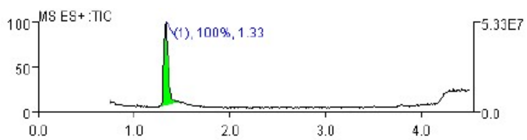


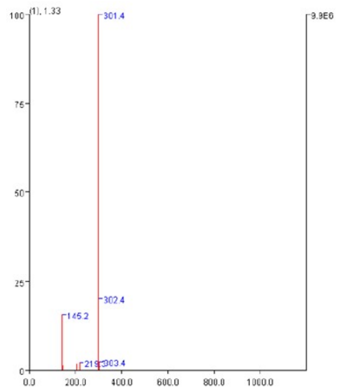


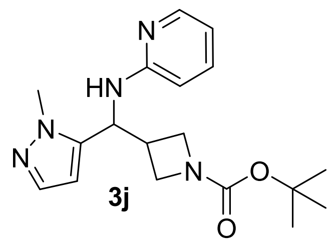


3h

2.5 mg product obtained. LC-MS data – Ret. time 1.3: MS ES+ *m/z* 301 ([M+H]$^+$).

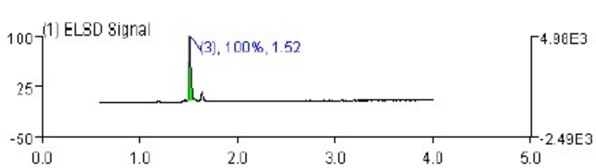


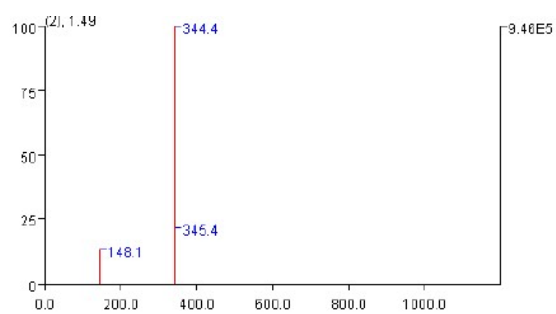


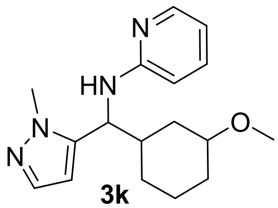


3j

3.3 mg product obtained. LC-MS data – Ret. time 1.48: MS ES+ *m/z* 344 ([M+H]$^+$).

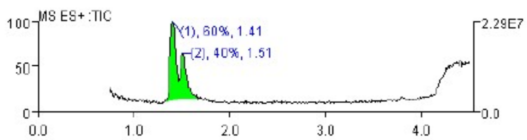


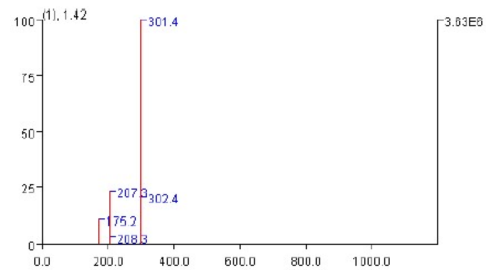


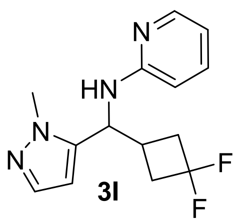


3k

2.6 mg product obtained. LC-MS data – Ret. time 1.36, 1.48: MS ES+ *m/z* 301 ([M+H]$^+$).

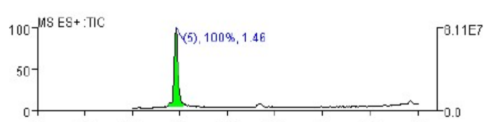


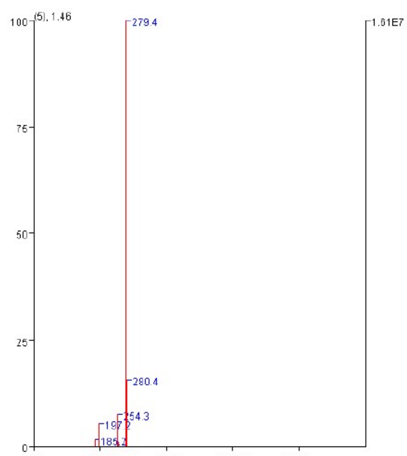


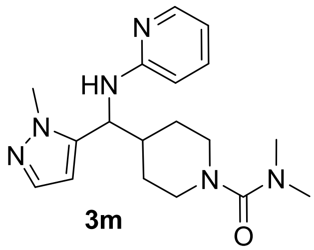


3l

1.6 mg product obtained. LC-MS data – Ret. time 1.41: MS ES+ *m/z* 279 ([M+H]$^+$).

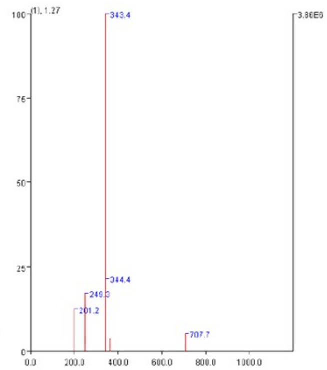


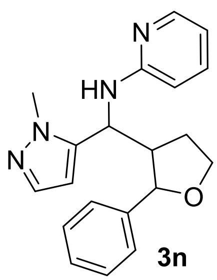




3m

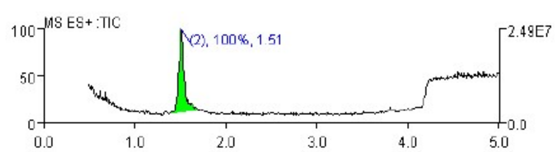
3.2 mg product obtained. LC-MS data – Ret. time 1.27: MS ES+ *m/z* 343 ($[M+H]^+$).

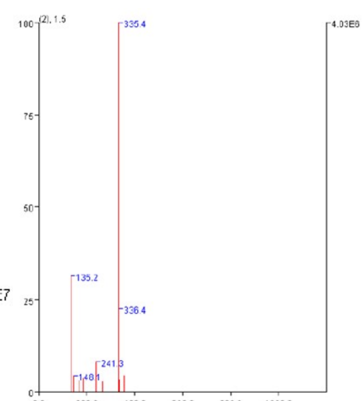




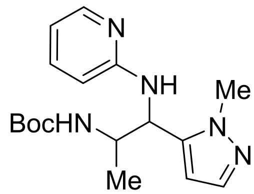
3n

5.7 mg product obtained. LC-MS data – Ret. time 1.48: MS ES+ *m/z* 335 ($[M+H]^+$).



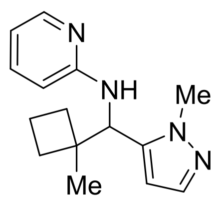


*tert-butyl (1-(1-methyl-1H-pyrazol-5-yl)-1-(pyridin-2-ylamino)propan-2-yl)carbamate (**3o**)*

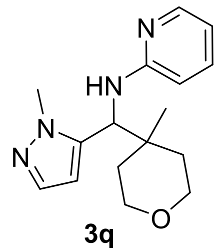


Prepared in parallel format according to Library Procedure A. Mix of diastereomers (2.5:1), 4.2 mg isolated; ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.98 (d, *J* = 5.8 Hz, 1H), 7.74-7.71 (m, 1H), 7.32 (s, 1H), 7.09-6.73 (m, 2H), 6.25 (br s, 1H), 5.20 (t, *J* = 7.4 Hz, 1H), 4.00-3.90 (m, 2H), 3.84 (s, 3H), 1.29 (s, 9H), 1.05 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.11, 155.12, 144.70, 142.19, 138.16, 137.44, 112.62, 112.52, 104.46, 77.99, 77.89, 49.28, 48.76, 36.68, 28.07, 17.21, 17.00; HRMS (ESI) m/z:[M + H]+ calcd for $C_{17}H_{25}N_5O_2$, 332.2081; found, 332.2081.

*N-((1-methyl-1H-pyrazol-5-yl)(1-methylcyclobutyl)methyl)pyridin-2-amine (**3p**)*

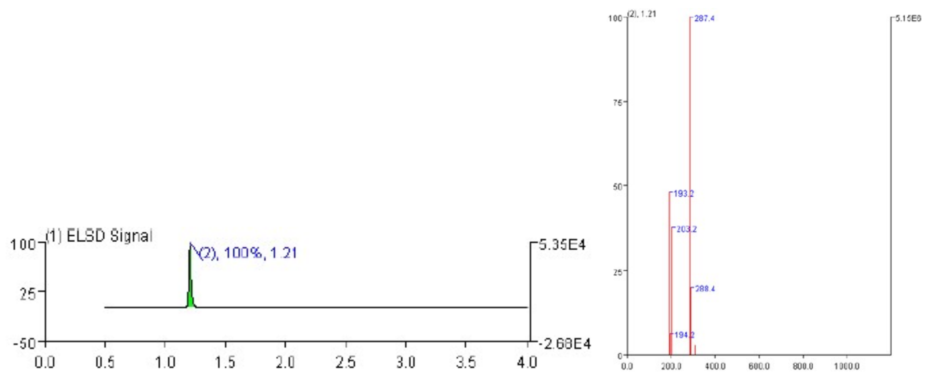


Prepared in parallel format according to Library Procedure A. 4.1 mg isolated; ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.99 (d, *J* = 5.4 Hz, 1H), 7.83 (br s, 4H), 7.34 (s, 1H), 6.18 (br s, 1H), 5.21 (d, *J* = 8.6 Hz, 1H), 3.82 (s, 3H), 2.24-2.17 (m, 1H), 2.08-1.90 (m, 2H), 1.71-1.54 (3H), 1.22 (s, 3H); HRMS (ESI) m/z:[M + H]+ calcd for $C_{15}H_{20}N_4$, 257.1761; found, 257.1760.

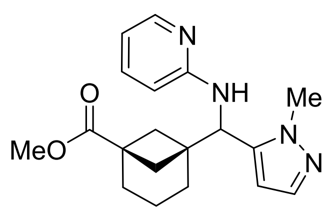


3q

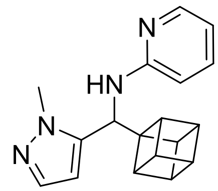
4.3 mg product obtained. LC-MS data – Ret. time 1.16: MS ES+ *m/z* 287 ($[M+H]^+$).



*methyl (1r,5r)-5-((1-methyl-1H-pyrazol-5-yl)(pyridin-2-ylamino)methyl)bicyclo[3.1.1]heptane-1-carboxylate **(3r)***

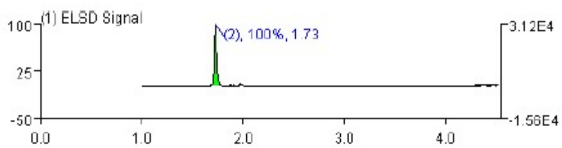


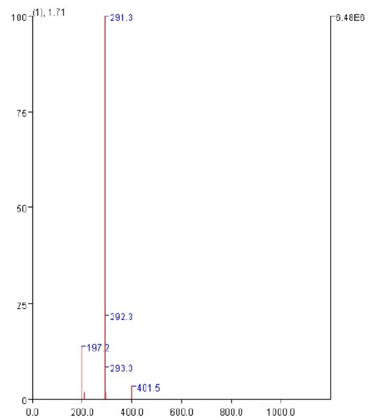
Prepared in parallel format according to Library Procedure A. 5 mg isolated; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.85 (d, *J* = 6.2 Hz, 1H), 7.73 (t, *J* = 7.8 Hz, 1H), 7.46 (s, 1H), 6.79 (t, *J* = 6.6 Hz, 1H), 6.42-6.38 (m, 1H), 6.27 (s, 1H), 4.52 (s, 1H), 3.94 (s, 3H), 3.67 (s, 3H), 2.25 (d, J = 9.0 Hz, 1H), 2.04-1.81 (m, 9H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 175.58, 164.28, 164.00, 153.96, 143.65, 138.97, 112.37, 109.51, 106.01, 57.15, 51.79, 42.87, 42.29, 37.38, 36.65, 29.98, 29.89, 16.43; HRMS (ESI) m/z:[M + H]+ calcd for $C_{19}H_{24}N_4O_2$, 341.1972; found, 341.1972.

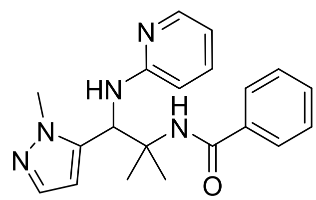


3s

1.8 mg product obtained. LC-MS data – Ret. time 1.71: MS ES+ *m/z* 291 ([M+H]$^+$).

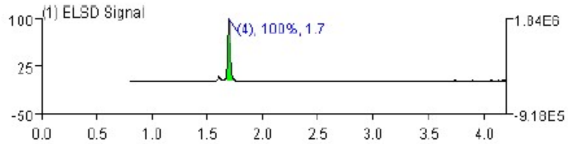


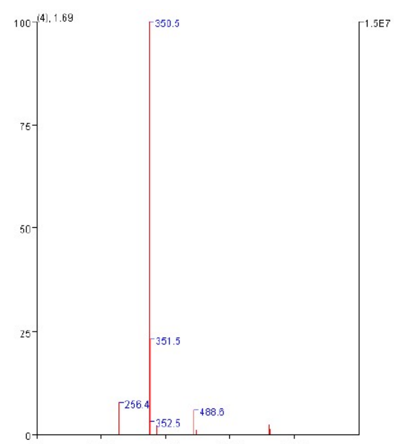




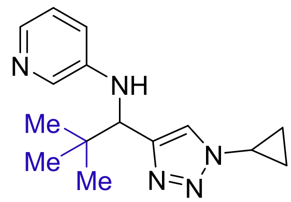
3t

2.7 mg product obtained. LC-MS data – Ret. time 1.69: MS ES+ *m/z* 350 ([M+H]$^+$).



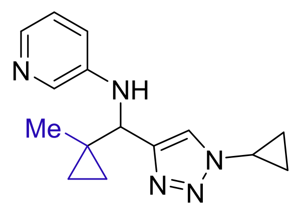


*N-(1-(1-cyclopropyl-1H-1,2,3-triazol-4-yl)-2,2-dimethylpropyl)pyridin-3-amine (**3u**)*



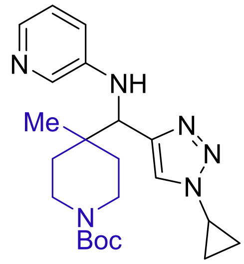
Prepared according to general procedure B (0.17 mmol scale). Purification via flash column chromatography (linear gradient: 1% MeOH / CH_2Cl_2 to 9% MeOH / CH_2Cl_2) provided 25 mg (54% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (br s, 1H), 7.87 (d, *J* = 3.9 Hz, 1H), 7.45 (s, 1H), 7.05-7.02 (m, 1H), 6.91-6.89 (m, 1H), 4.66 (d, *J* = 7.4 Hz, 1H), 4.32 (d, *J* = 7.8 Hz, 1H), 3.73-3.68 (m, 1H), 1.24-1.20 (m, 2H), 1.14-1.10 (m, 2H), 1.04 (s, 9H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 147.02, 144.27, 137.44, 135.88, 124.02, 122.49, 120.07, 59.59, 35.04, 31.32, 26.62, 6.87; HRMS (ESI) m/z:[M + H]+ calcd for $C_{15}H_{21}N_5$, 272.1864; found, 272.1871.

*N-((1-cyclopropyl-1H-1,2,3-triazol-4-yl)(1-methylcyclopropyl)methyl)pyridin-3-amine (**3v**).*



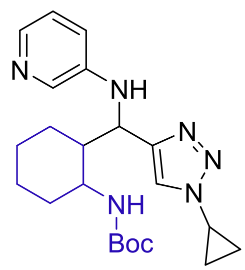
Prepared according to general procedure B (0.25 mmol scale). Purification via flash column chromatography (linear gradient: 0% MeOH / CH_2Cl_2 to 7% MeOH / CH_2Cl_2) provided 15 mg (22% yield); ^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.04-7.98 (m, 3H), 7.62-7.57 (m, 2H), 7.28 (br s, 1H), 4.34 (br s, 1H), 3.96-3.92 (m, 1H), 1.15-1.06 (m, 7H), 0.63-0.60 (m, 1H), 0.55-0.51 (m, 1H), 0.42-0.38 (m, 1H), 0.34-0.30 (m, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ = 146.60, 145.89, 129.04, 126.61, 126.10, 122.65, 55.53, 31.19, 19.58, 19.31, 11.72, 10.82, 6.63; HRMS (ESI) m/z:[M + H]+ calcd for $C_{15}H_{19}N_5$, 270.1713; found, 270.1713.

*tert-butyl 4-((1-cyclopropyl-1H-1,2,3-triazol-4-yl)(pyridin-3-ylamino)methyl)-4-methylpiperidine-1-carboxylate (**3w**)*



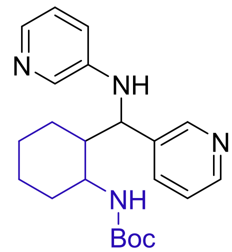
Prepared according to general procedure B (0.25 mmol scale). Purification via flash column chromatography (linear gradient: 2% MeOH / CH_2Cl_2 to 7% MeOH / CH_2Cl_2) provided 48 mg (47% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.26 (br s, 1H), 7.92 (d, *J* = 4.3 Hz, 1H), 7.51 (s, 1H), 7.11 (dd, *J* = 8.2, 4.7 Hz, 1H), 6.98 (dd, J = 8.0, 1.6 Hz, 1H), 4.87 (br s, 1H), 4.43 (d, *J* = 8.6 Hz, 1H), 3.92-3.84 (m, 2H), 3.76-3.71 (m, 1H), 3.09-3.02 (m, 2H), 1.65-1.62 (m, 3H), 1.48 (s, 9H), 1.29-1.24 (m, 3H), 1.17-1.14 (m, 5H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 154.88, 145.93, 144.13, 135.90, 124.05, 122.70 (2 peaks), 79.49, 59.19, 36.49, 31.86, 31.39, 28.43, 22.67, 18.09, 6.88; HRMS (ESI) m/z:[M + H]+ calcd for $C_{22}H_{32}N_6O_2$, 413.2660; found, 413.2651.

*tert-butyl (2-((1-cyclopropyl-1H-1,2,3-triazol-4-yl)(pyridin-3-ylamino)methyl)cyclohexyl)carbamate (**3x**)*



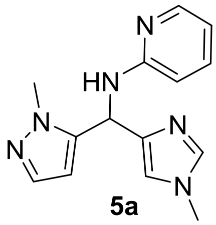
Prepared according to general procedure B (0.50 mmol scale). Purification via flash column chromatography (linear gradient: 0% MeOH / CH_2Cl_2 to 5% MeOH / CH_2Cl_2) provided 57 mg (28% yield) as a mixture of diastereomers; ^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.06 (d, *J* = 2.0 Hz, 1H), 7.81 (s, 1H), 7.81-7.80 (m, 1H), 7.20-7.17 (m, 2H), 7.04 (d, J = 7.2, 1H), 6.45 (d, J = 5.3 Hz, 1H), 4.81-4.79 (m, 1H), 3.96-3.92 (m, 1H), 2.92-2.89 (m, 1H), 1.93-1.87 (m, 2H), 1.71-1.68 (m, 1H), 1.59 (br s, 2H), 1.41 (s, 9H), 1.27-1.01 (m, 7H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 155.21, 144.60, 144.54, 134.53, 127.66, 124.43, 122.95, 122.86, 77.63, 50.43, 49.30, 44.73, 33.26, 30.96, 28.26, 28.06, 25.61, 24.74, 6.53. HRMS (ESI) m/z:[M + H]+ calcd for $C_{22}H_{32}N_6O_2$, 413.2660; found, 413.2641.

*tert-butyl (2-(pyridin-3-yl(pyridin-3-ylamino)methyl)cyclohexyl)carbamate (**3y**)*



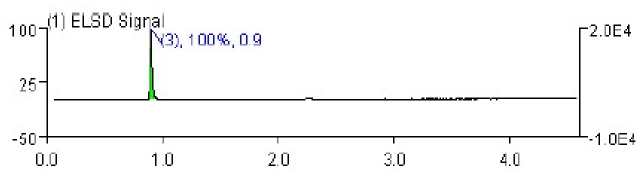
Prepared according to general procedure B (0.50 mmol scale). Purification via flash column chromatography (linear gradient: 1% MeOH / CH_2Cl_2 to 6% MeOH / CH_2Cl_2) provided 84 mg (44% yield) as a mixture of diastereomers; ^{1}H NMR (400 MHz, DMSO-d_6) (major diastereomer) δ = 8.58-8.54 (m, 2H), 8.03-8.00 (m, 2H), 7.62-7.60 (m, 1H), 7.51-7.47 (m, 2H), 7.06 (d, *J* = 7.2 Hz, 1H), 4.95 (t, *J* = 5.5 Hz, 1H), 4.77 (br s, 1H), 3.05-2.99 (m, 1H), 1.99-1.90 (m, 2H), 1.77-1.76 (m, 1H), 1.63-1.56 (m, 1H), 1.41 (s, 9H), 1.23-1.10 (m, 3H), 1.03-0.99 (m, 1H), 0.60-0.55 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.84, 158.57, 155.67, 146.32, 129.81, 127.38, 127.08, 124.54, 118.19, 115.83, 78.37, 55.12, 54.13, 50.51, 46.44, 33.77, 28.74, 26.39, 24.95, 24.87; HRMS (ESI) m/z:[M + H]+ calcd for $C_{22}H_{30}N_4O_2$, 383.2442; found, 383.2427.

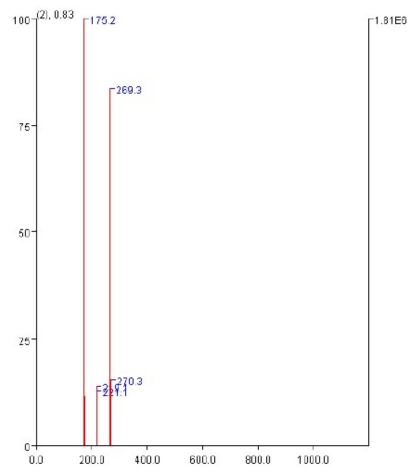
Characterization Data: Aryl Bromide Diversity Set

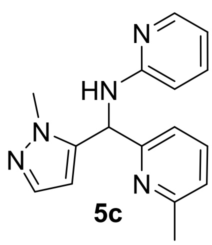


5a

8.4 mg product obtained. LC-MS data – Ret. time 0.86: MS ES+ *m/z* 269 ([M+H]$^+$).

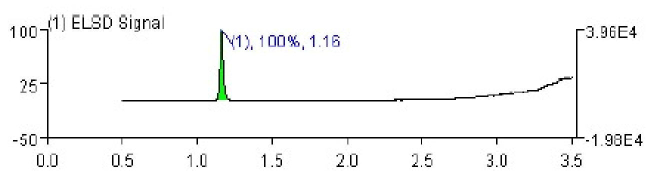


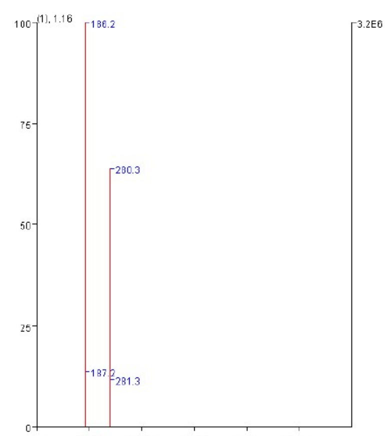




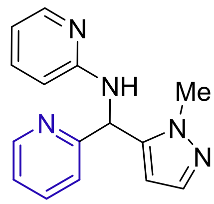
5c

17 mg product obtained. LC-MS data – Ret. time 1.16: MS ES+ *m/z* 280 ([M+H]$^+$).



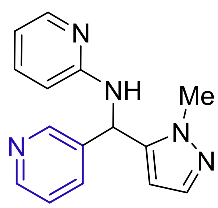


N-((1-methyl-1H-pyrazol-5-yl)(pyridin-2-yl)methyl)pyridin-2-amine (**5d**)

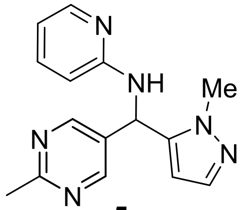


55 mg isolated according to General Library Procedure C. ^{1}H NMR (400 MHz, CHLOROFORM-*d*) δ ppm 8.56 - 8.55 (d, *J*=4.3 Hz, 1 H), 8.04 - 8.03 (d, *J*=4.7 Hz, 1 H), 7.64 - 7.60 (t, *J*= 7.4, 7.4 Hz, 1 H), 7.36 - 7.30 (m, 3 H), 7.20 - 7.17 (t, *J*=6.2, 5.1 Hz, 1 H), 6.58 - 6.55 (t, *J*=5.5, 5.5 Hz, 1 H), 6.47 - 6.45 (d, *J*=7.8 Hz, 1 H), 6.36 - 6.34 (d, *J*=7.0 Hz, 1 H), 6.10 - 6.09 (d, *J*=7.4 Hz, 1 H), 5.96 (s, 1 H), 3.90 (s, 3 H); ^{13}C NMR (101 MHz, CHLOROFORM-*d*) δ ppm 158.22, 156.77, 148.74, 147.53, 142.51, 137.60, 136.95, 136.50, 122.27, 121.58, 113.38, 107.98, 105.24, 52.02, 36.68; HRMS (ESI) m/z: [M + H]+ calculated for $C_{15}H_{15}N_5$, 266.1400; found, 266.1402.

N-((1-methyl-1H-pyrazol-5-yl)(pyridin-3-yl)methyl)pyridin-2-amine (**5e**)

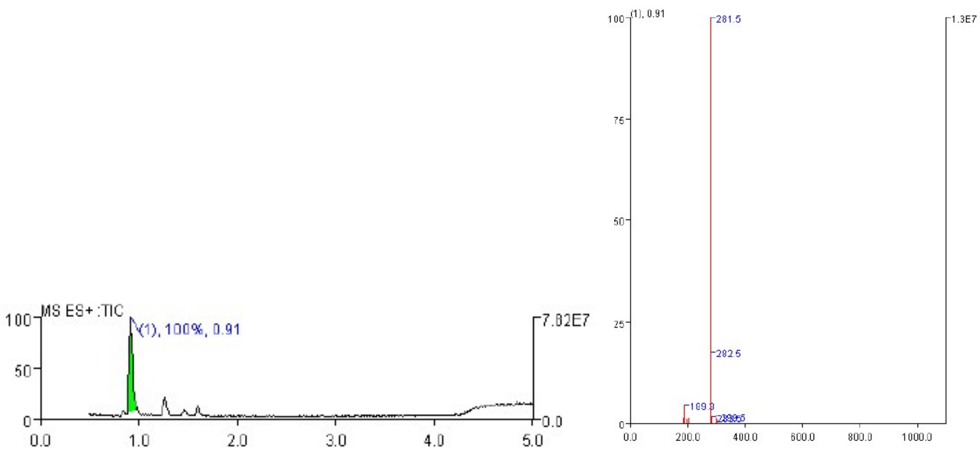


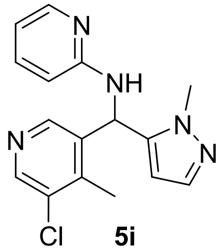
35 mg isolated according to General Library Procedure C. ^{1}H NMR (400 MHz, CHLOROFORM-*d*) δ ppm 8.67 (d, *J*=2 Hz 1 H), 8.57 - 8.56 (d, *J*=3.9 Hz, 1 H), 8.09 - 8.07 (d, *J*=4.3 Hz, 1 H), 7.69 - 7.67 (d, *J*=7.8 Hz, 1 H), 7.46 - 7.40 (m, 2 H), 7.31 - 7.29 (t, *J*=4.7, 3.1 Hz, 1 H), 6.67 - 6.64 (t, *J*= 5, 2 Hz, 1 H), 6.45 - 6.39 (dd, *J*=8.2, 10.5 Hz, 2 H), 5.94 (d, *J*=2 Hz, 1 H), 5.09-5.07 (d, *J*=6.6 Hz, 1 H), 3.85 (s, 3 H); ^{13}C NMR (101 MHz, CHLOROFORM-*d*) δ ppm 156.40, 149.23, 149.02, 147.84, 142.57, 138.28, 137.84, 135.71, 134.76, 123.54, 114.32, 108.17, 106.03, 49.38, 36.94; HRMS (ESI) m/z: [M + H]+ calculated for $C_{15}H_{15}N_5$, 266.1400; found, 266.1405.



5g

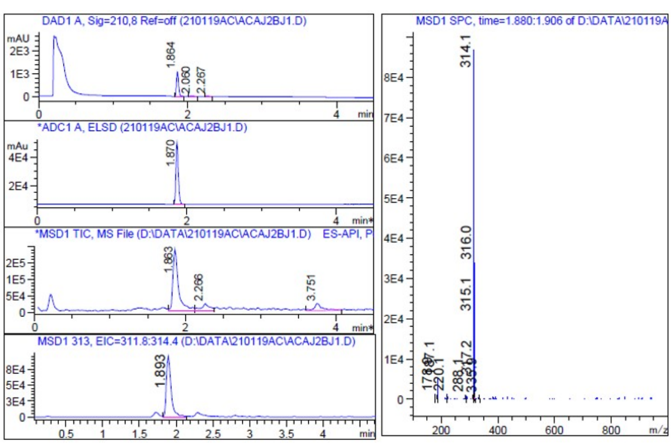
9.3 mg product obtained. LC-MS data – Ret. time 0.91: MS ES+ *m/z* 281 ([M+H]$^+$).

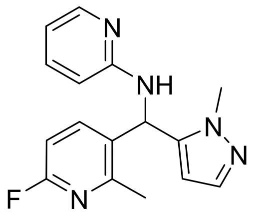




5i

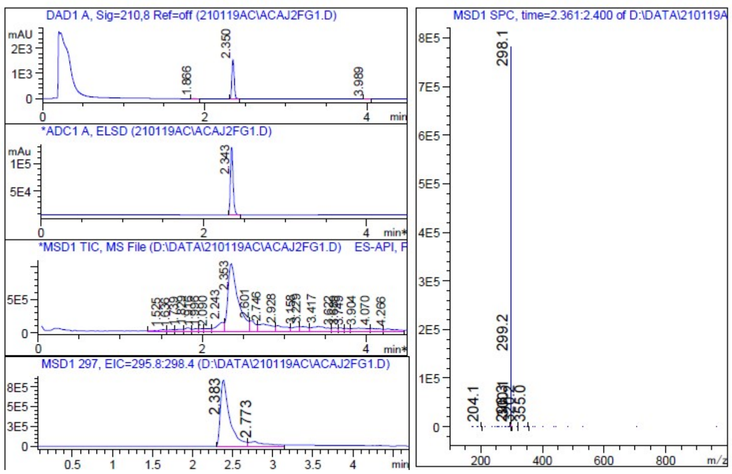
Protocol executed on smaller scale (0.2 mmol imine). 2.5 mg product obtained. LC-MS data – Ret. time 1.86: MS ES+ *m/z* 314 ([M+H]$^+$).

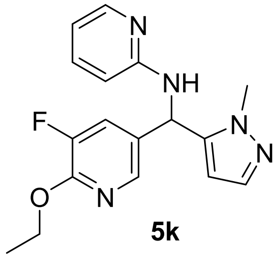




5j

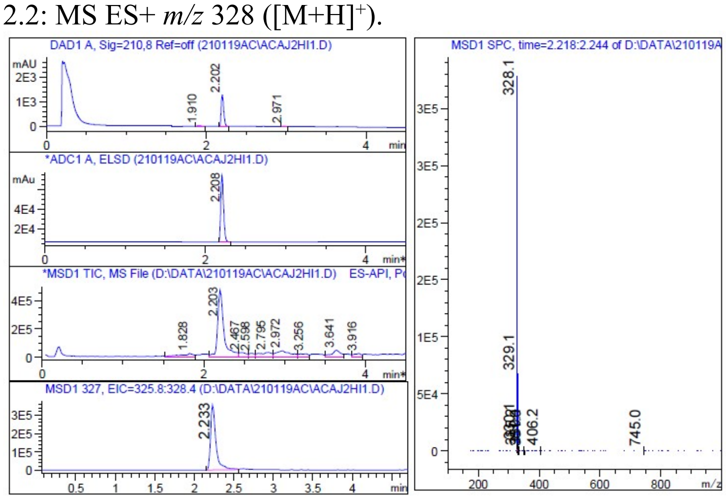
Protocol executed on smaller scale (0.2 mmol imine). 3.4 mg product obtained. LC-MS data – Ret. time 2.35: MS ES+ *m/z* 298 ([M+H]$^+$).



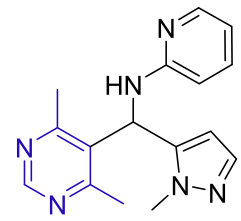


5k

Protocol executed on smaller scale (0.2 mmol imine). 1.1 mg product obtained. LC-MS data – Ret. time 2.2: MS ES+ *m/z* 328 ([M+H]$^+$).

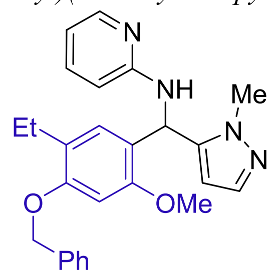


*N-((4,6-dimethylpyrimidin-5-yl)(1-methyl-1H-pyrazol-5-yl)methyl)pyridin-2-amine (**5l**)*

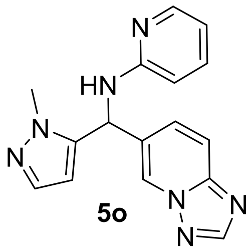


47 mg isolated according to General Library Procedure C. ^{1}H NMR (400 MHz, CHLOROFORM-*d*) δ ppm 8.87 (s, 1 H), 8.06-8.05 (d, *J*=4.29 Hz, 1 H), 7.45-7.38 (m, 2 H), 6.78-6.76 (d, *J*=7.80 Hz, 1 H), 6.66-6.63 (t, *J*=5.85 Hz, 1 H), 6.43-6.41 (d, *J*=7.80 Hz, 1 H), 5.85-5.84 (d, *J*=1.56 Hz, 1 H), 5.02-5.01 (d, *J*=5.85 Hz, 1 H), 3.85 (s, 3 H), 2.65 (s, 6 H); ^{13}C NMR (101 MHz, CHLOROFORM-*d*) δ ppm 164.98, 156.60, 155.97, 148.06, 139.88, 138.29, 137.78, 130.18, 114.33, 107.89, 106.68, 46.43, 37.13, 23.49; HRMS (ESI) m/z: [M + H]+ calculated for $C_{16}H_{18}N_6$, 295.1666; found, 295.1676.

*N-((4-(benzyloxy)-5-ethyl-2-methoxyphenyl)(1-methyl-1H-pyrazol-5-yl)methyl)pyridin-2-amine (**5m**)*

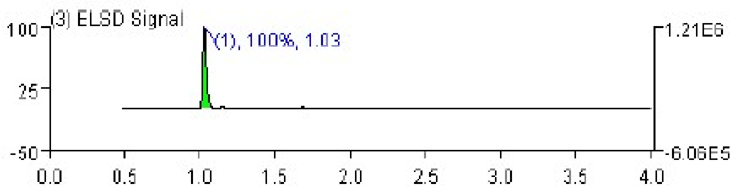


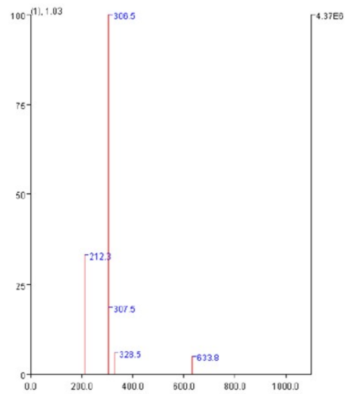
26 mg isolated according to General Library Procedure C. ^{1}H NMR (400 MHz, CHLOROFORM-*d*) δ ppm 8.09-8.08 (d, *J*=3.90 Hz, 1 H), 7.46-7.32 (m, *J*=53.90 Hz, 7 H), 7.02 (s, 1 H), 6.61-6.58 (t, *J*=5.85 Hz, 1 H), 6.53 (s, 1 H), 6.37-6.35 (d, *J*=8.20 Hz, 1 H), 6.29-6.27 (d, *J*=7.41 Hz, 1 H), 6.04 (d, *J*=1.56 Hz, 1 H), 5.10 (s, 2 H), 3.79 (d, *J*=3.12 Hz, 6 H), 2.61-2.56 (q, *J*=7.41 Hz, 2 H), 1.15-1.11 (t, *J*=7.41 Hz, 3 H); ^{13}C NMR (126 MHz, CHLOROFORM-*d*) δ ppm 157.01, 156.69, 155.43, 143.64, 137.69, 137.56, 136.90, 128.32, 128.11, 127.62, 126.83, 125.13, 119.22, 113.19, 107.08, 105.04, 96.55, 69.98, 55.59, 46.71, 36.50, 22.52, 14.24; HRMS (ESI) m/z: [M + H]+ calculated for $C_{26}H_{28}N_4O_2$, 429.2285; found, 429.2290.

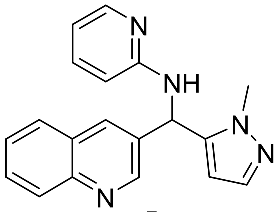


5o

4.2 mg product obtained. LC-MS data – Ret. time 1.03: MS ES+ *m/z* 306 ([M+H]$^+$).

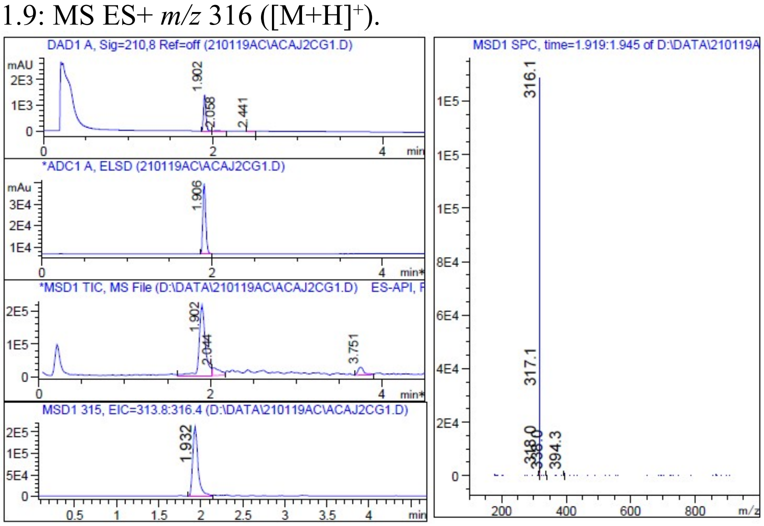


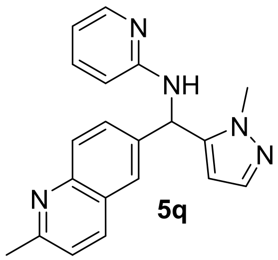




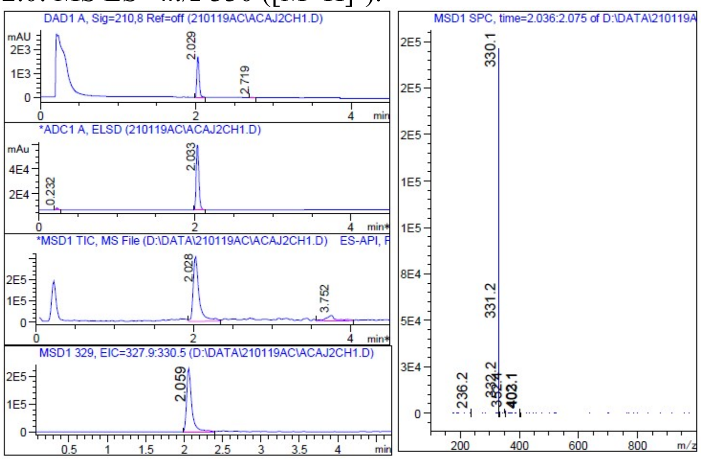
5p

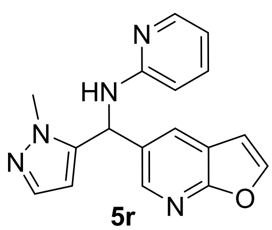
Protocol executed on smaller scale (0.2 mmol imine). 1.4 mg product obtained. LC-MS data – Ret. time 1.9: MS ES+ *m/z* 316 ([M+H]$^+$).



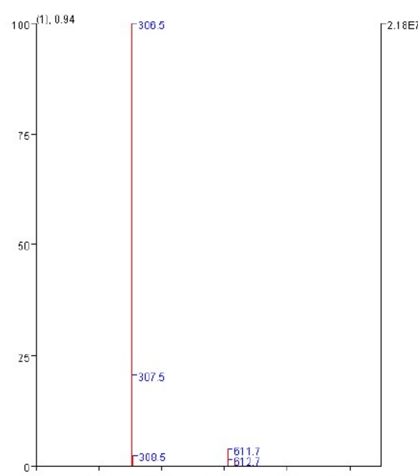


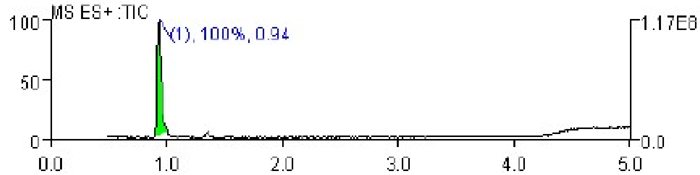
Protocol executed on smaller scale (0.2 mmol imine). 1.1 mg product obtained. LC-MS data – Ret. time 2.0: MS ES+ *m/z* 330 ([M+H]$^+$).



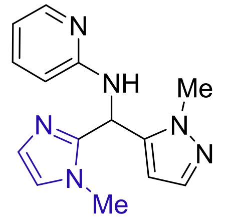


31 mg product obtained. LC-MS data – Ret. time 0.94: MS ES+ *m/z* 306 ([M+H]$^+$).

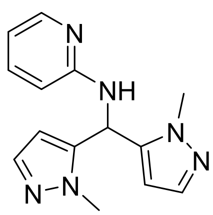




*N-((1-methyl-1H-imidazol-2-yl)(1-methyl-1H-pyrazol-5-yl)methyl)pyridin-2-amine (**5s**)*

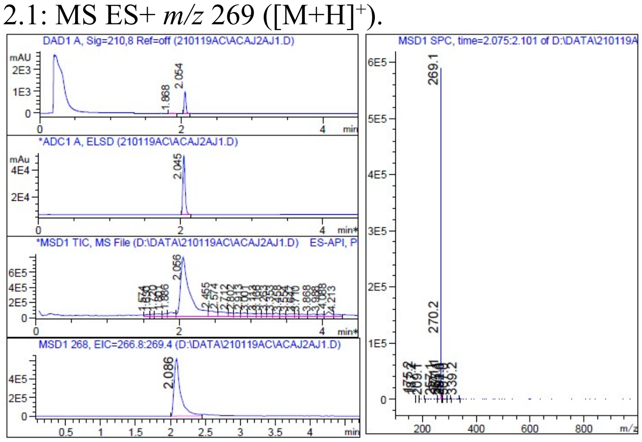


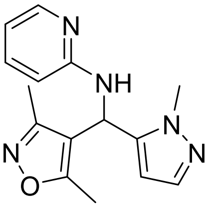
50 mg isolated according to General Library Procedure C. ^{1}H NMR (400 MHz, CHLOROFORM-*d*) δ ppm 8.08 - 8.07 (d, *J*=4.68 Hz, 1 H), 7.43 - 7.37 (dd, *J*=19.9 Hz, 1 H), 7.39-7.37 (dd, *J*=16.78, 1 H), 7.02 (s, 1 H), 6.85 (s, 1 H), 6.71 - 6.69 (d, *J*=8.2 Hz, 1 H), 6.64 - 6.61 (t, *J*=5.9, 5.9 Hz, 1 H), 6.59 - 6.57 (d, *J*=8.6 Hz, 1 H), 6.02 (d, *J*= 2 Hz, 1 H), 5.88 - 5.87 (d, *J*=7.81 Hz, 1 H), 3.94 (s, 3 H), 3.61 (s, 3 H); ^{13}C NMR (101 MHz, CHLOROFORM-*d*) δ ppm 156.75, 147.42, 146.51, 140.45, 138.44, 137.89, 126.70, 121.85, 114.49, 110.17, 106.48, 43.87, 37.37, 33.93; HRMS (ESI) m/z: [M + H]+ calculated for $C_{14}H_{16}N_6$, 269.1509; found, 269.1519.



5t

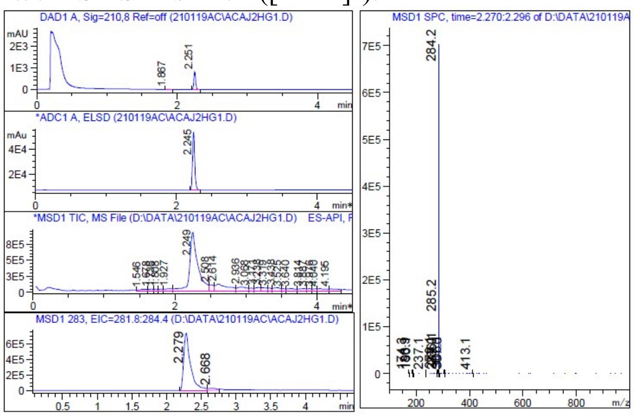
Protocol executed on smaller scale (0.2 mmol imine). 1.4 mg product obtained. LC-MS data – Ret. time 2.1: MS ES+ *m/z* 269 ([M+H]$^{+}$).

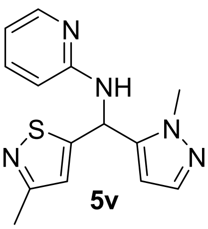




5u

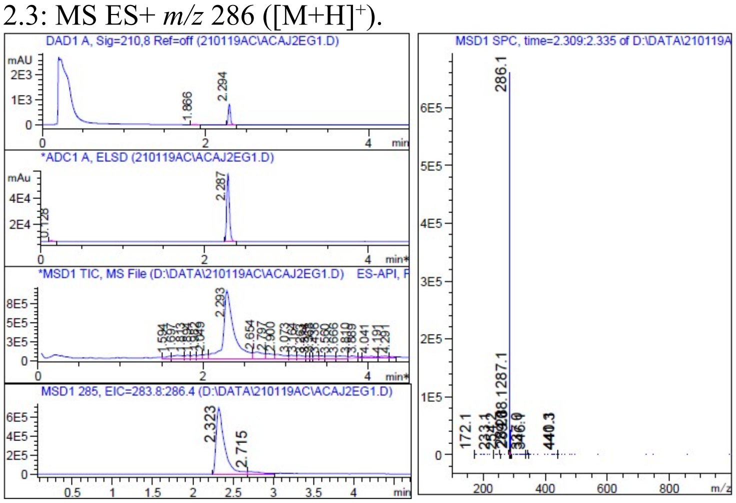
Protocol executed on smaller scale (0.2 mmol imine). 2.1 mg product obtained. LC-MS data – Ret. time 2.3: MS ES+ *m/z* 284 ([M+H]$^+$).

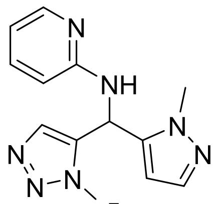




5v

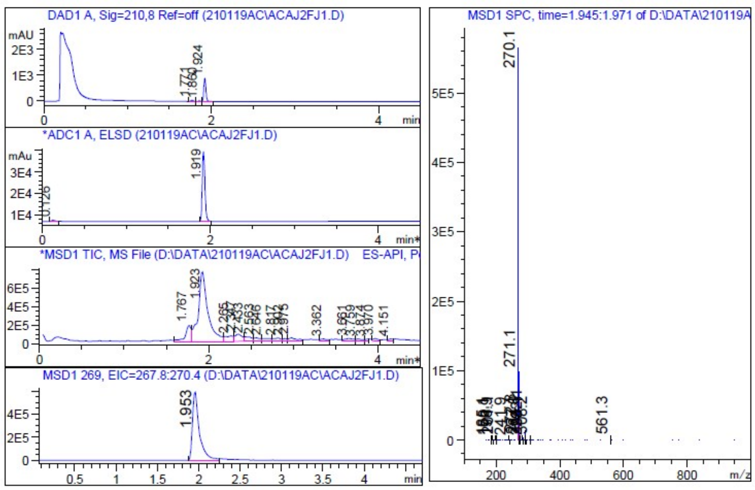
Protocol executed on smaller scale (0.2 mmol imine). 1.3 mg product obtained. LC-MS data – Ret. time 2.3: MS ES+ *m/z* 286 ([M+H]$^+$).

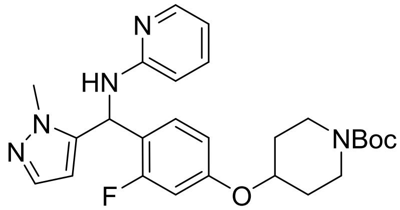




5w

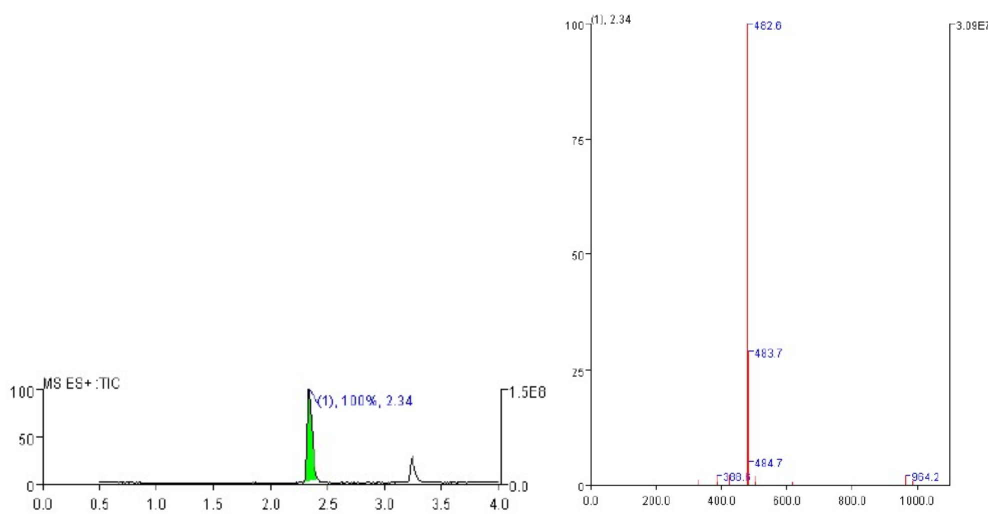
Protocol executed on smaller scale (0.2 mmol imine). 1.1 mg product obtained. LC-MS data – Ret. time 1.9: MS ES+ *m/z* 270 ([M+H]$^+$).

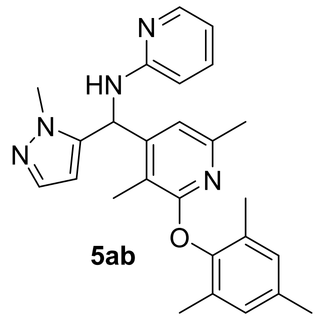




5y

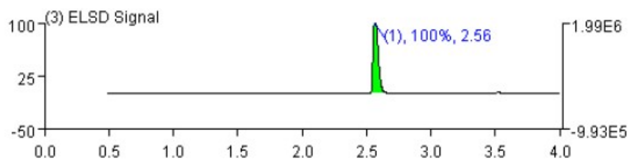
82 mg product obtained. LC-MS data – Ret. time 2.3: MS ES+ *m/z* 482 ([M+H]$^+$).

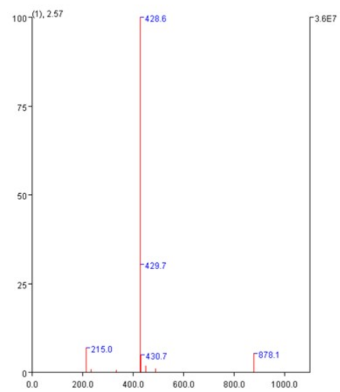


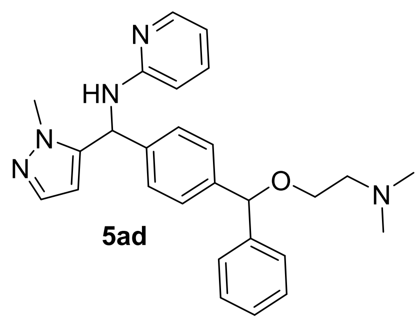


5ab

53 mg product obtained. LC-MS data – Ret. time 2.6: MS ES+ *m/z* 428 ([M+H]$^+$).

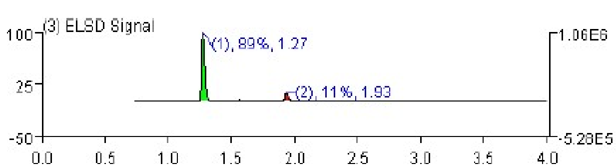


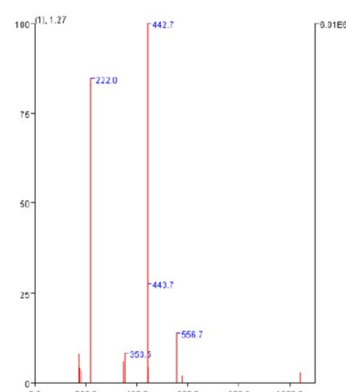




5ad

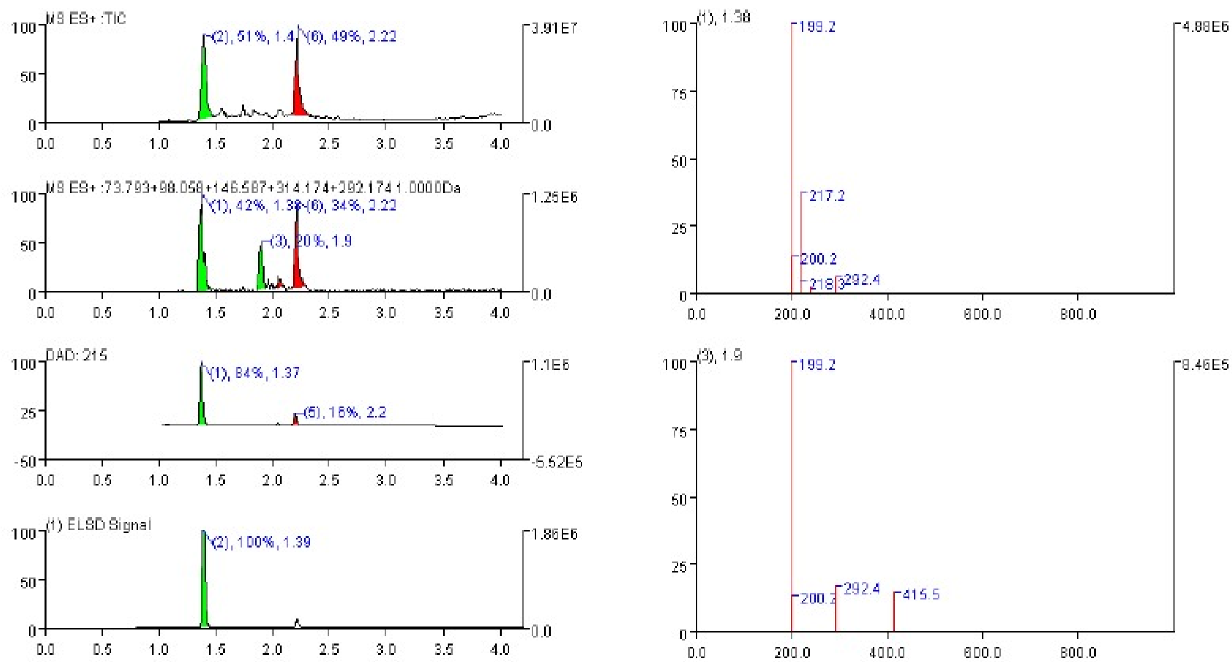
2.2 mg product obtained. LC-MS data – Ret. time 1.3: MS ES+ *m/z* 443 ([M+H]$^+$).



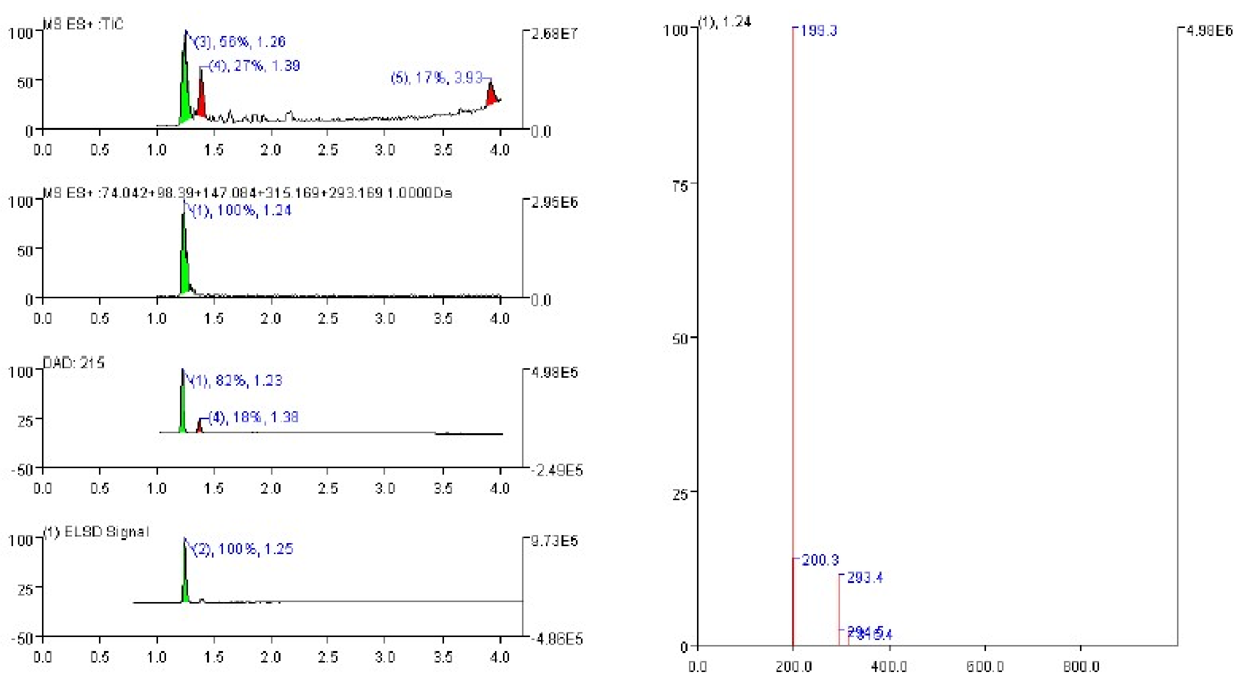


Characterization Data: Amine Diversity Set

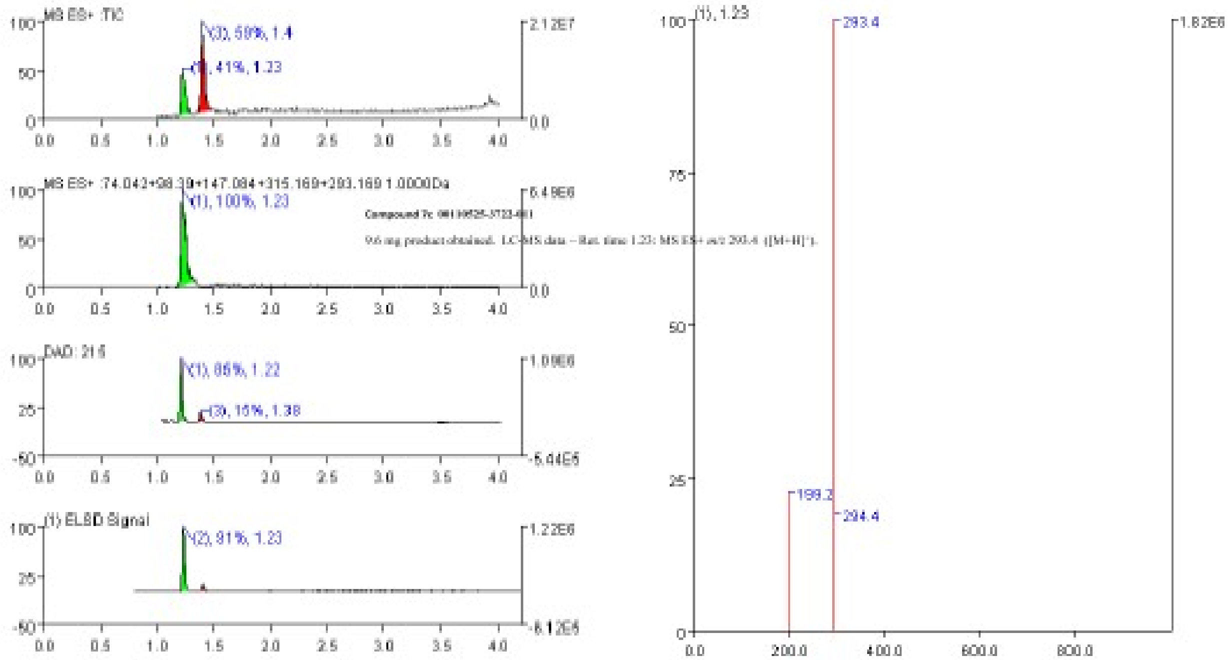
7a - 7.5 mg product obtained. LC-MS data – Ret. time 1.37: MS ES+ *m/z* 292.4 ([M+H]$^{+}$).



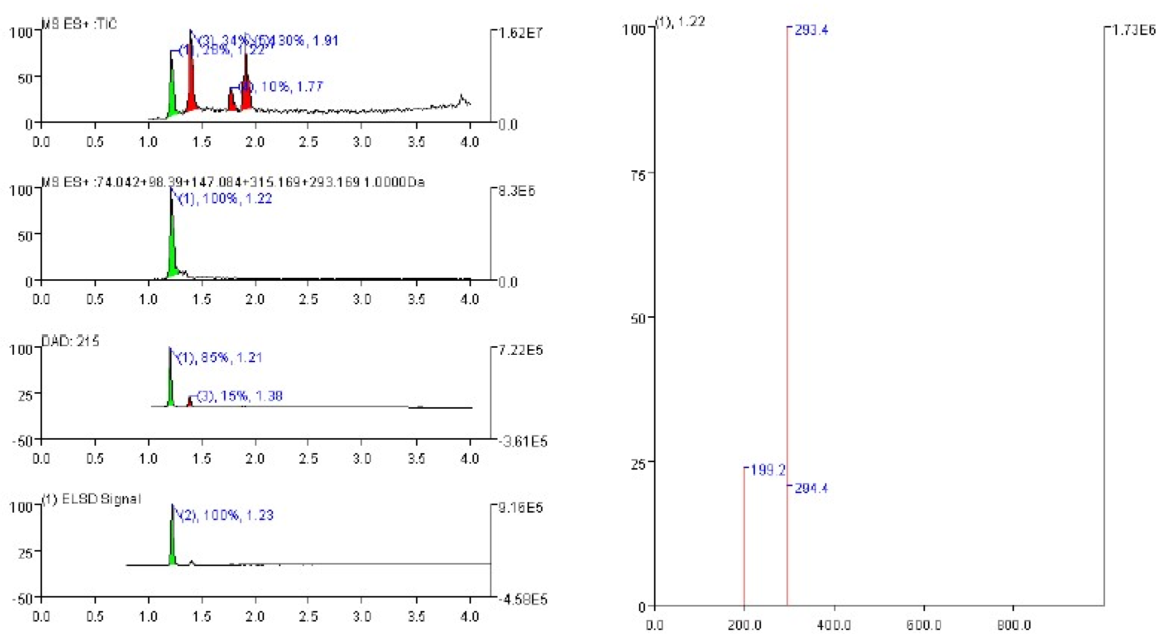
7b - 39.7 mg product obtained. LC-MS data – Ret. time 1.24: MS ES+ *m/z* 293.4 ([M+H]$^{+}$).



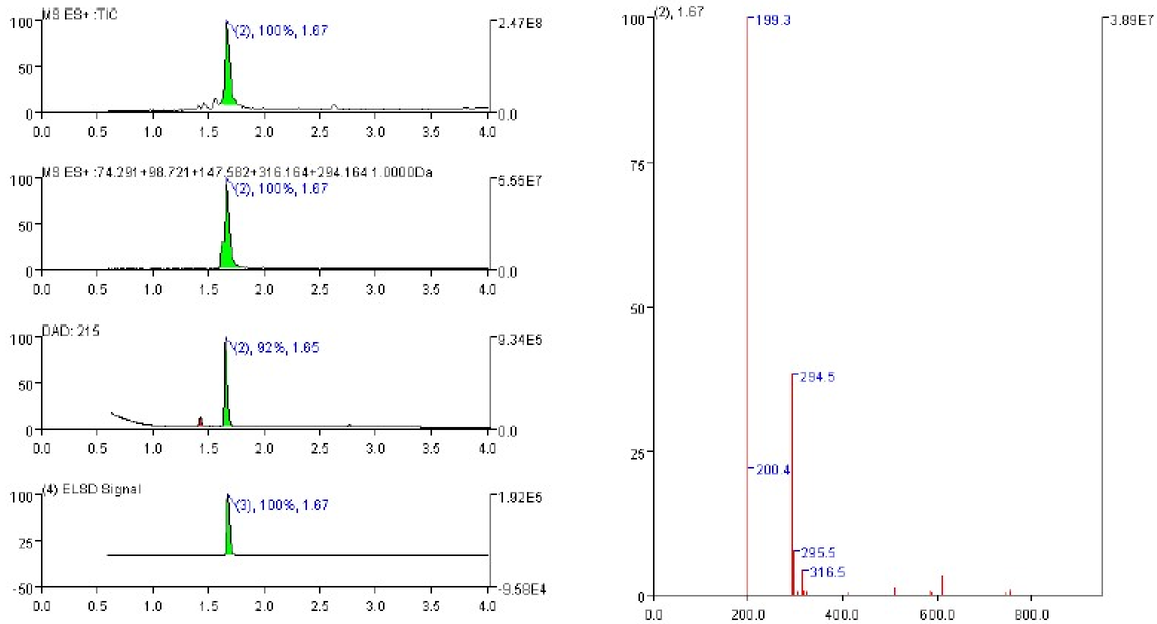
7c - 9.6 mg product obtained. LC-MS data – Ret. time 1.23: MS ES+ *m/z* 293.4 ([M+H]$^+$).



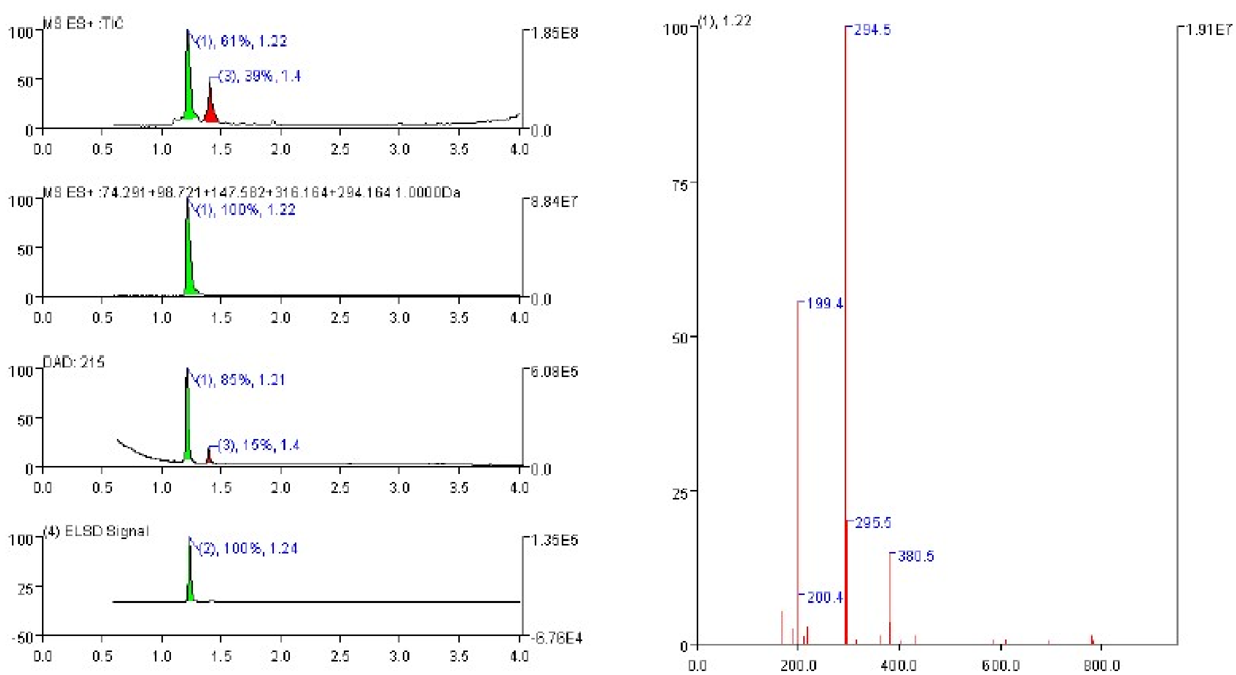
7d - 5.1 mg product obtained. LC-MS data – Ret. time 1.22: MS ES+ *m/z* 293.4 ([M+H]$^+$).



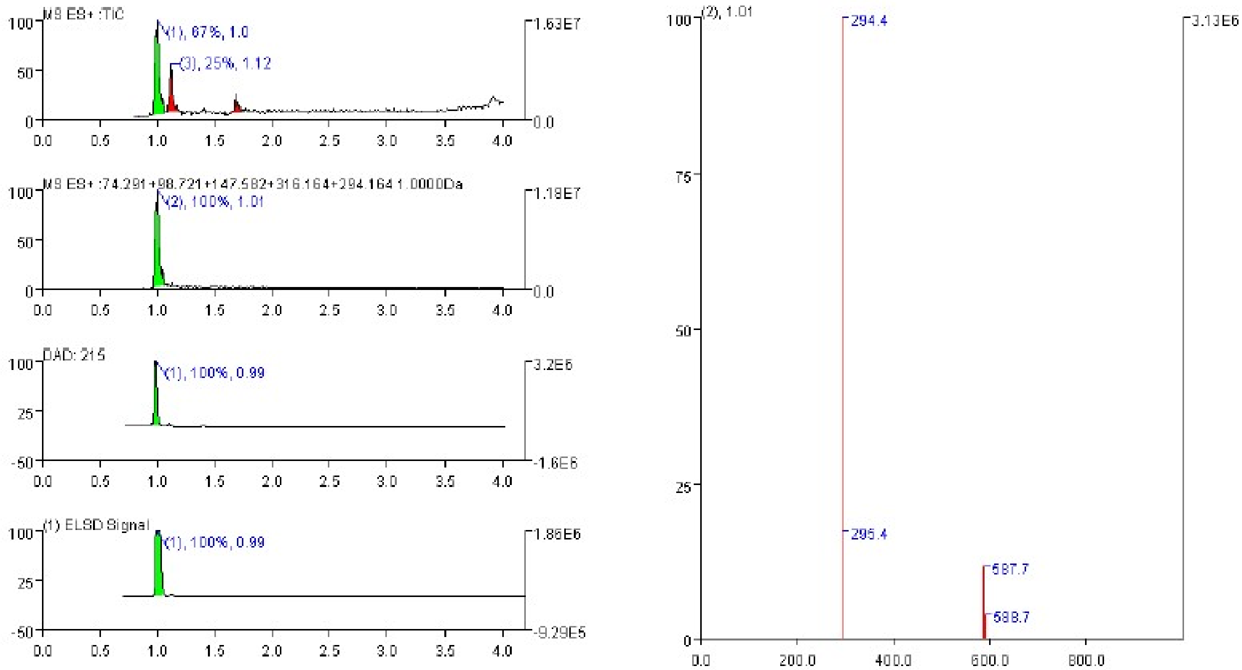
7e - 1.5 mg product obtained. LC-MS data – Ret. time 1.22: MS ES+ *m/z* 294.5 ([M+H]$^+$).



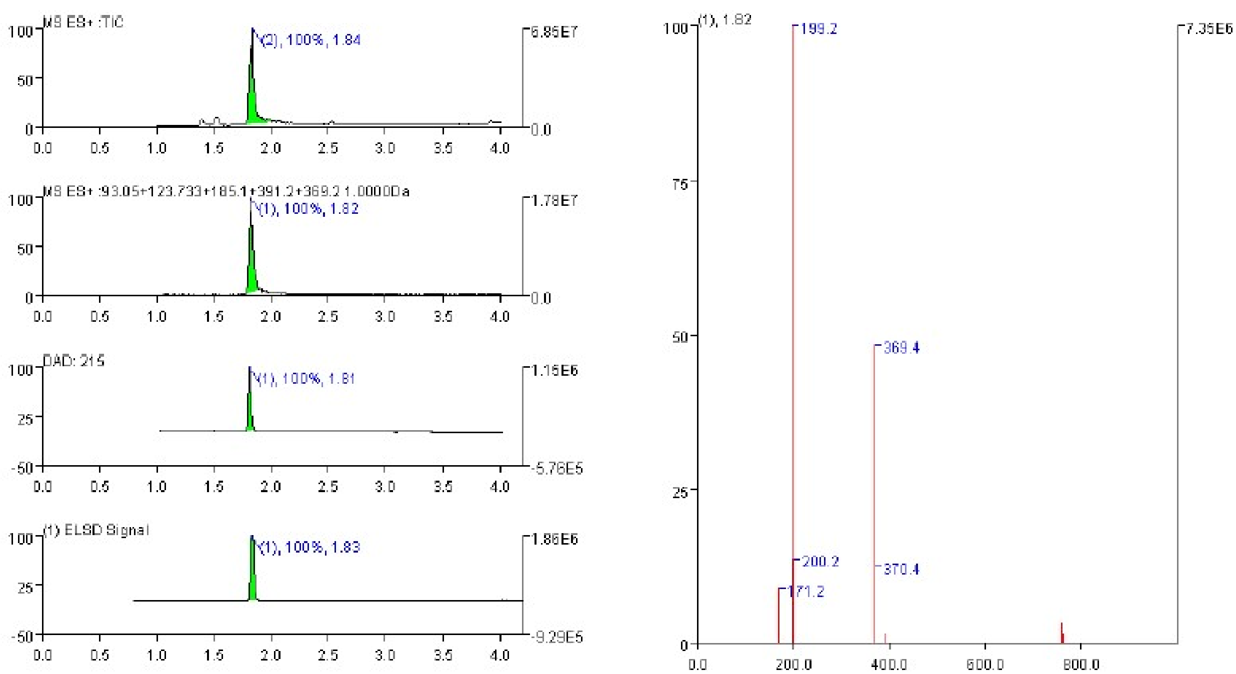
7f - 17.2 mg product obtained. LC-MS data – Ret. time 1.67: MS ES+ *m/z* 307.4 ([M+H]$^+$).



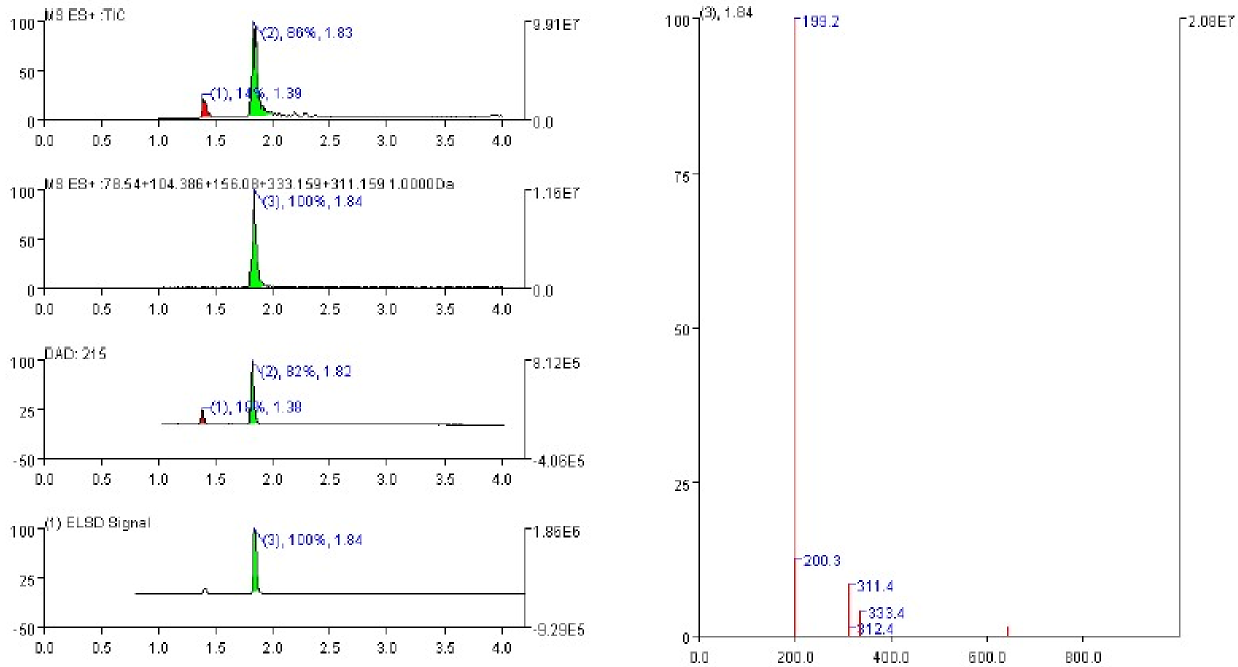
7g - 5.0 mg product obtained. LC-MS data – Ret. time 0.99: MS ES+ *m/z* 294.4 ([M+H]$^+$).



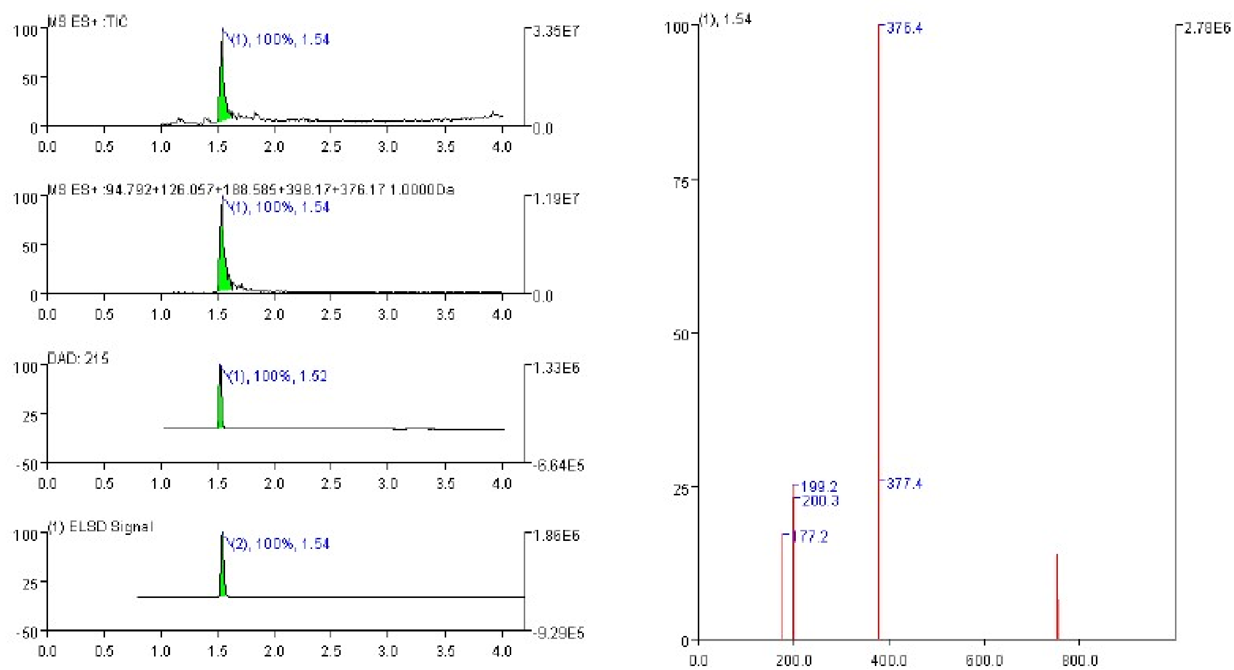
7h - 33.1 mg product obtained. LC-MS data – Ret. time 1.81: MS ES+ *m/z* 369.4 ([M+H]$^+$).



7i - 24.0 mg product obtained. LC-MS data – Ret. time 1.83: MS ES+ *m/z* 311.4 ([M+H]$^{+}$).

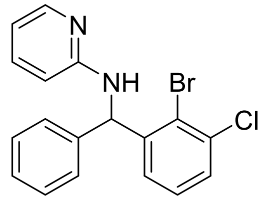


7j - 38.0 mg product obtained. LC-MS data – Ret. time 1.52: MS ES+ *m/z* 376.4 ([M+H]$^{+}$).



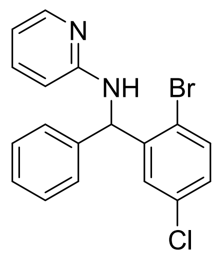
Characterization Data: Aldehyde Diversity Set

*N-((2-bromo-3-chlorophenyl)(phenyl)methyl)pyridin-2-amine (**9a**)*

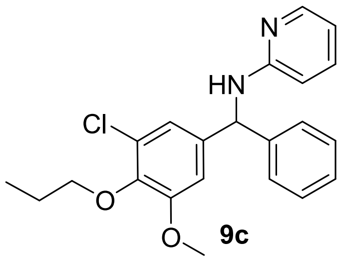


33 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ ppm 8.53 (br s, 1 H), 7.98 (d, *J*=5.46 Hz, 1 H), 7.73 (t, *J*=7.41 Hz, 1 H), 7.60 (d, *J*=7.80 Hz, 1 H), 7.27 - 7.48 (m, 7 H), 6.91 (d, *J*=8.20 Hz, 1 H), 6.76 (t, *J*=6.24 Hz, 1 H), 6.49 (d, *J*=6.63 Hz, 1 H); ^{13}C NMR (101 MHz, DMSO-d_6) δ ppm 158.68, 158.35, 154.44, 143.37, 140.53, 139.39, 134.36, 129.53, 128.90, 128.60, 128.06, 127.74, 127.15, 123.68, 112.85, 58.92; HRMS (ESI) m/z: [M + H]+ calculated for $C_{18}H_{14}BrClN_2$, 373.0102; found, 373.0095.

*N-((2-bromo-5-chlorophenyl)(phenyl)methyl)pyridin-2-amine (**9b**)*

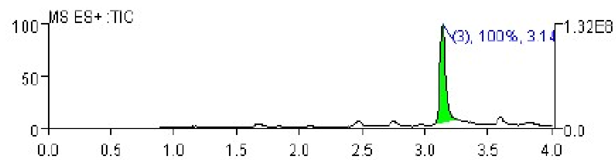


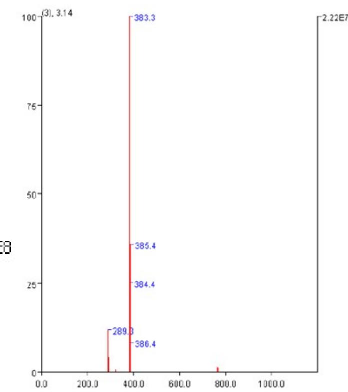
40 mg isolated according to General Library Procedure D. 1H NMR (400 MHz, DMSO-*d*6) δ ppm 8.34 (s, 1 H), 7.99 (d, *J*=4.68 Hz, 1 H), 7.69 (dd, *J*=8.20, 5.46 Hz, 2 H), 7.27 - 7.45 (m, 7 H), 6.87 (d, *J*=8.98 Hz, 1 H), 6.74 (t, *J*=6.24 Hz, 1 H), 6.47 (d, *J*=7.40 Hz, 1 H); 13C NMR (101 MHz, DMSO-*d*6) δ ppm 154.83, 143.04, 140.05, 139.48, 134.62, 132.75, 129.26, 128.64, 128.45, 127.86 (2 peaks), 127.72, 121.96, 112.92, 110.77, 57.68; HRMS (ESI) m/z: [M + H]+ calculated for $C_{18}H_{14}BrClN_2$, 373.0102; found, 373.0093.

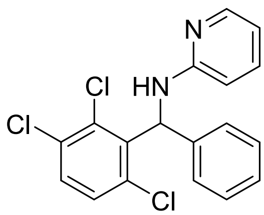


9c

48 mg product obtained. LC-MS data – Ret. time 3.14: MS ES+ *m/z* 383 ([M+H]$^+$).

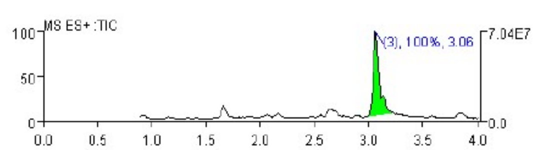


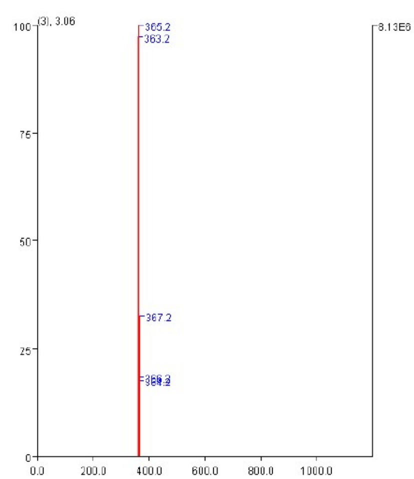


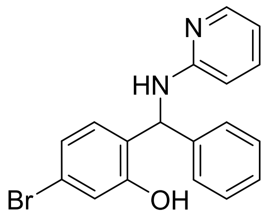


9d

38 mg product obtained. LC-MS data – Ret. time 3.06: MS ES+ *m/z* 363 ([M+H]$^+$).

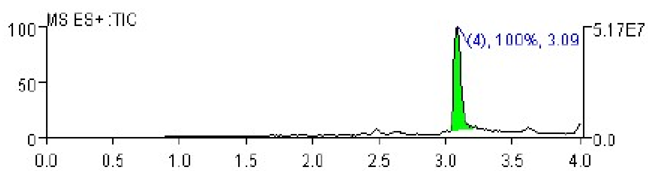


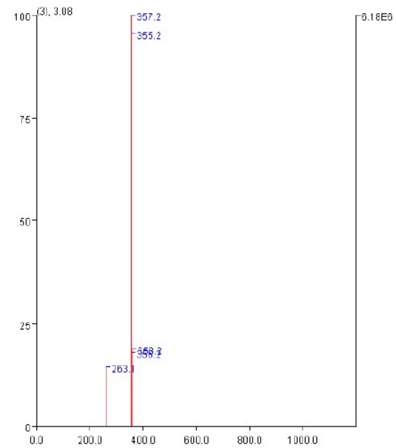


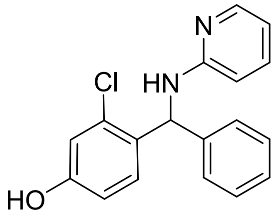


9e

70 mg product obtained. LC-MS data – Ret. time 3.09: MS ES+ *m/z* 355 ([M+H]$^+$).

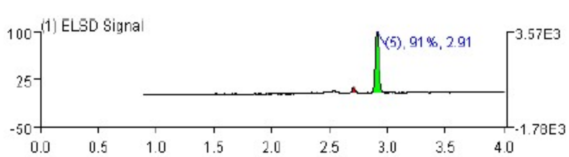


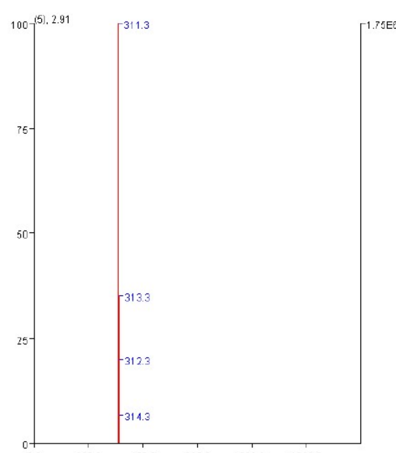


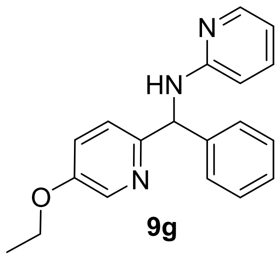


9f

5.6 mg product obtained. LC-MS data – Ret. time 2.91: MS ES+ *m/z* 311 ([M+H]$^+$).

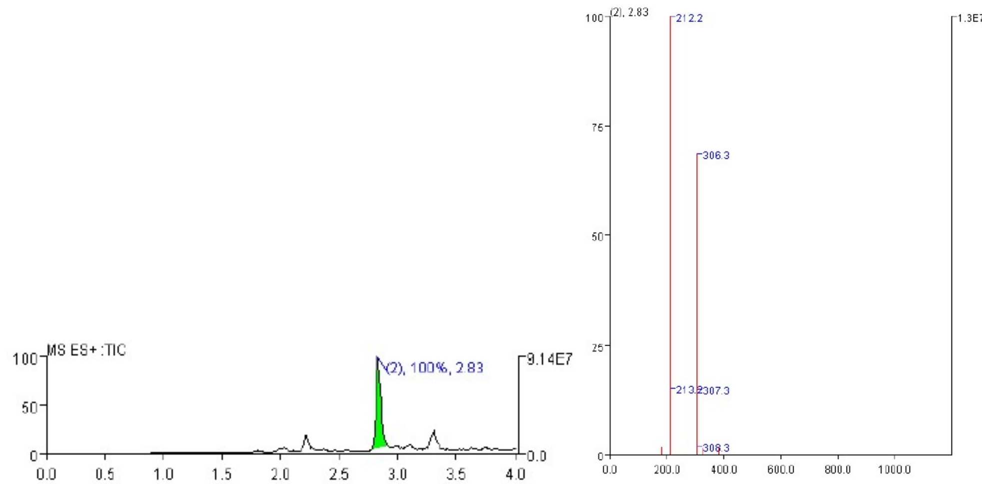


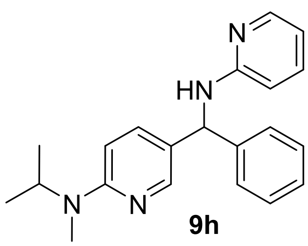




9g

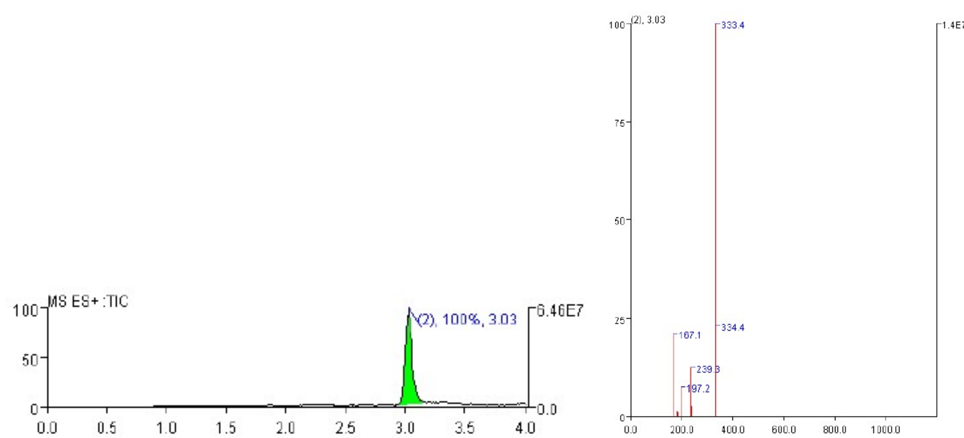
44 mg product obtained. LC-MS data – Ret. time 2.83: MS ES+ *m/z* 306 ([M+H]$^+$).

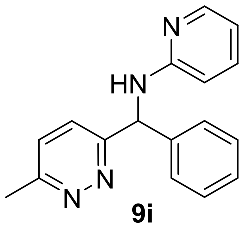




9h

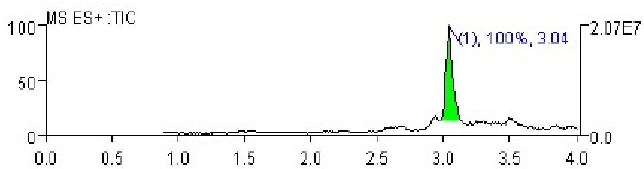
78 mg product obtained. LC-MS data – Ret. time 3.03: MS ES+ *m/z* 333 ([M+H]$^+$).

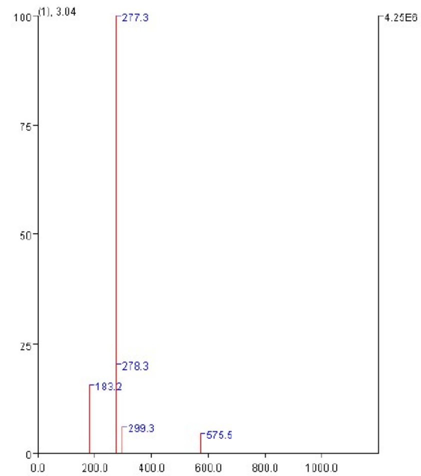


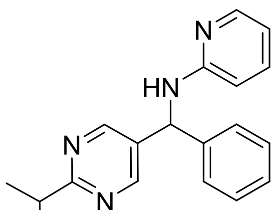


9i

29 mg product obtained. LC-MS data – Ret. time 3.04: MS ES+ *m/z* 277 ([M+H]$^+$).

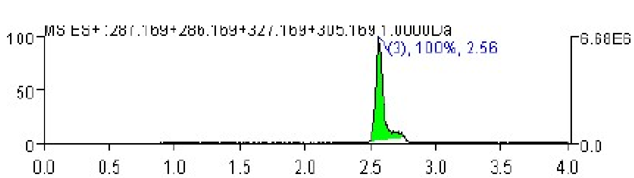


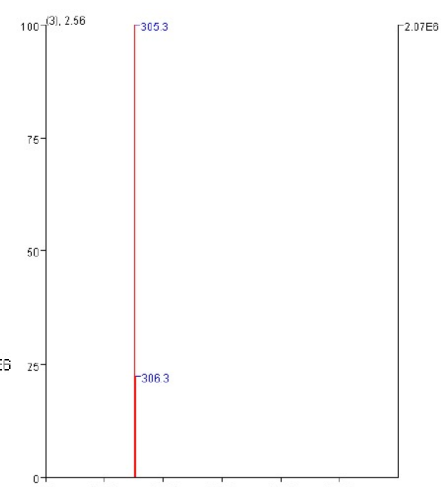




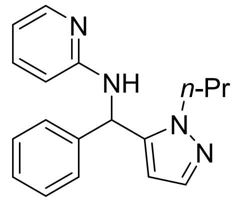
9j

4.5 mg product obtained. LC-MS data – Ret. time 2.56: MS ES+ *m/z* 305 ([M+H]$^+$).

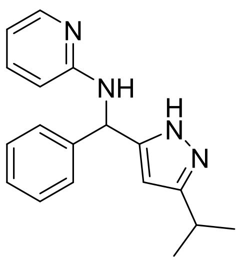




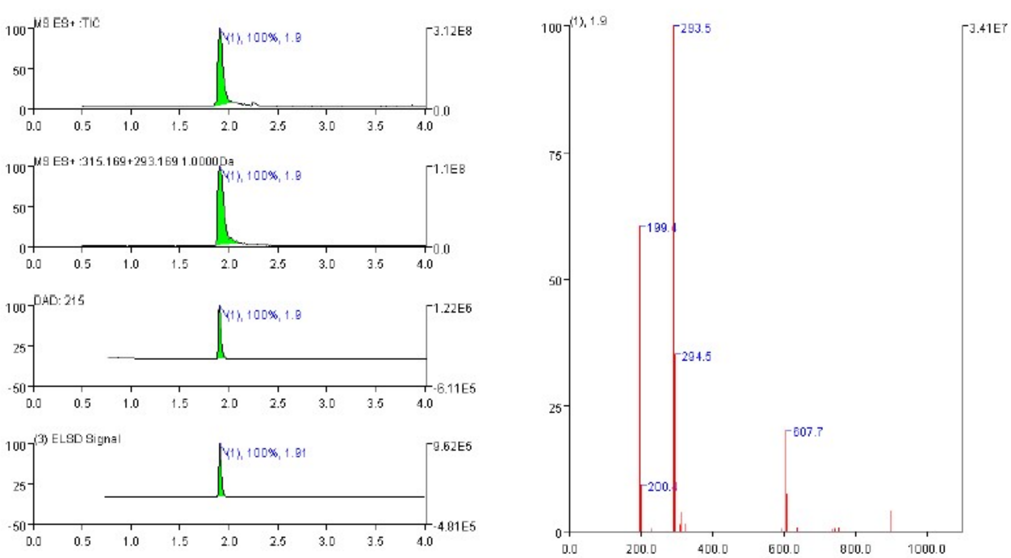
*N-(phenyl(1-propyl-1H-pyrazol-5-yl)methyl)pyridin-2-amine (**9l**)*



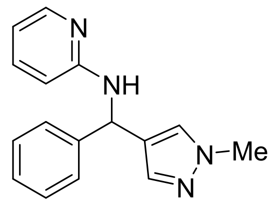
17 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 7.98 - 7.94 (m, 1H), 7.46 - 7.39 (m, 4H), 7.38 - 7.34 (m, 2H), 7.32 (d, *J* = 2.0 Hz, 1H), 7.31 - 7.25 (m, 1H), 6.66 (d, *J* = 8.2 Hz, 1H), 6.54 (d, *J* = 7.4 Hz, 1H), 6.53 - 6.48 (m, 1H), 5.86 (d, *J* = 1.6 Hz, 1H), 3.99 (t, *J* = 7.2 Hz, 2H), 1.75 - 1.60 (m, 2H), 0.75 (t, *J* = 7.4 Hz, 3H) ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 157.84, 147.77, 144.71, 142.05, 137.79, 137.30, 128.78, 127.80, 127.67, 112.86, 109.53, 105.42, 50.71, 49.78, 23.57, 11.43 HRMS (ESI) m/z:[M + H]$^+$ calcd for $C_{18}H_{20}N_4$, 293.1761; found, 293.1771.



9m: 26.9 mg product obtained. LC-MS data – Ret. time 1.90: MS ES+ *m/z* 293.4 ([M+H]$^+$).

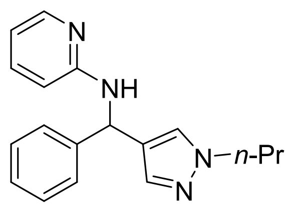


*N-((1-methyl-1H-pyrazol-4-yl)(phenyl)methyl)pyridin-2-amine (**9n**)*



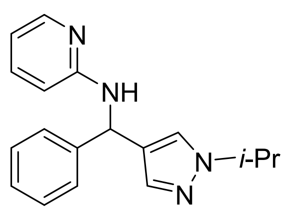
17 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.96 - 7.89 (m, 1H), 7.44 (s, 1H), 7.42 - 7.39 (m, 2H), 7.36 (ddd, *J* = 2.0, 6.9, 8.7 Hz, 1H), 7.33 - 7.28 (m, 2H), 7.27 (s, 1H), 7.24 - 7.17 (m, 2H), 6.61 (d, *J* = 8.6 Hz, 1H), 6.50 - 6.44 (m, 1H), 6.20 (d, *J* = 8.2 Hz, 1H), 3.82 - 3.73 (m, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.29, 147.84, 144.96, 137.77, 137.04, 129.39, 128.62, 127.23, 126.91, 124.84, 112.40, 109.29, 50.18, 38.88; HRMS (ESI) m/z:[M + H]$^+$ calcd for $C_{16}H_{16}N_4$, 265.1448; found, 265.1456.

N-(phenyl(1-propyl-1H-pyrazol-4-yl)methyl)pyridin-2-amine (**9o**)



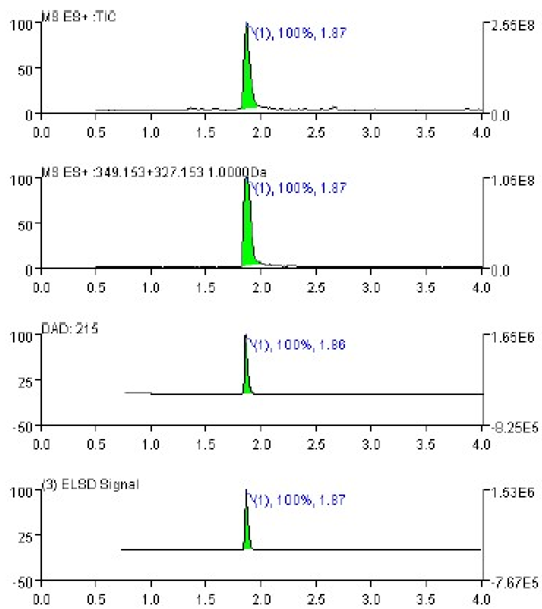
31 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.95 - 7.91 (m, 1H), 7.49 - 7.47 (m, 1H), 7.43 - 7.39 (m, 2H), 7.39 - 7.34 (m, 1H), 7.34 - 7.27 (m, 3H), 7.24 - 7.18 (m, 2H), 6.62 (d, *J* = 8.6 Hz, 1H), 6.49 - 6.44 (m, 1H), 6.24 - 6.20 (m, 1H), 4.01 - 3.95 (m, 2H), 1.73 (sxt, *J* = 7.2 Hz, 2H), 0.84 - 0.78 (m, 3H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.28, 147.80, 144.99, 137.72, 137.07, 128.62, 128.57, 127.25, 126.91, 124.34, 112.39, 109.29, 53.23, 50.20, 23.77, 11.45 HRMS (ESI) m/z:[M + H]$^+$ calcd for $C_{18}H_{20}N_4$, 293.1761; found, 293.1760.

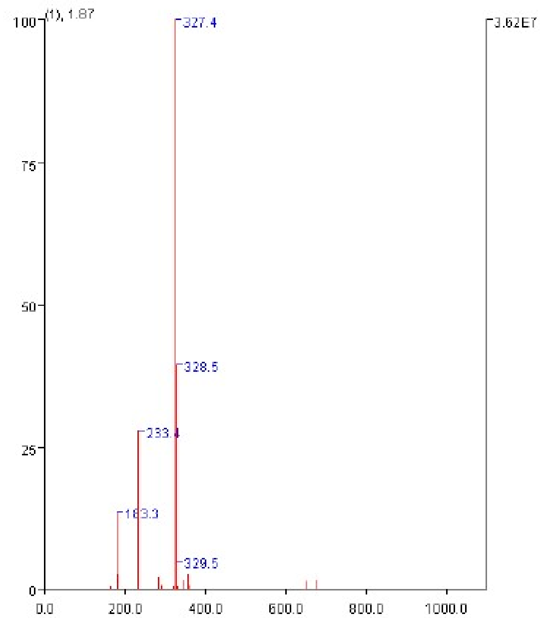
*N-((1-isopropyl-1H-pyrazol-4-yl)(phenyl)methyl)pyridin-2-amine (**9q**)*



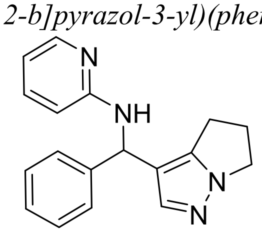
19 mg isolated according to General Library Procedure D. 1H NMR (400 MHz, DMSO-d6) δ = 7.94 - 7.90 (m, 1H), 7.54 (s, 1H), 7.44 - 7.39 (m, 2H), 7.39 - 7.34 (m, 1H), 7.33 - 7.27 (m, 3H), 7.24 (d, *J* = 8.6 Hz, 1H), 7.22 - 7.17 (m, 1H), 6.62 (d, *J* = 8.2 Hz, 1H), 6.46 (ddd, *J* = 1.0, 5.5, 6.4 Hz, 1H), 6.22 (d, *J* = 8.6 Hz, 1H), 4.49 - 4.38 (m, 1H), 1.37 (d, *J* = 6.6 Hz, 6H) 13C NMR (101 MHz, DMSO-d6) δ = 158.24, 147.79, 145.04, 137.36, 137.07, 128.63, 127.23, 126.89, 126.16, 124.12, 112.37, 109.29, 53.18, 50.24, 23.21; HRMS (ESI) m/z:[M + H]+ calcd for $C_{18}H_{20}N_4$, 293.1761; found, 293.1760.

9r - 28.5 mg product obtained. LC-MS data – Ret. time 1.92: MS ES+ *m/z* 327.4 ($[M+H]^+$).



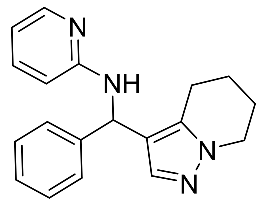


*N-((5,6-dihydro-4H-pyrrolo[1,2-b]pyrazol-3-yl)(phenyl)methyl)pyridin-2-amine (**9s**)*



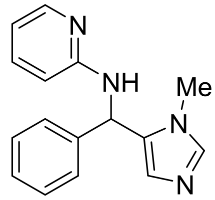
33 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.94 - 7.90 (m, 1H), 7.42 - 7.37 (m, 2H), 7.37 - 7.28 (m, 3H), 7.27 (s, 1H), 7.24 - 7.19 (m, 1H), 7.14 (d, *J* = 8.2 Hz, 1H), 6.62 (d, *J* = 8.6 Hz, 1H), 6.49 - 6.44 (m, 1H), 6.15 (d, *J* = 8.2 Hz, 1H), 4.00 - 3.93 (m, 2H), 2.47 - 2.35 (m, 4H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.36, 147.84, 144.47, 143.63, 141.98, 137.01, 128.57, 127.29, 126.92, 116.94, 112.34, 109.24, 50.39, 47.43, 26.20, 22.57 HRMS (ESI) m/z:[M + H]+ calcd for $C_{18}H_{18}N_4$, 291.1604; found, 291.1610.

*N-(phenyl(4,5,6,7-tetrahydropyrazolo[1,5-a]pyridin-3-yl)methyl)pyridin-2-amine (**9t**)*



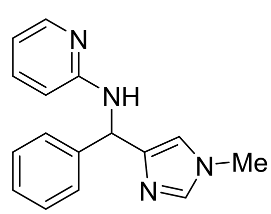
6.5 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 7.94 - 7.89 (m, 1H), 7.39 - 7.34 (m, 3H), 7.34 - 7.33 (m, 1H), 7.34 - 7.28 (m, 2H), 7.23 - 7.17 (m, 1H), 7.14 - 7.09 (m, 2H), 6.61 (d, *J* = 8.6 Hz, 1H), 6.48 - 6.43 (m, 1H), 6.13 (d, *J* = 8.2 Hz, 1H), 4.00 (t, *J* = 6.0 Hz, 2H), 2.59 (t, *J* = 6.4 Hz, 2H), 1.95 - 1.87 (m, 2H), 1.78 - 1.70 (m, 2H) ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 158.35, 147.81, 144.43, 137.31, 137.02, 136.35 - 136.20 (m, 1C), 128.54, 128.64 - 128.49 (m, 1C), 127.26, 127.35 - 127.11 (m, 1C), 126.80, 119.59, 112.27, 109.19, 49.66, 47.88, 23.29, 21.74, 20.18 HRMS (ESI) m/z:[M + H]+ calcd for $C_{19}H_{20}N_4$, 305.1761; found, 305.1763.

*N-((1-methyl-1H-imidazol-5-yl)(phenyl)methyl)pyridin-2-amine (**9u**)*



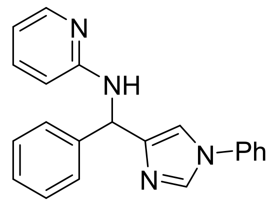
17 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 7.97 - 7.92 (m, 1H), 7.60 - 7.57 (m, 1H), 7.46 - 7.41 (m, 2H), 7.41 - 7.32 (m, 4H), 7.30 - 7.24 (m, 1H), 6.65 (d, *J* = 8.6 Hz, 1H), 6.53 - 6.47 (m, 1H), 6.38 (d, *J* = 8.6 Hz, 1H), 6.32 (s, 1H), 3.53 (s, 3H) ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 158.02, 147.79, 142.02, 139.04, 137.22, 134.12, 128.63, 128.03, 127.70, 127.49, 112.75, 109.45, 49.30, 31.69 HRMS (ESI) m/z:[M + H]+ calcd for $C_{16}H_{16}N_4$, 265.1448; found, 265.1454.

*N-((1-methyl-1H-imidazol-4-yl)(phenyl)methyl)pyridin-2-amine (**9v**)*



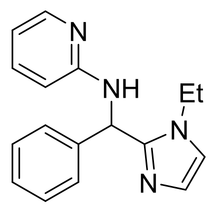
15 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d$_6$) δ = 7.95 - 7.89 (m, 1H), 7.50 (d, *J* = 1.2 Hz, 1H), 7.43 - 7.39 (m, 2H), 7.37 - 7.32 (m, 1H), 7.30 - 7.25 (m, 2H), 7.21 - 7.15 (m, 1H), 7.02 (d, *J* = 8.2 Hz, 1H), 6.86 - 6.83 (m, 1H), 6.64 (d, *J* = 8.6 Hz, 1H), 6.48 - 6.43 (m, 1H), 6.12 (d, *J* = 8.2 Hz, 1H), 3.60 - 3.57 (m, 3H) ^{13}C NMR (101 MHz, DMSO-d$_6$) δ = 158.35, 147.84, 144.52, 144.10, 137.97, 136.99, 128.36, 127.56, 126.75, 117.68, 112.29, 109.17, 53.07, 33.26 HRMS (ESI) m/z:[M + H]+ calcd for $C_{16}H_{16}N_4$, 265.1448; found, 265.1445.

N-(phenyl(1-phenyl-1H-imidazol-4-yl)methyl)pyridin-2-amine ***(9w)***



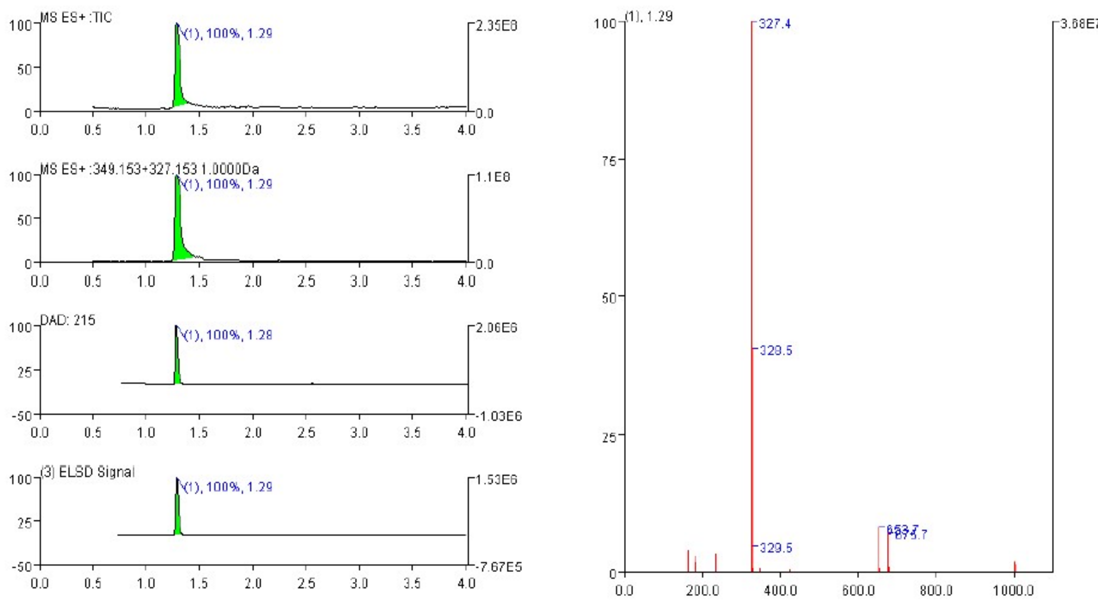
28 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.24 - 8.21 (m, 1H), 7.95 (dd, *J* = 1.4, 4.9 Hz, 1H), 7.63 - 7.59 (m, 2H), 7.55 (d, *J* = 0.8 Hz, 1H), 7.54 - 7.46 (m, 4H), 7.40 - 7.34 (m, 2H), 7.34 - 7.28 (m, 2H), 7.23 - 7.16 (m, 2H), 6.70 (d, *J* = 8.2 Hz, 1H), 6.51 - 6.45 (m, 1H), 6.28 (d, *J* = 8.2 Hz, 1H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.40 - 158.20 (m, 1C), 147.84, 145.50, 144.12, 137.31, 137.06, 135.71, 130.36, 128.46, 127.67, 127.27, 126.91, 120.61, 114.83, 112.44, 109.37, 52.85 HRMS (ESI) m/z:[M + H]+ calcd for $C_{21}H_{18}N_4$, 327.1604; found, 327.1614.

N-((1-ethyl-1H-imidazol-2-yl)(phenyl)methyl)pyridin-2-amine ***(9x)***

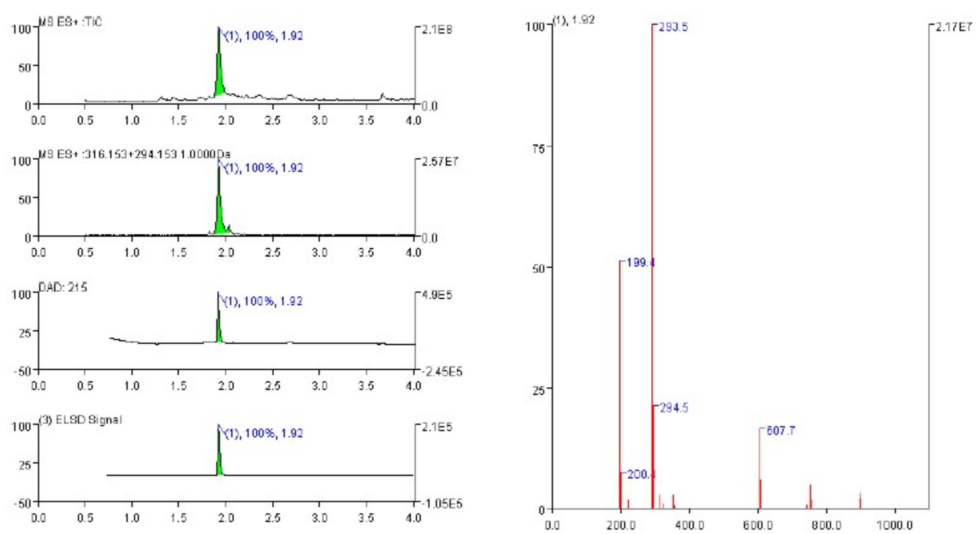


19 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.98 - 7.94 (m, 1H), 7.45 - 7.40 (m, 2H), 7.40 - 7.36 (m, 1H), 7.35 - 7.29 (m, 3H), 7.26 - 7.20 (m, 1H), 7.13 (d, *J* = 1.2 Hz, 1H), 6.86 - 6.83 (m, 1H), 6.75 - 6.70 (m, 1H), 6.52 - 6.47 (m, 2H), 0.00 (q, *J* = 7.0 Hz, 2H), 1.18 (t, *J* = 7.2 Hz, 3H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 157.89, 147.84, 147.71, 141.94, 137.15, 128.52, 128.14, 127.37, 127.19, 119.94, 112.75, 109.67, 50.35, 40.57, 16.53 HRMS (ESI) m/z:[M + Na]+ calcd for $C_{17}H_{18}N_4$, 301.1448; found, 301.1450.

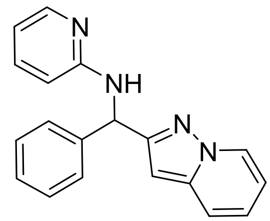
9y - 30 mg product obtained. LC-MS data – Ret. time 1.29: MS ES+ *m/z* 327 ([M+H]$^+$).



9z - 1.4 mg product obtained. LC-MS data – Ret. time 1.92: MS ES+ *m/z* 293.5 ([M+H]$^+$).

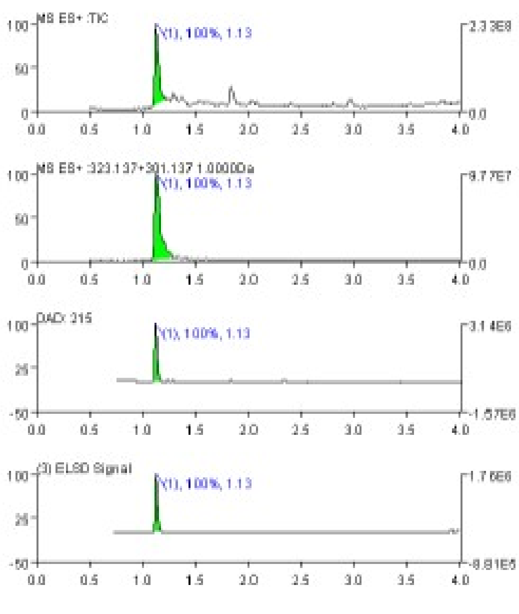


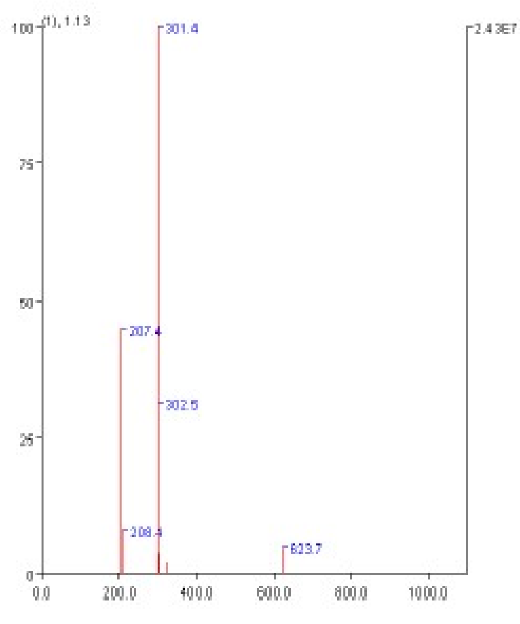
N-(phenyl(pyrazolo[1,5-a]pyridin-2-yl)methyl)pyridin-2-amine ***(9aa)***



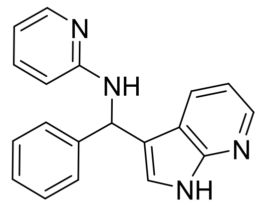
16 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.62 - 8.57 (m, 1H), 7.97 - 7.92 (m, 1H), 7.64 - 7.59 (m, 1H), 7.49 - 7.44 (m, 2H), 7.44 - 7.36 (m, 2H), 7.34 - 7.29 (m, 2H), 7.25 - 7.19 (m, 1H), 7.19 - 7.14 (m, 1H), 6.86 - 6.80 (m, 1H), 6.74 - 6.70 (m, 1H), 6.55 - 6.51 (m, 2H), 6.51 - 6.46 (m, 1H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.28, 157.42, 147.82, 143.66, 140.73, 137.14, 128.99, 128.62, 127.71, 127.17, 124.06, 118.24, 112.62, 112.19, 109.48, 95.38, 53.25 HRMS (ESI) m/z:[M + H]+ calcd for $C_{19}H_{16}N_4$, 301.1448; found, 301.1450.

9ab -1.9 mg product obtained. LC-MS data – Ret. time 1.13: MS ES+ *m/z* 301.4 ([M+H]$^+$).





N-(phenyl(1H-pyrrolo[2,3-b]pyridin-3-yl)methyl)pyridin-2-amine ***(9ac)***

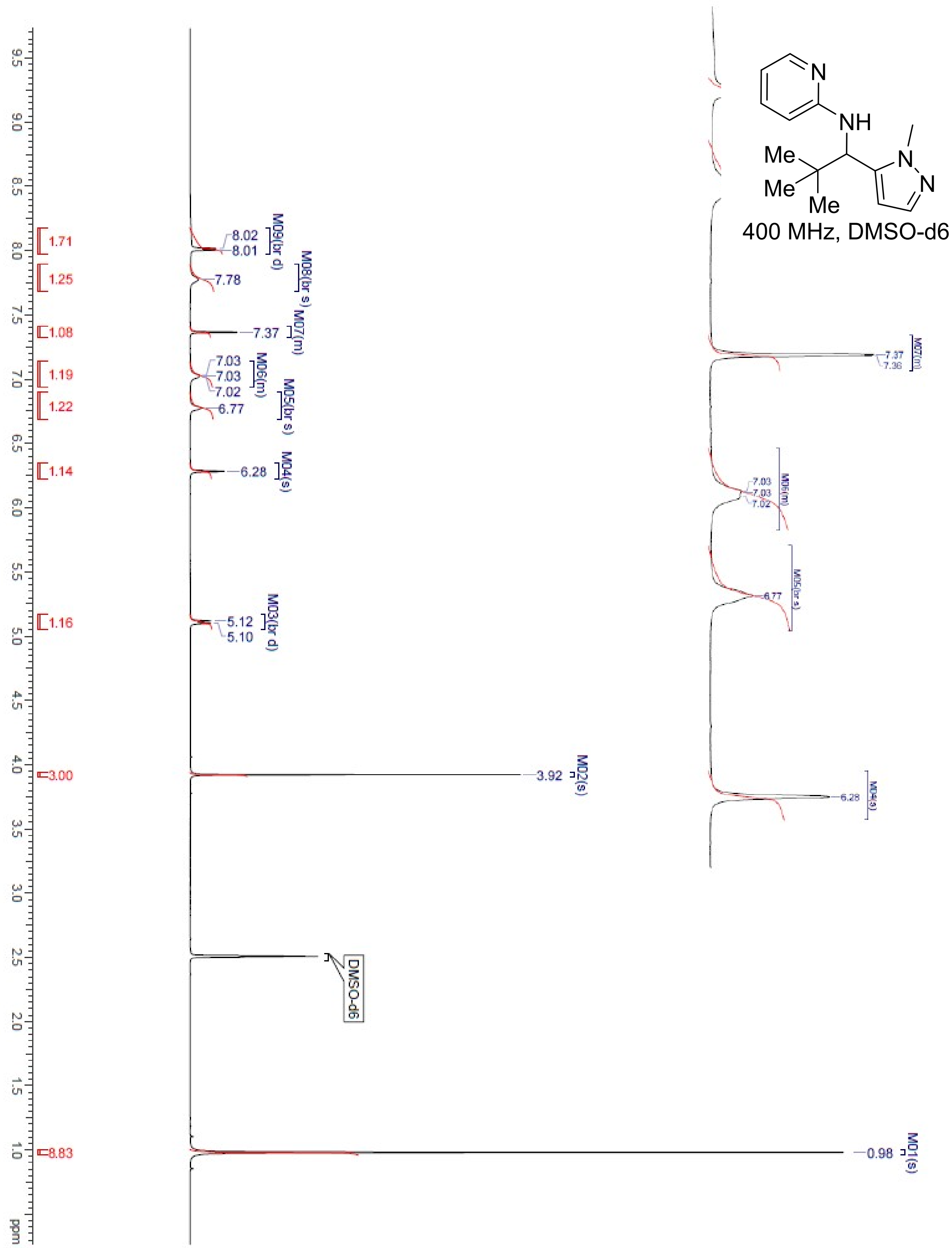


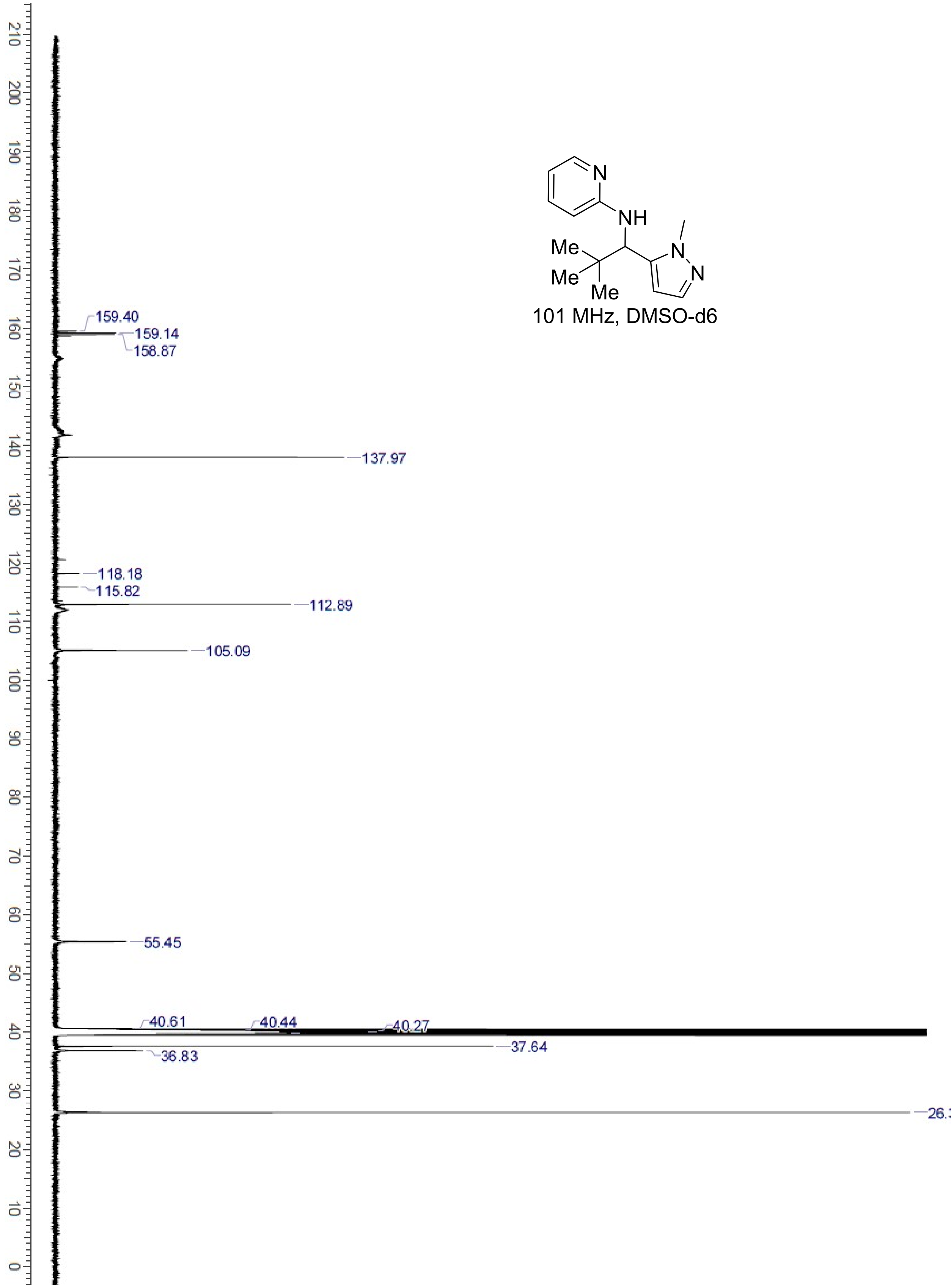
13 mg isolated according to General Library Procedure D. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 11.49 - 11.42 (m, 1H), 8.22 - 8.16 (m, 1H), 7.99 - 7.93 (m, 1H), 7.76 (dd, *J* = 1.4, 8.0 Hz, 1H), 7.47 (d, *J* = 7.0 Hz, 2H), 7.40 - 7.35 (m, 1H), 7.35 - 7.27 (m, 3H), 7.25 - 7.20 (m, 1H), 7.12 (d, *J* = 2.0 Hz, 1H), 6.99 (dd, *J* = 4.7, 7.8 Hz, 1H), 6.68 - 6.64 (m, 1H), 6.56 - 6.52 (m, 1H), 6.50 - 6.46 (m, 1H) ^{13}C NMR (101 MHz, DMSO-d_6) δ = 158.49, 149.28, 147.88, 144.24, 143.09, 137.09, 128.56, 127.75, 127.59, 127.00, 124.00, 118.74, 116.99, 115.53, 112.35, 109.27, 51.47 HRMS (ESI) m/z:[M + H]+ calcd for $C_{19}H_{16}N_4$, 301.1448; found, 301.1451.

.

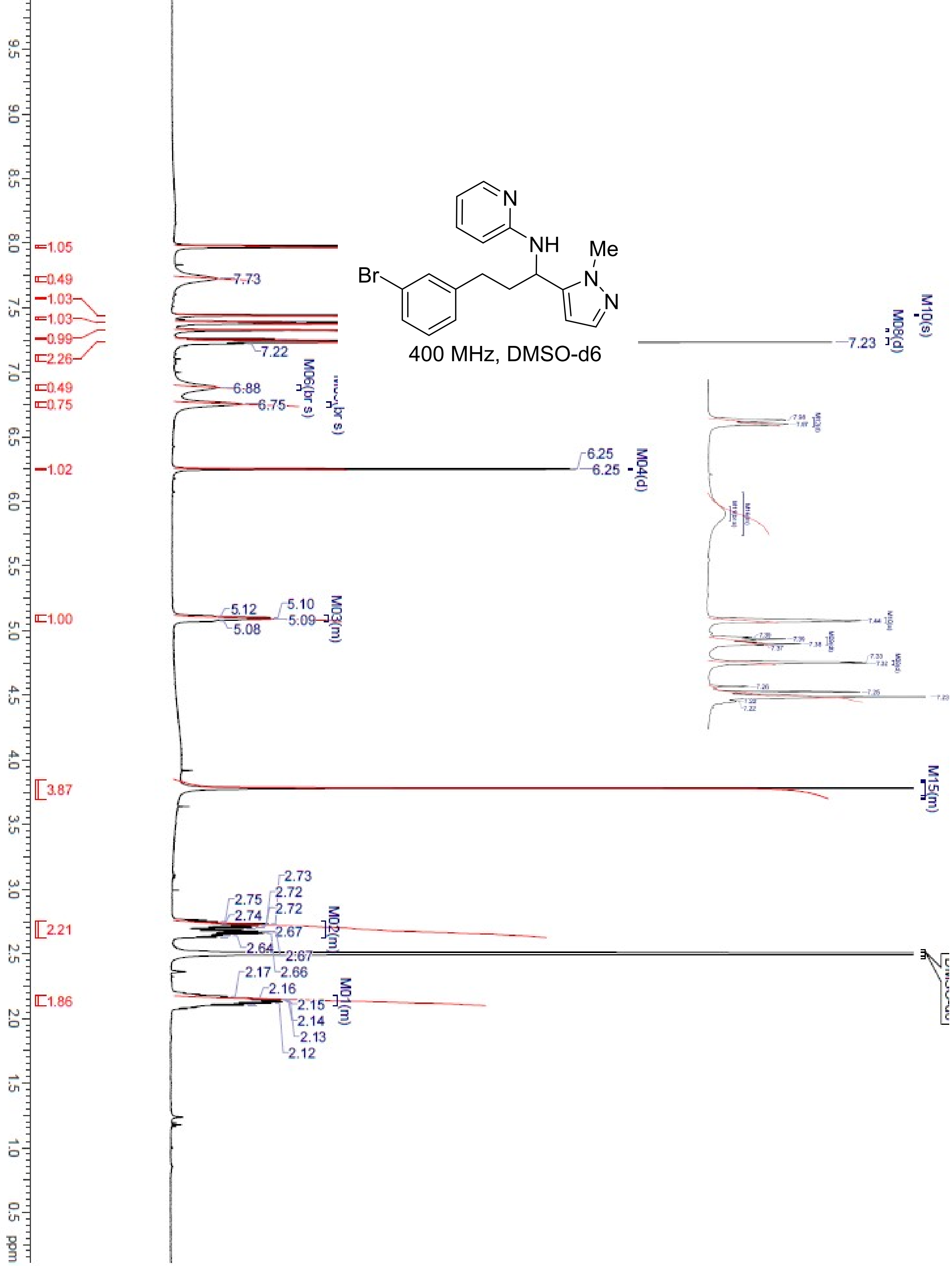
Copies of ^{1}H

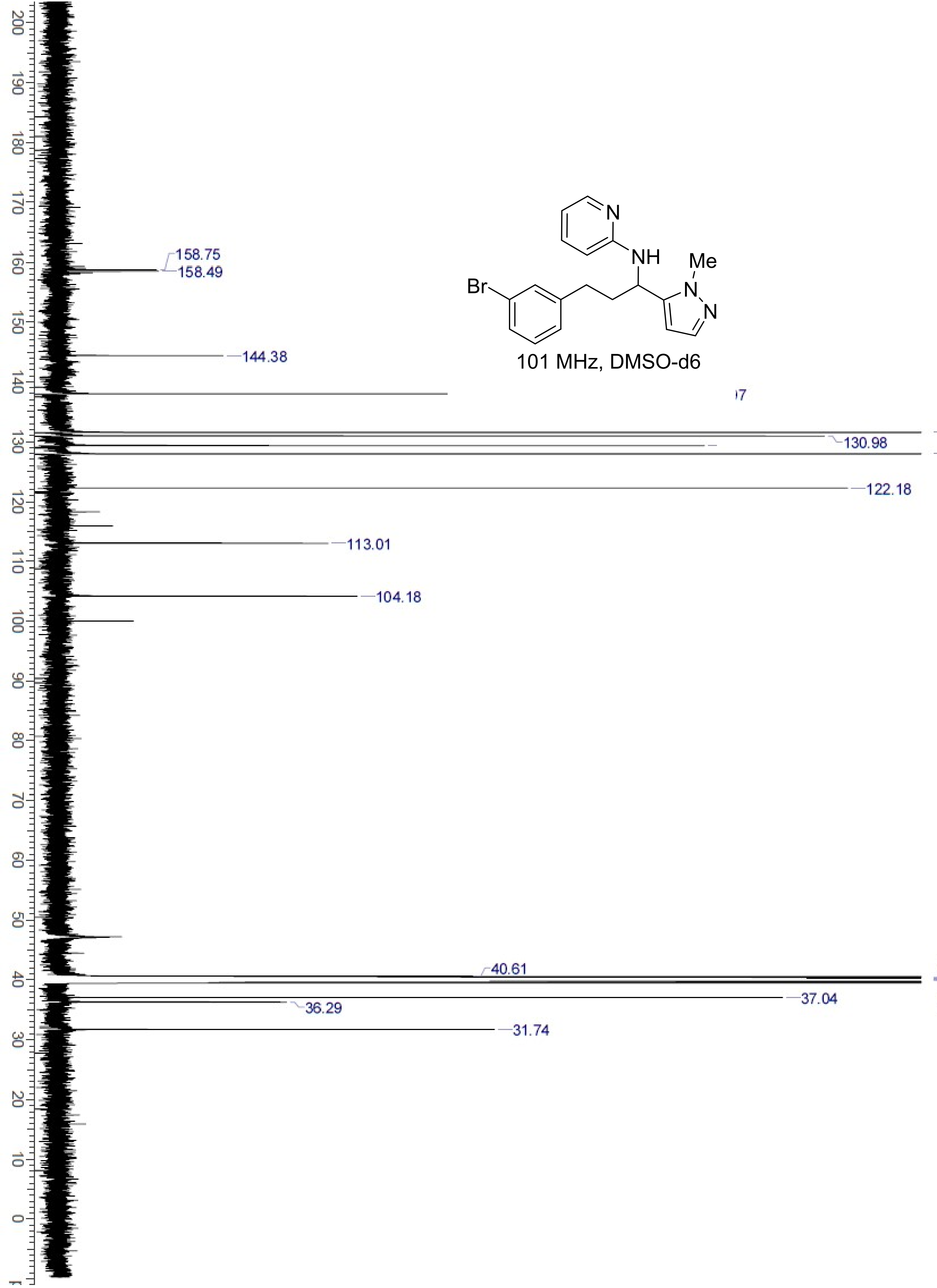
3a




N
NH
N
N
Me
Me
Me
101 MHz, DMSO-d6
159.40
159.14
158.87
137.97
118.18
115.82
112.89
105.09
55.45
40.61
40.44
40.27
37.64
36.83

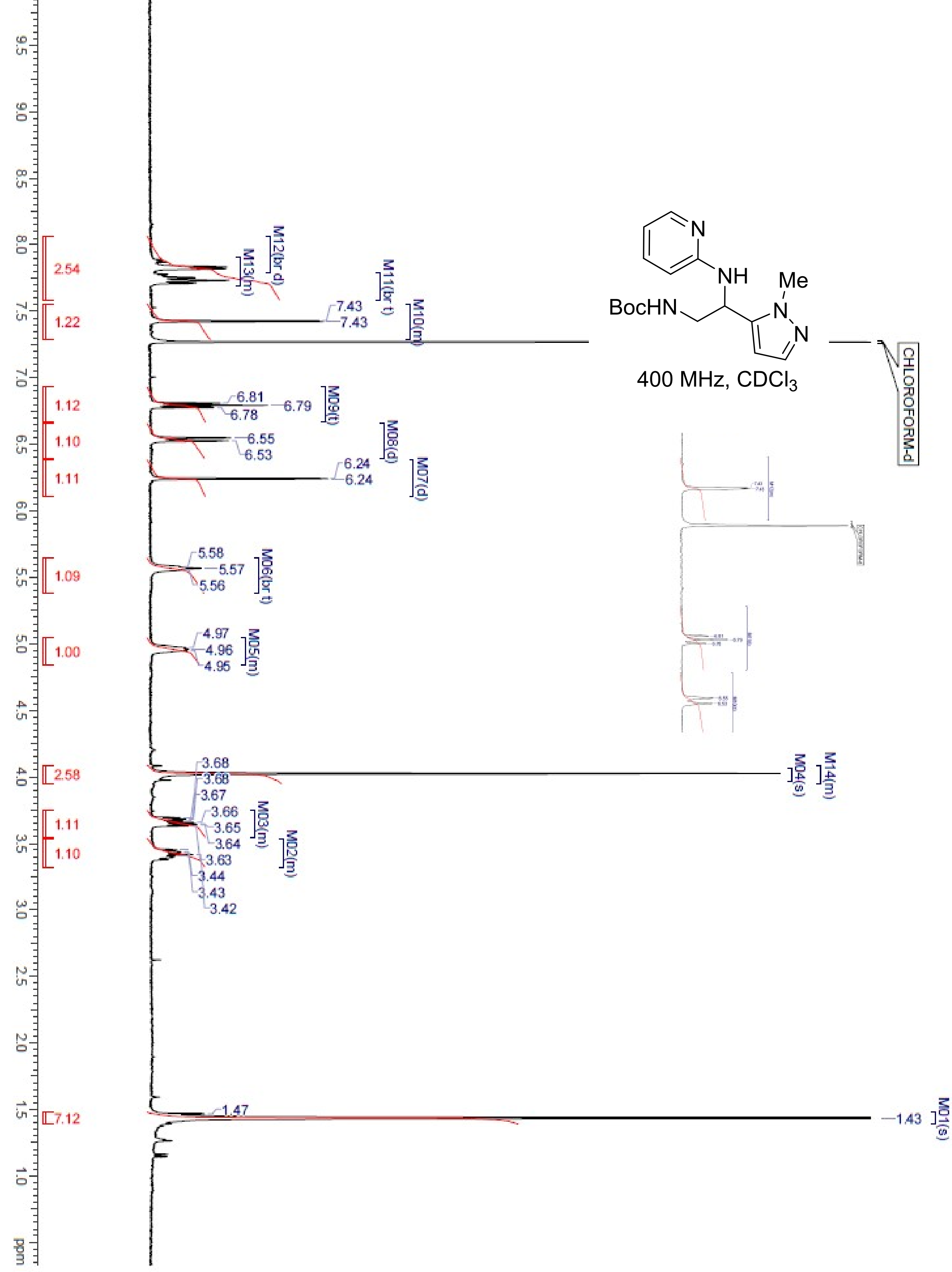
3b

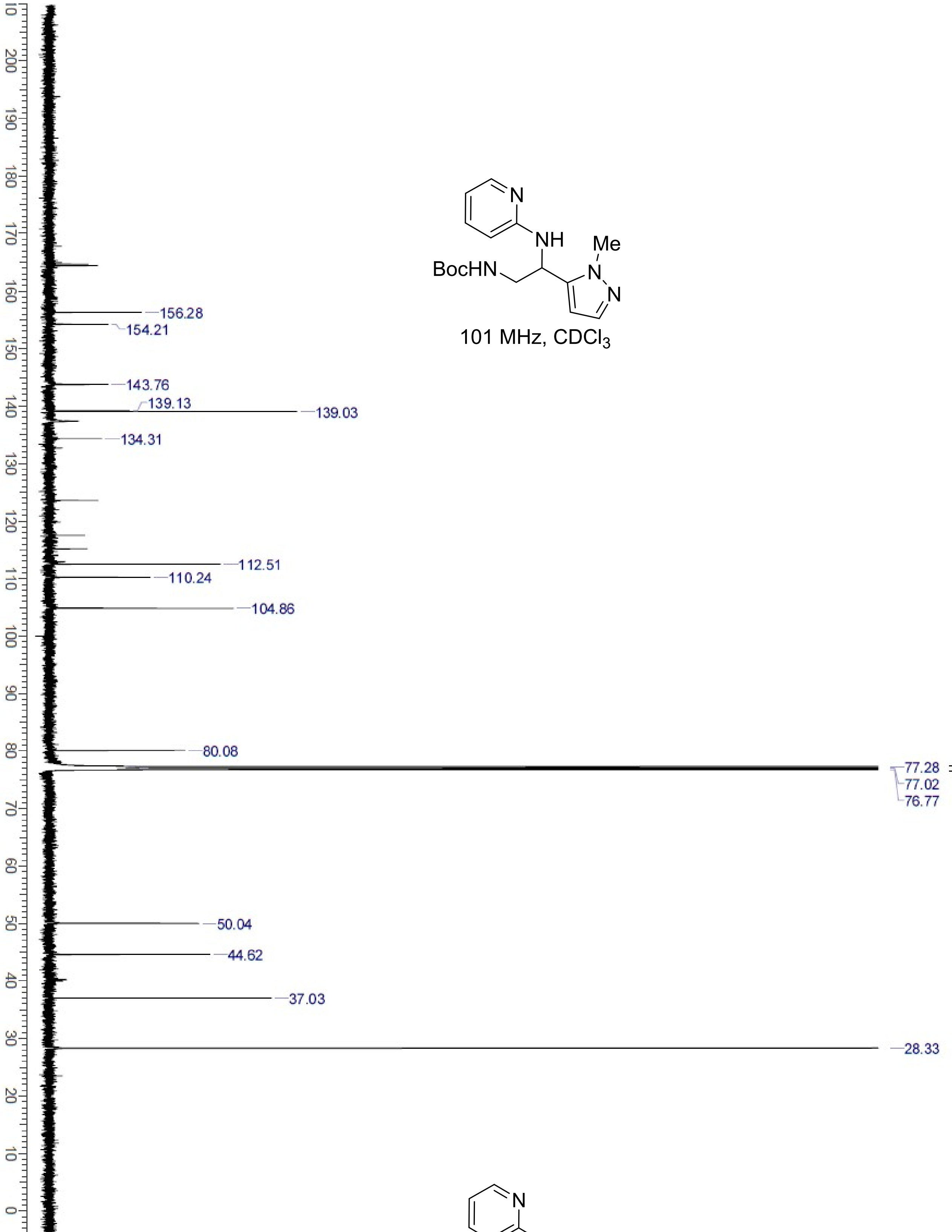

Br
NH
N
Me
400 MHz, DMSO-d6



158.75
158.49
144.38
130.98
122.18
113.01
104.18
40.61
37.04
36.29
31.74
Br
NH
Me
N
101 MHz, DMSO-d6

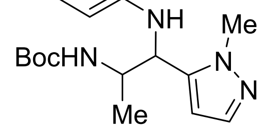
3f


400 MHz, CDCl3
CHLOROFORM-d

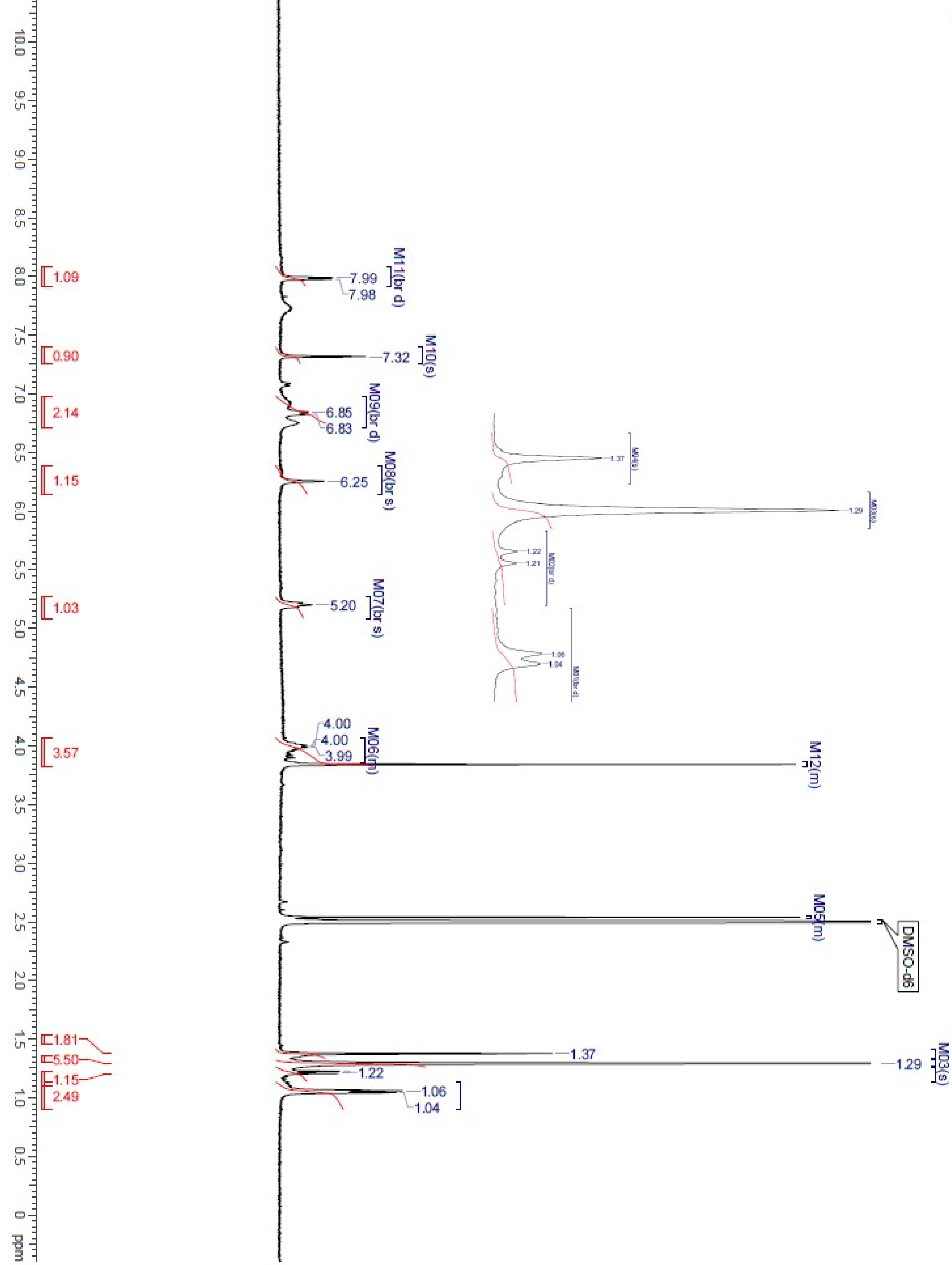


101 MHz, $CDCl_3$

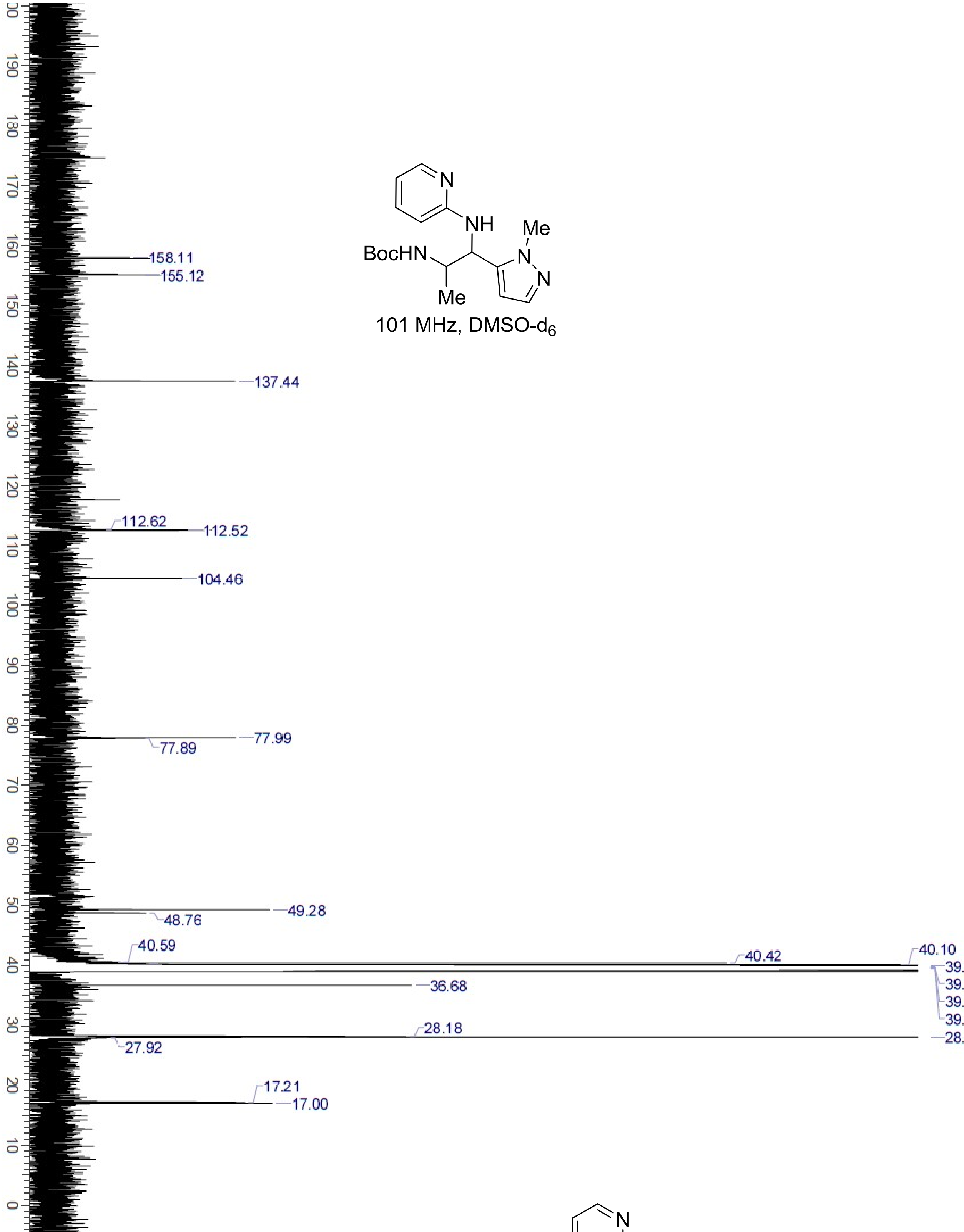
3o



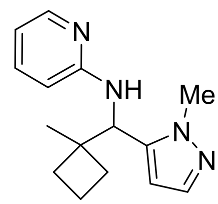
400 MHz, DMSO-d_6



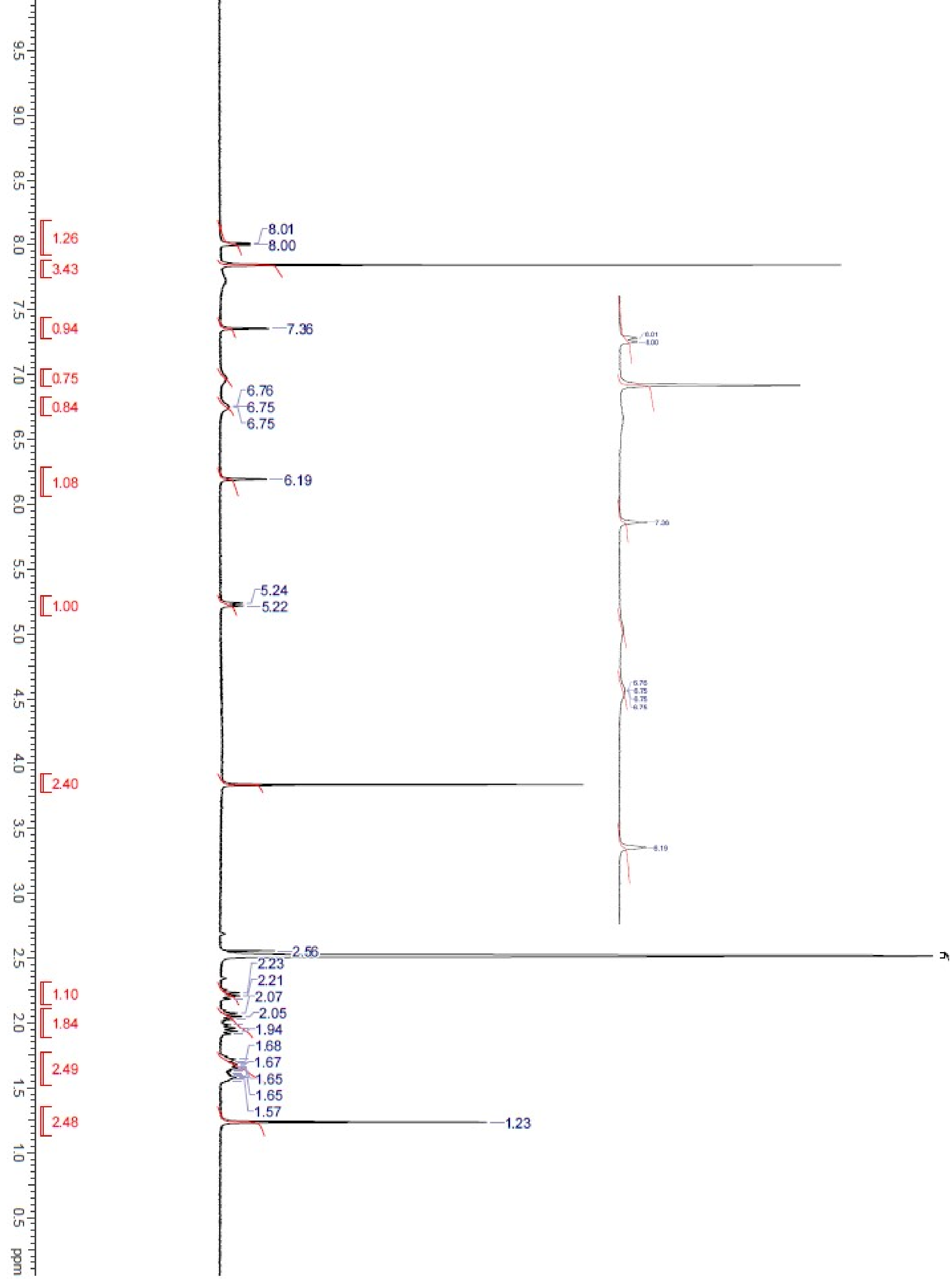
ppm
M11(br d)
7.99
7.98
M10(s)
7.32
M09(br d)
6.85
6.83
M08(br s)
6.25
M07(br s)
5.20
M06(m)
4.00
4.00
3.99
M12(m)
M05(m)
DMSO-d6
1.37
1.29
M03(s)
1.22
1.06
1.04
1.09
0.90
2.14
1.15
1.03
3.57
1.81
5.50
1.15
2.49



3p

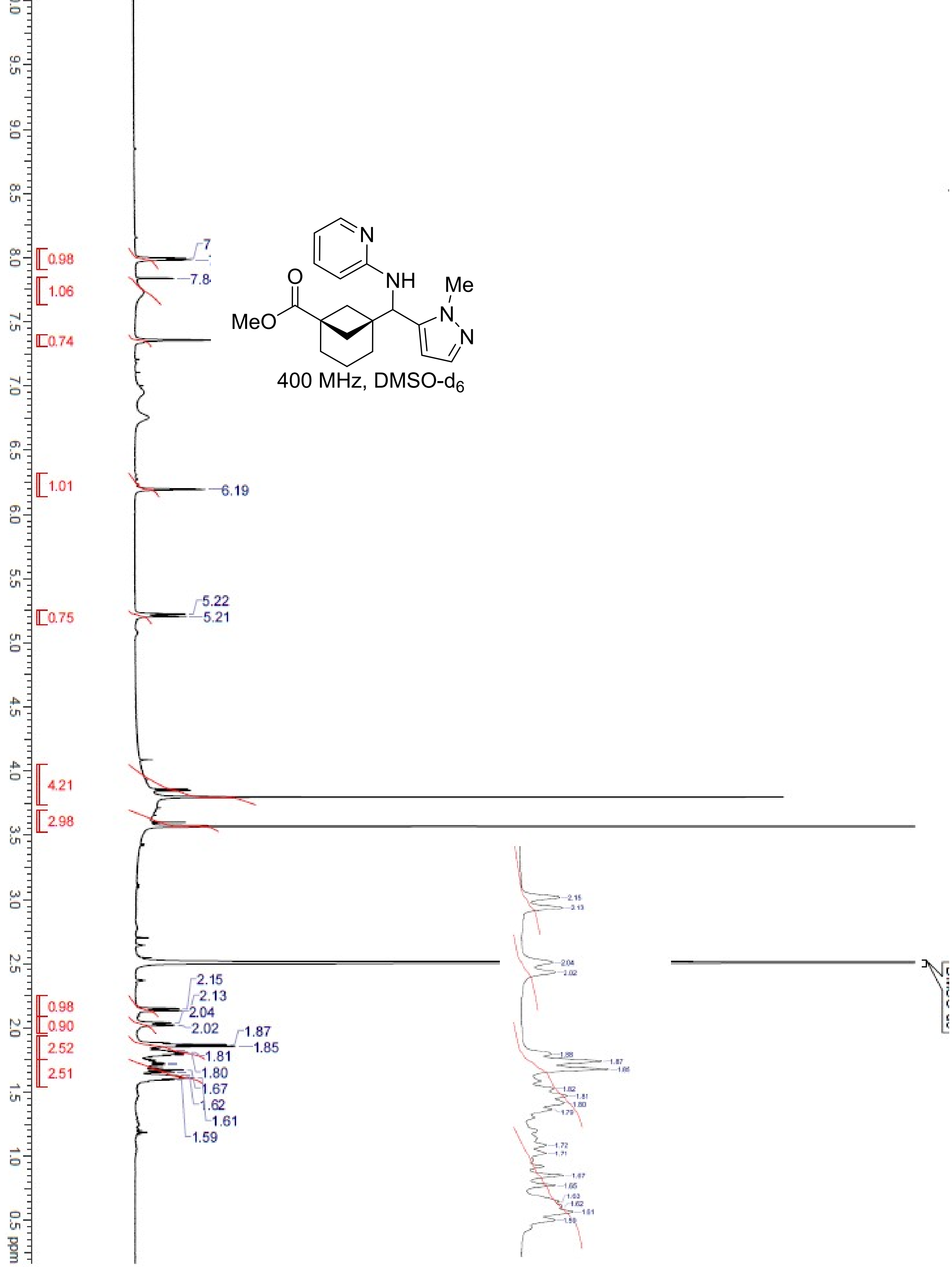


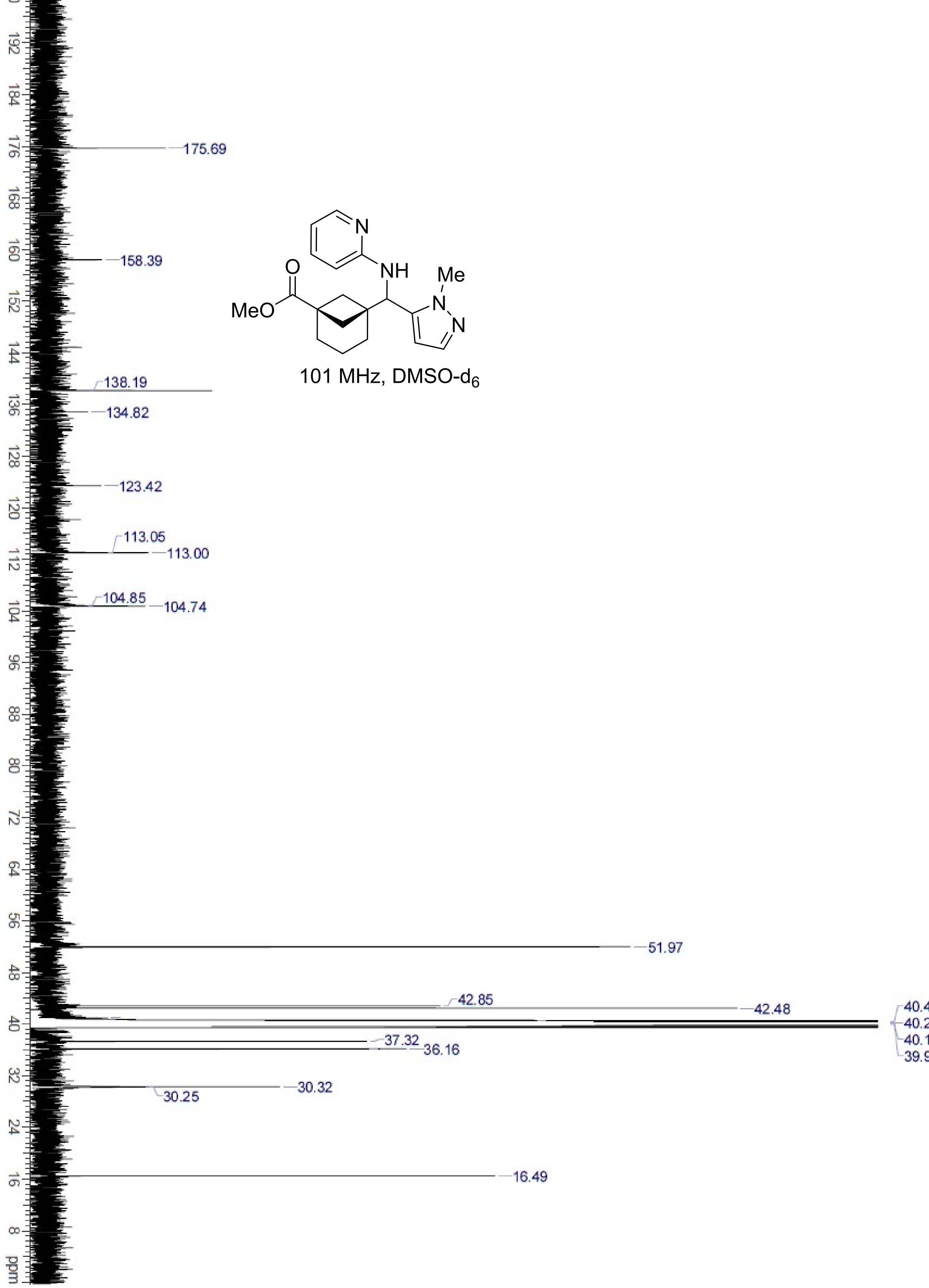
400 MHz, DMSO-d_6



8.01
8.00
7.36
6.76
6.75
6.75
6.19
5.24
5.22
2.56
2.23
2.21
2.07
2.05
1.94
1.68
1.67
1.65
1.65
1.57
1.23
1.26
3.43
0.94
0.75
0.84
1.08
1.00
2.40
1.10
1.84
2.49
2.48
ppm

3r

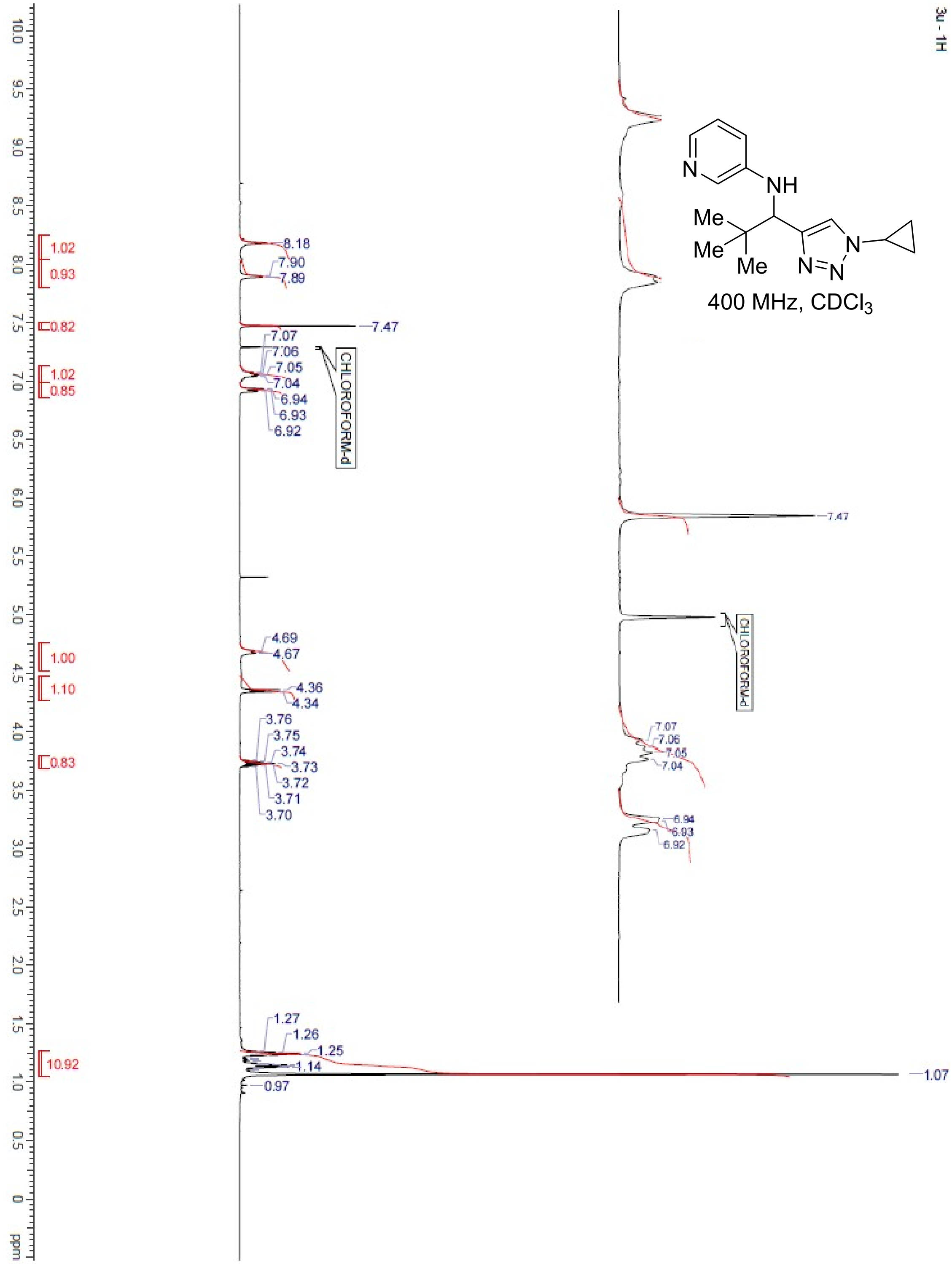

N
NH
Me
O
MeO
N
N
400 MHz, DMSO-d6

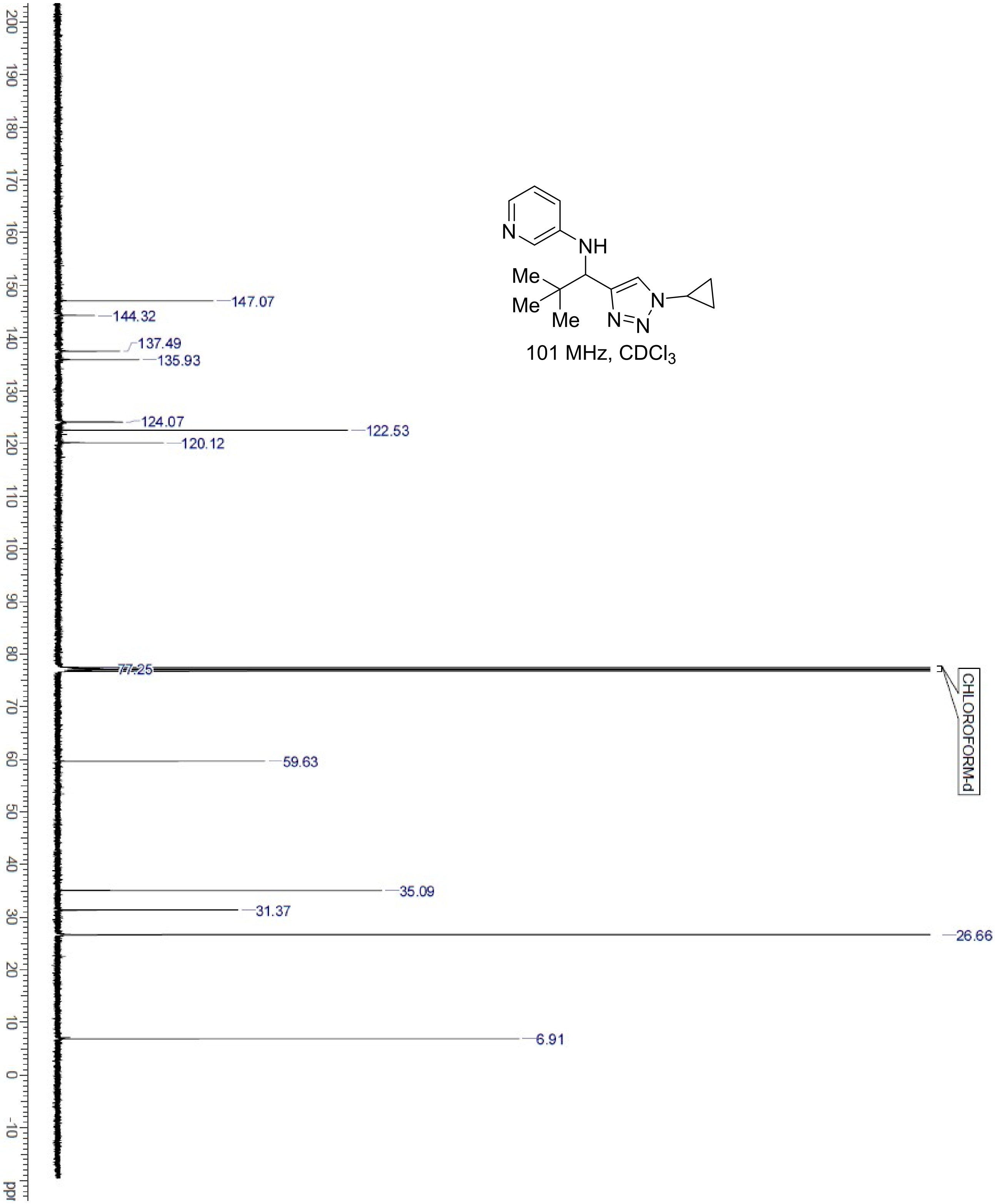


175.69
158.39
138.19
134.82
123.42
113.05
113.00
104.85
104.74
51.97
42.85
42.48
37.32
36.16
30.32
30.25
16.49
101 MHz, DMSO-d6

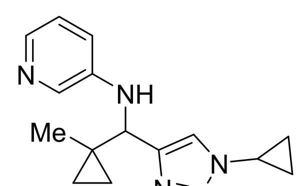
3u

3u

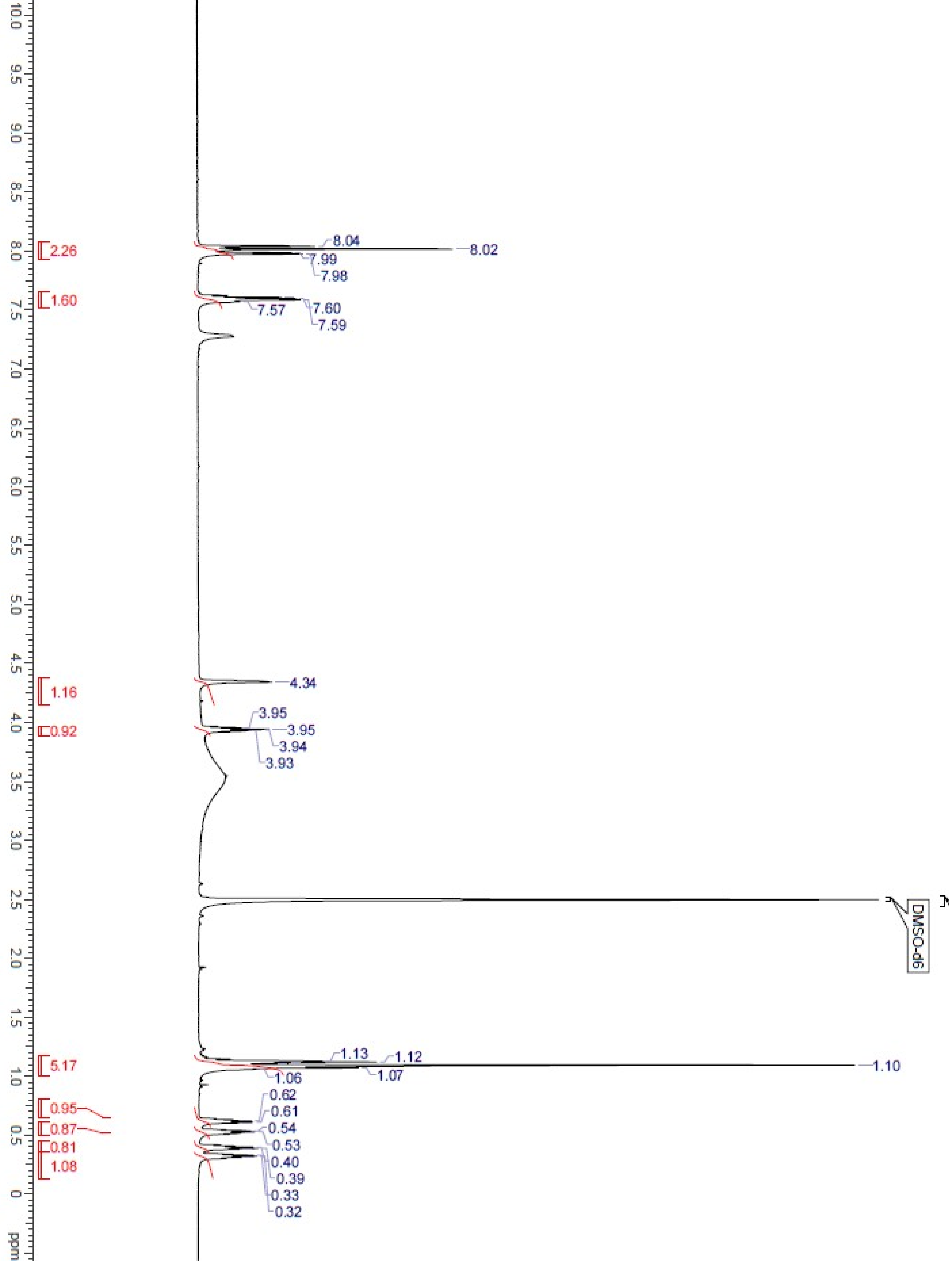




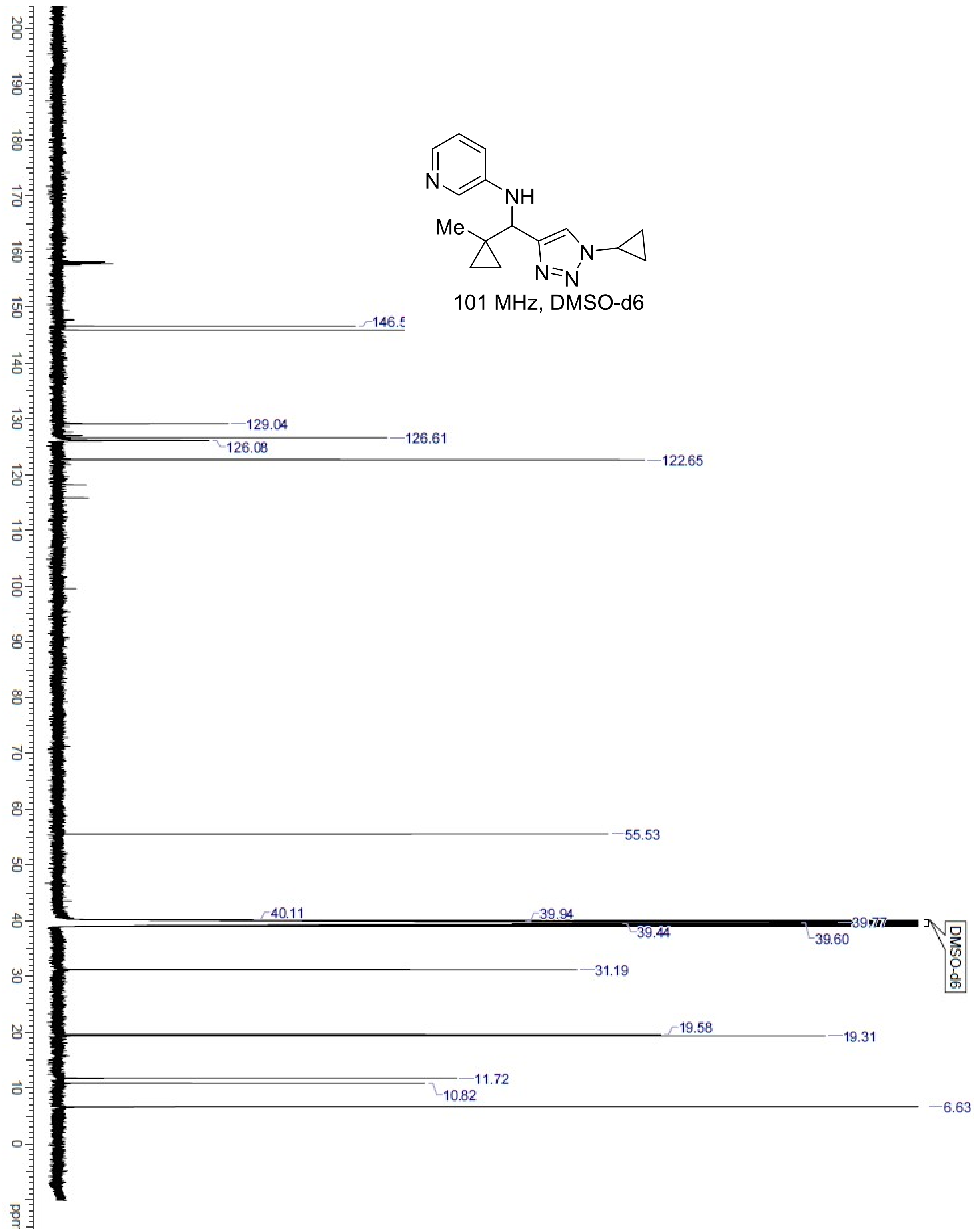
3v



400 MHz, DMSO-d6

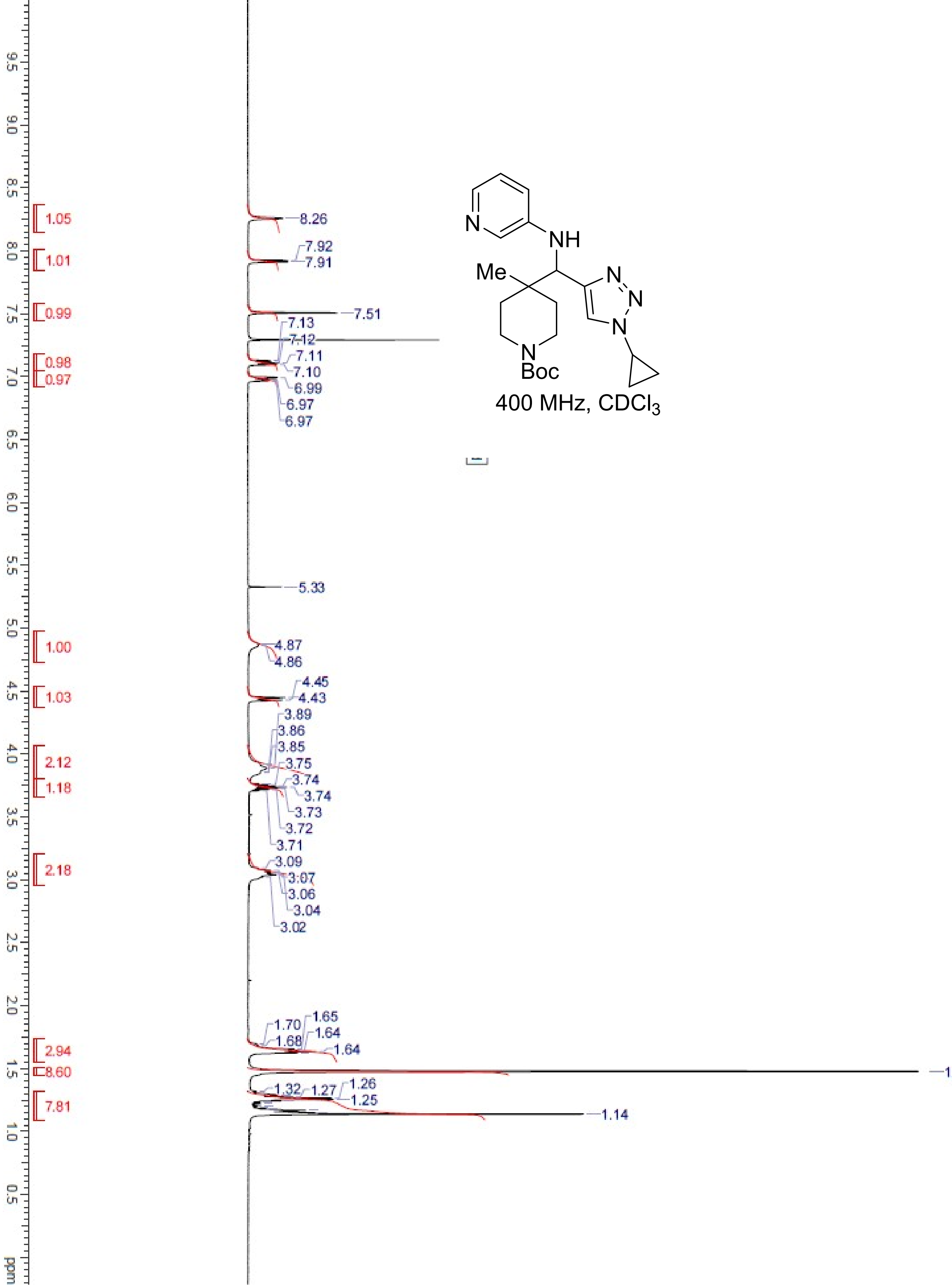


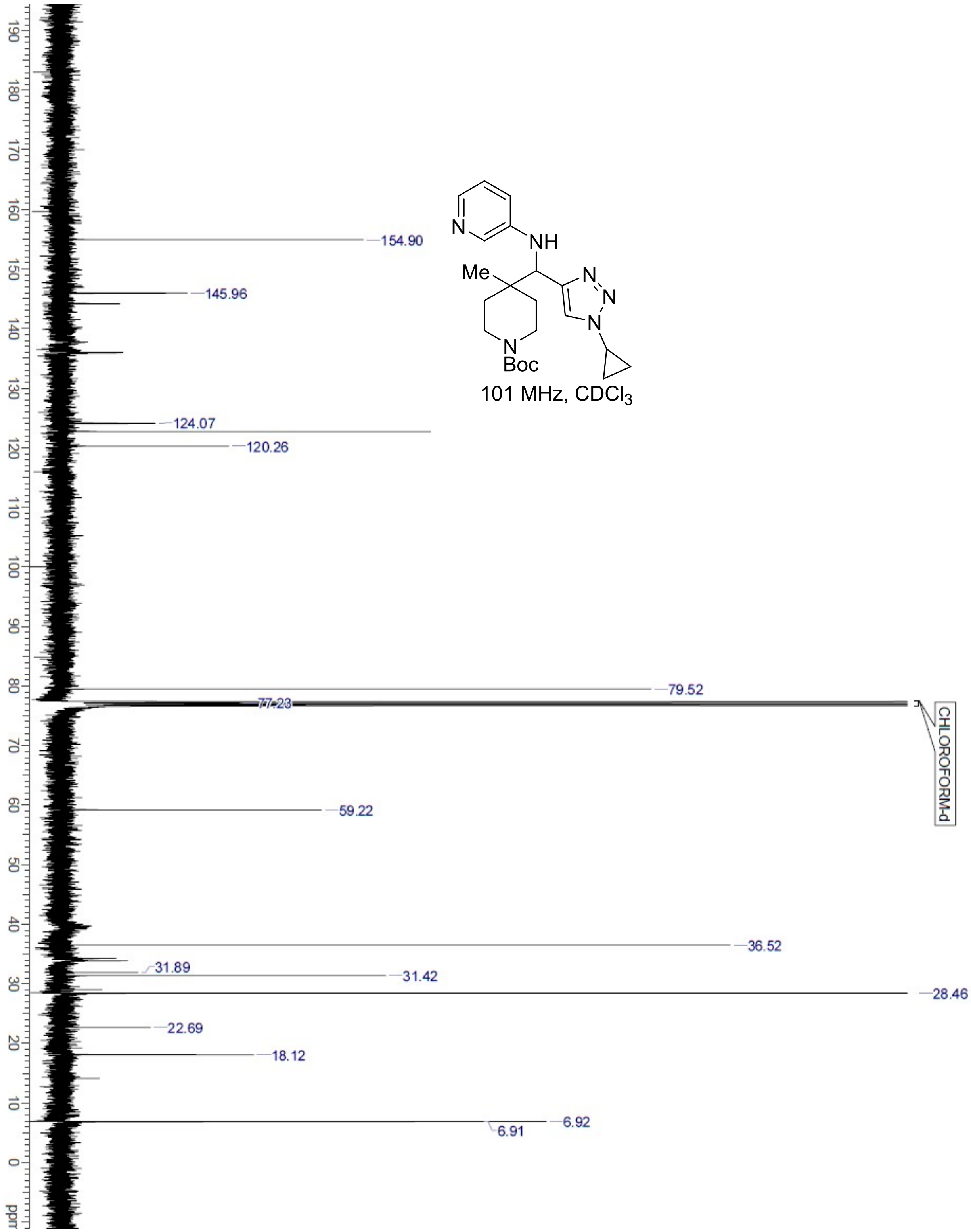
8.04
8.02
7.99
7.98
7.60
7.59
7.57
4.34
3.95
3.95
3.94
3.93
DMSO-d6
1.13
1.12
1.10
1.07
1.06
0.62
0.61
0.54
0.53
0.40
0.39
0.33
0.32
2.26
1.60
1.16
0.92
5.17
0.95
0.87
0.81
1.08
ppm



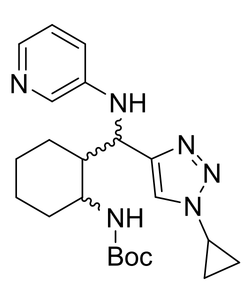
N
NH
Me
N
N
N
101 MHz, DMSO-d6
146.5
129.04
126.61
126.08
122.65
55.53
40.11
39.94
39.77
39.44
39.60
31.19
19.58
19.31
11.72
10.82
6.63
DMSO-d6
ppm

3w

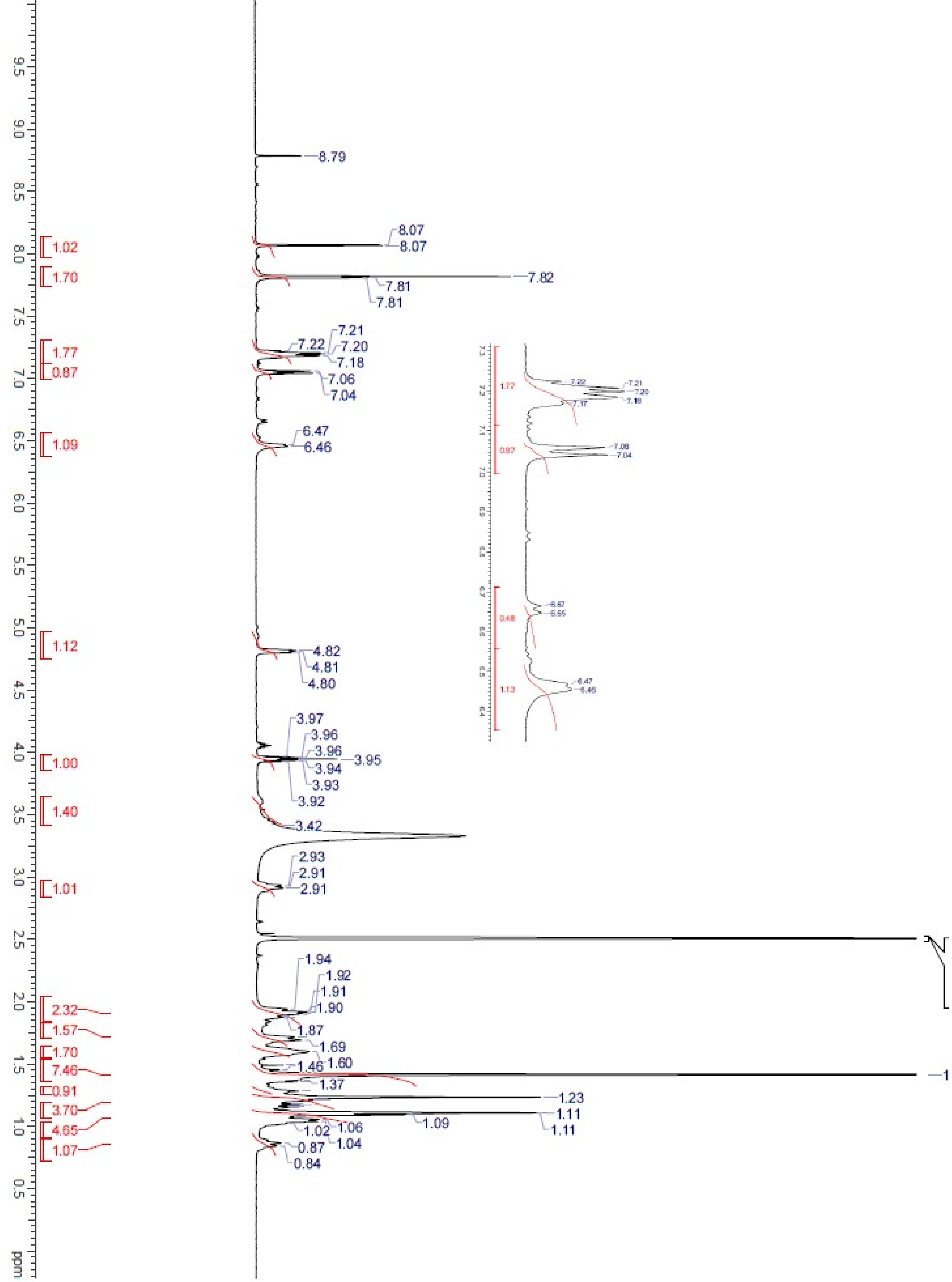

NH
Me
N
Boc
400 MHz, $CDCl_3$
ppm

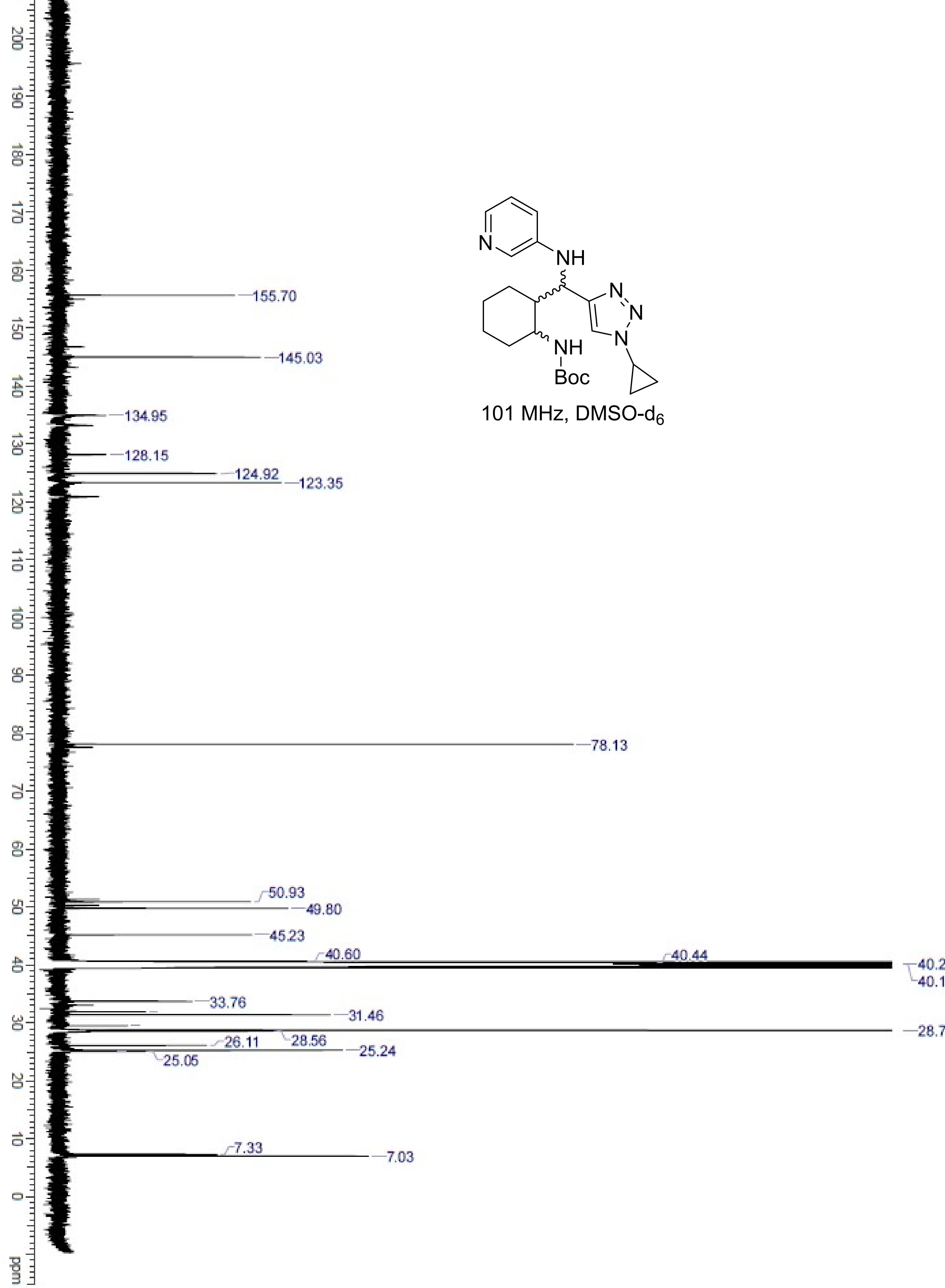


3x



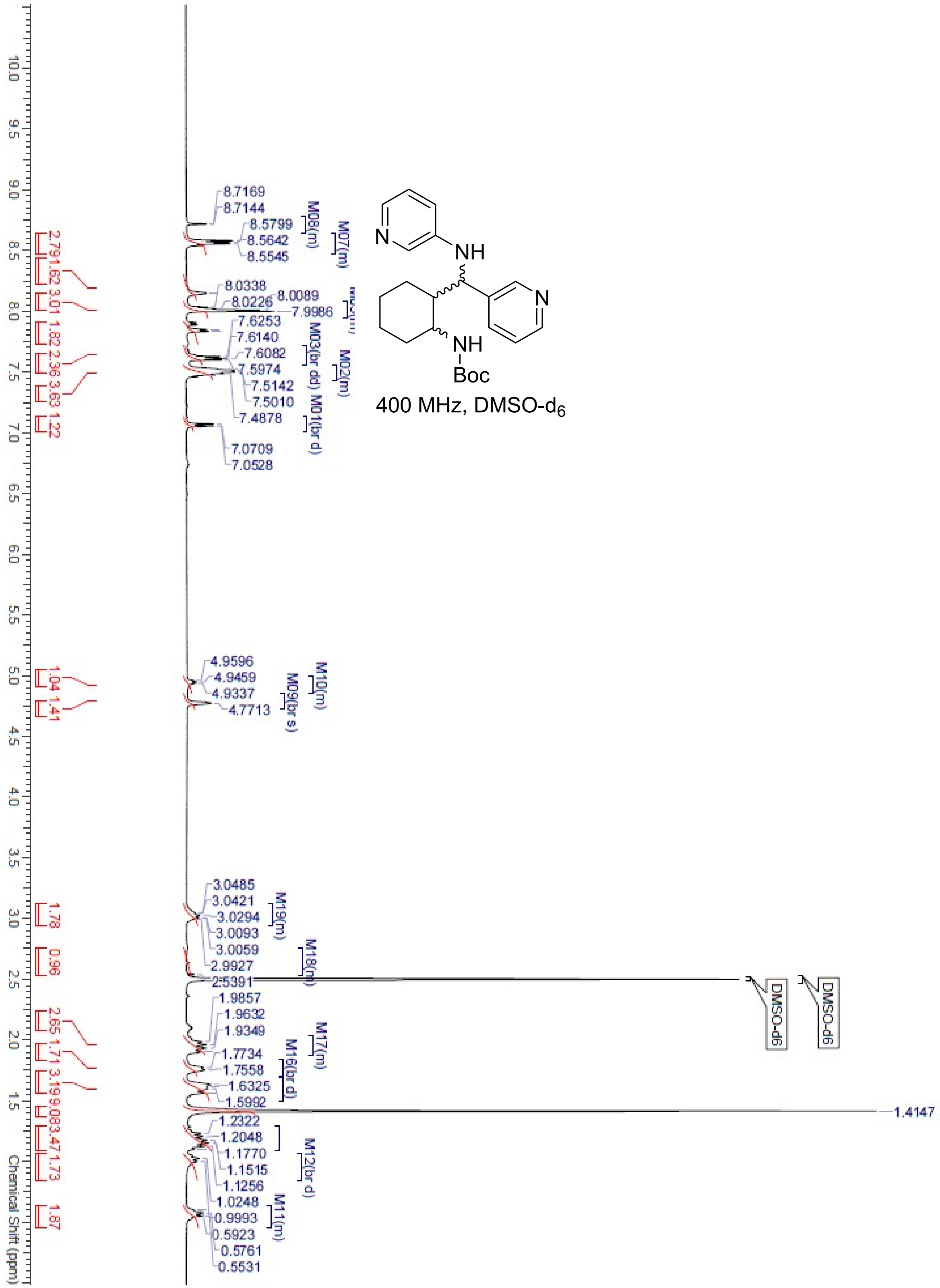
400 MHz, DMSO-d_6

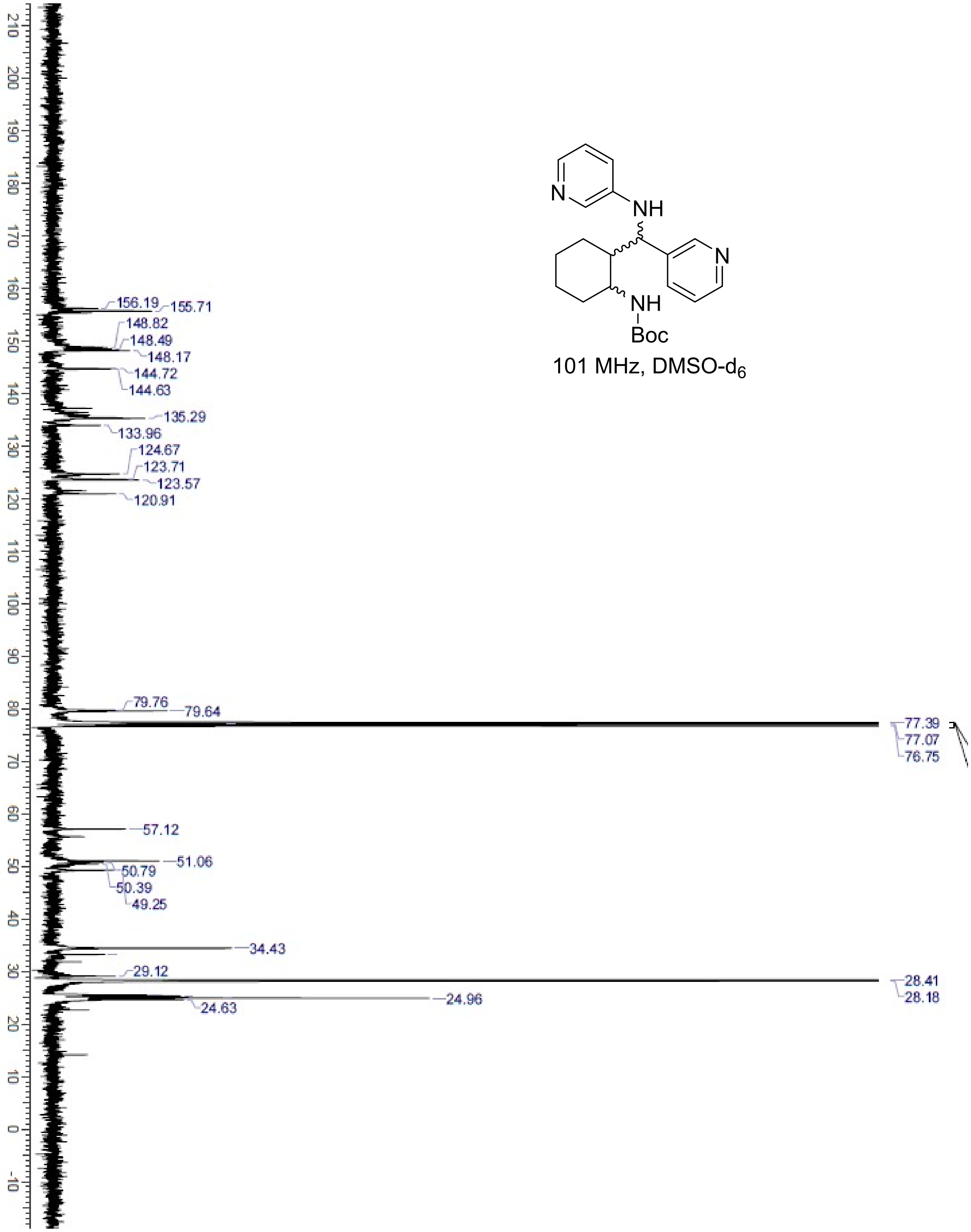




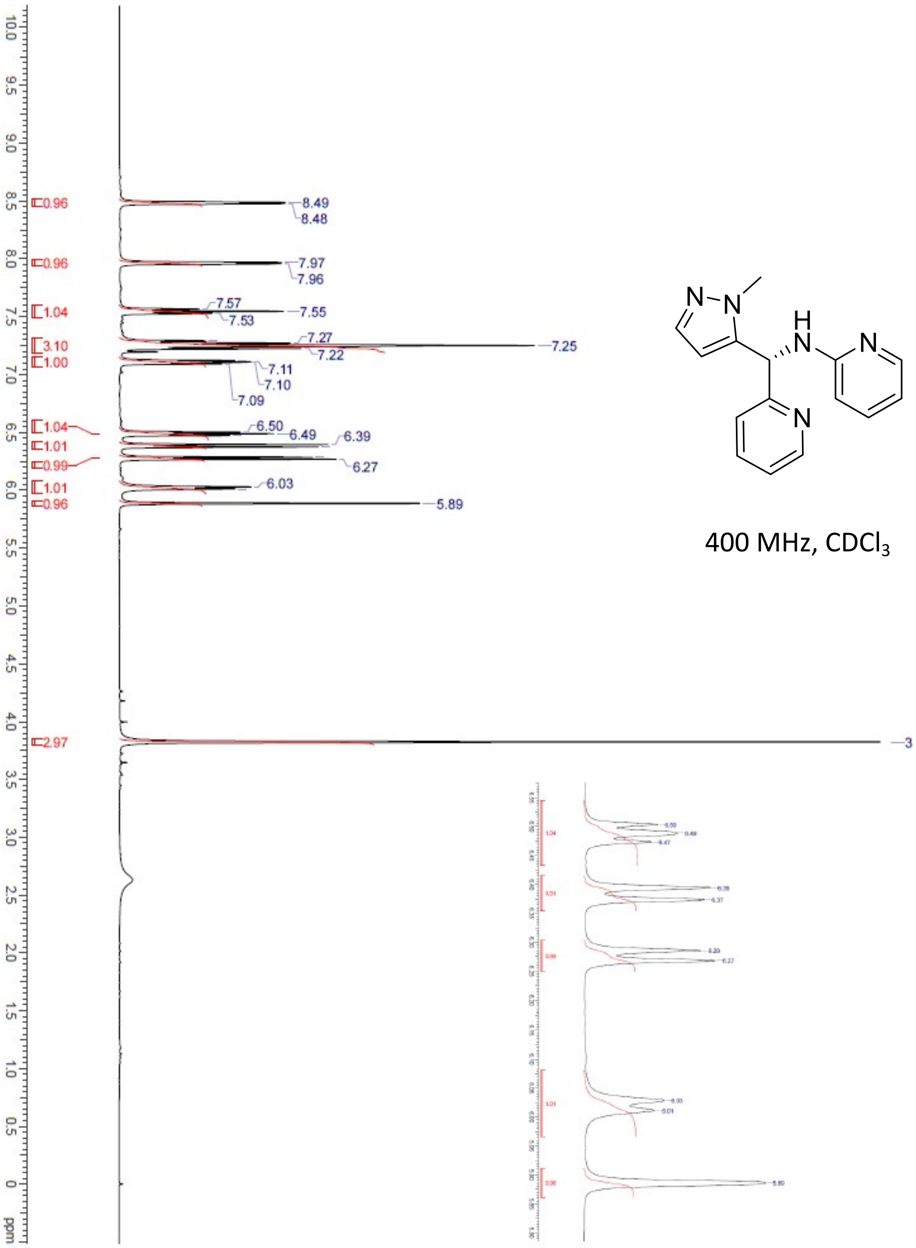
155.70
145.03
134.95
128.15
124.92
123.35
78.13
50.93
49.80
45.23
40.60
40.44
33.76
31.46
26.11
28.56
25.24
25.05
7.33
7.03
NH
N
N
N
N
NH
Boc
101 MHz, DMSO-d$_6$

3y

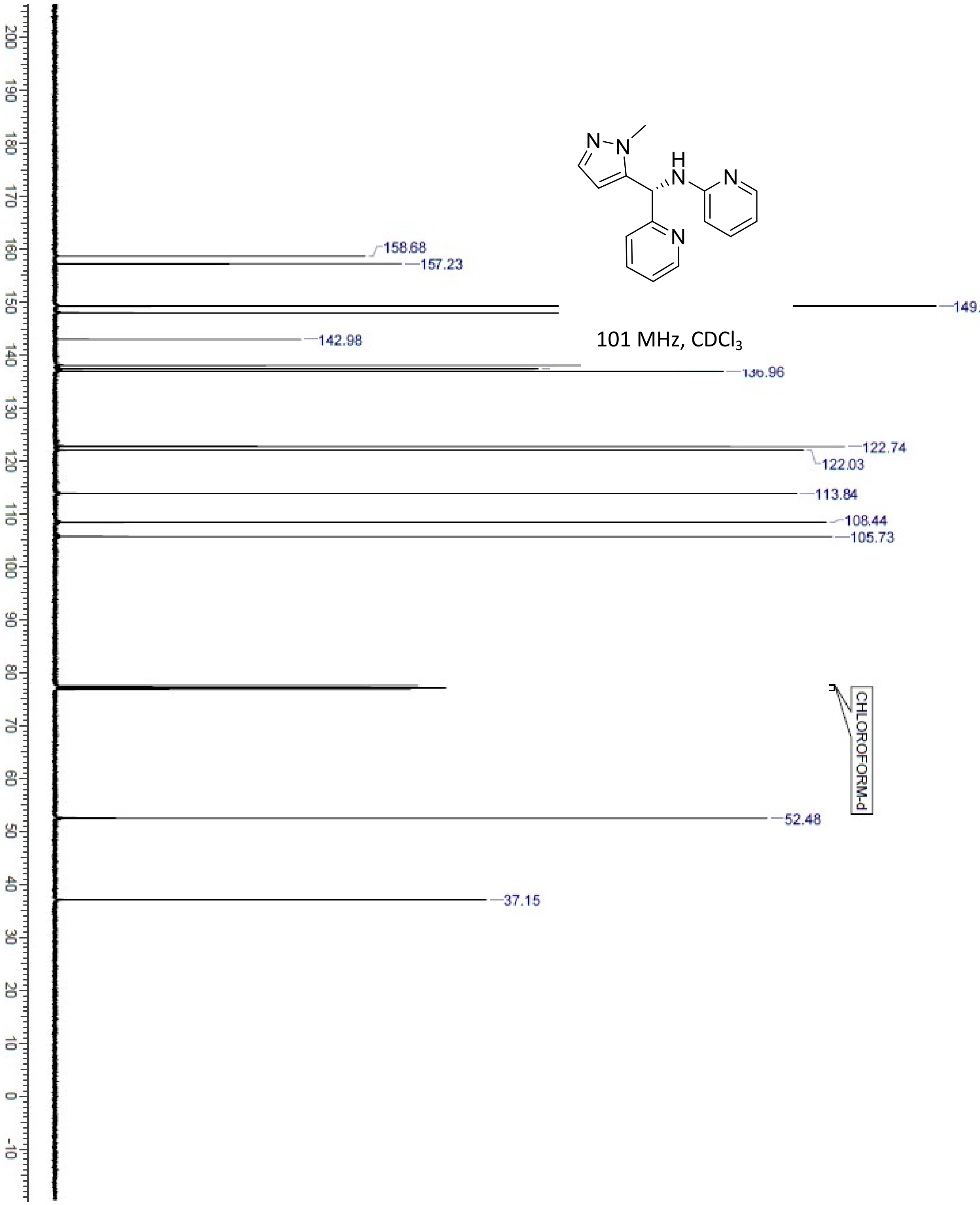

N
NH
N
NH
Boc
400 MHz, DMSO-d$_6$
8.7169
8.7144
8.5799
8.5642
8.5545
8.0338
8.0226
8.0089
7.9986
7.6253
7.6140
7.6082
7.5974
7.5142
7.5010
7.4878
7.0709
7.0528
4.9596
4.9459
4.9337
4.7713
3.0485
3.0421
3.0294
3.0093
3.0059
2.9927
2.5391
1.9857
1.9632
1.9349
1.7734
1.7558
1.6325
1.5992
1.4147
1.2322
1.2048
1.1770
1.1515
1.1256
1.0248
0.9993
0.5923
0.5761
0.5531
M08(m)
M07(m)
M03(br dd)
M02(m)
M01(br d)
M10(m)
M09(br s)
M19(m)
M18(m)
M17(m)
M16(br d)
M12(br d)
M11(m)
DMSO-d6
DMSO-d6
2.79
1.62
3.01
1.82
2.36
3.63
1.22
1.04
1.41
1.78
0.96
2.65
1.71
3.19
9.08
3.47
1.73
1.87
Chemical Shift (ppm)

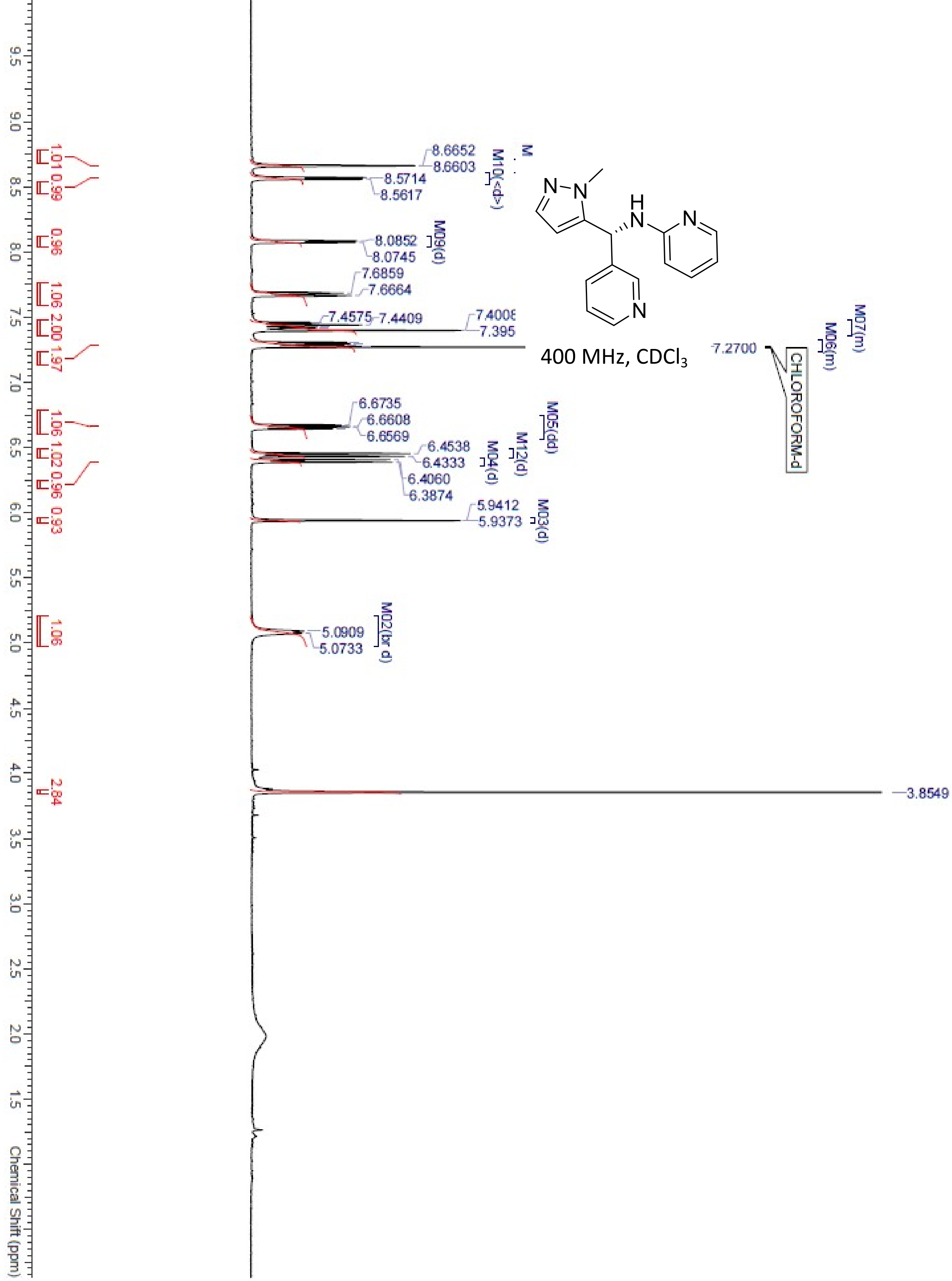


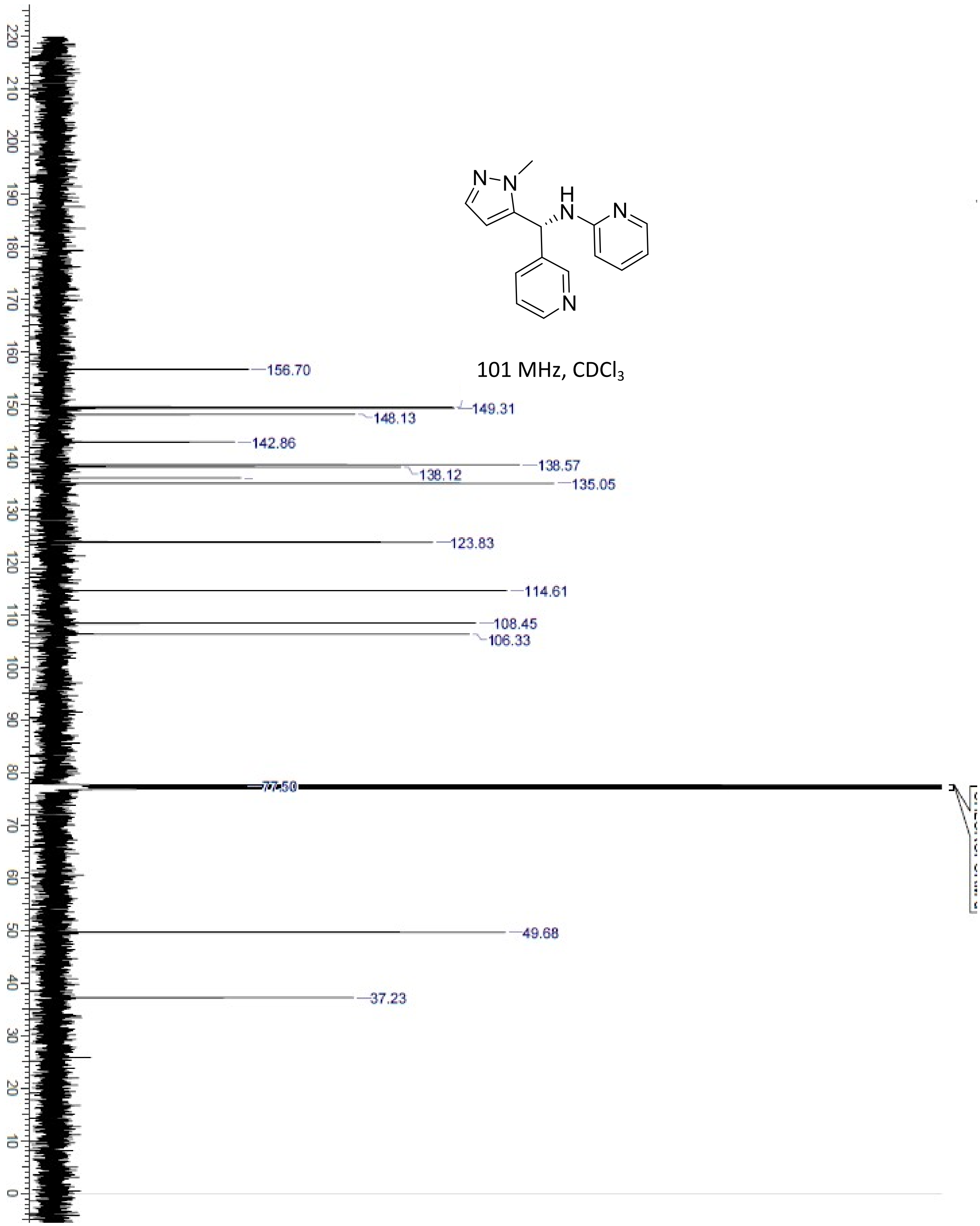
NH
N
NH
Boc
101 MHz, DMSO-d_6
156.19
155.71
148.82
148.49
148.17
144.72
144.63
135.29
133.96
124.67
123.71
123.57
120.91
79.76
79.64
77.39
77.07
76.75
57.12
51.06
50.79
50.39
49.25
34.43
29.12
28.41
28.18
24.96
24.63
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

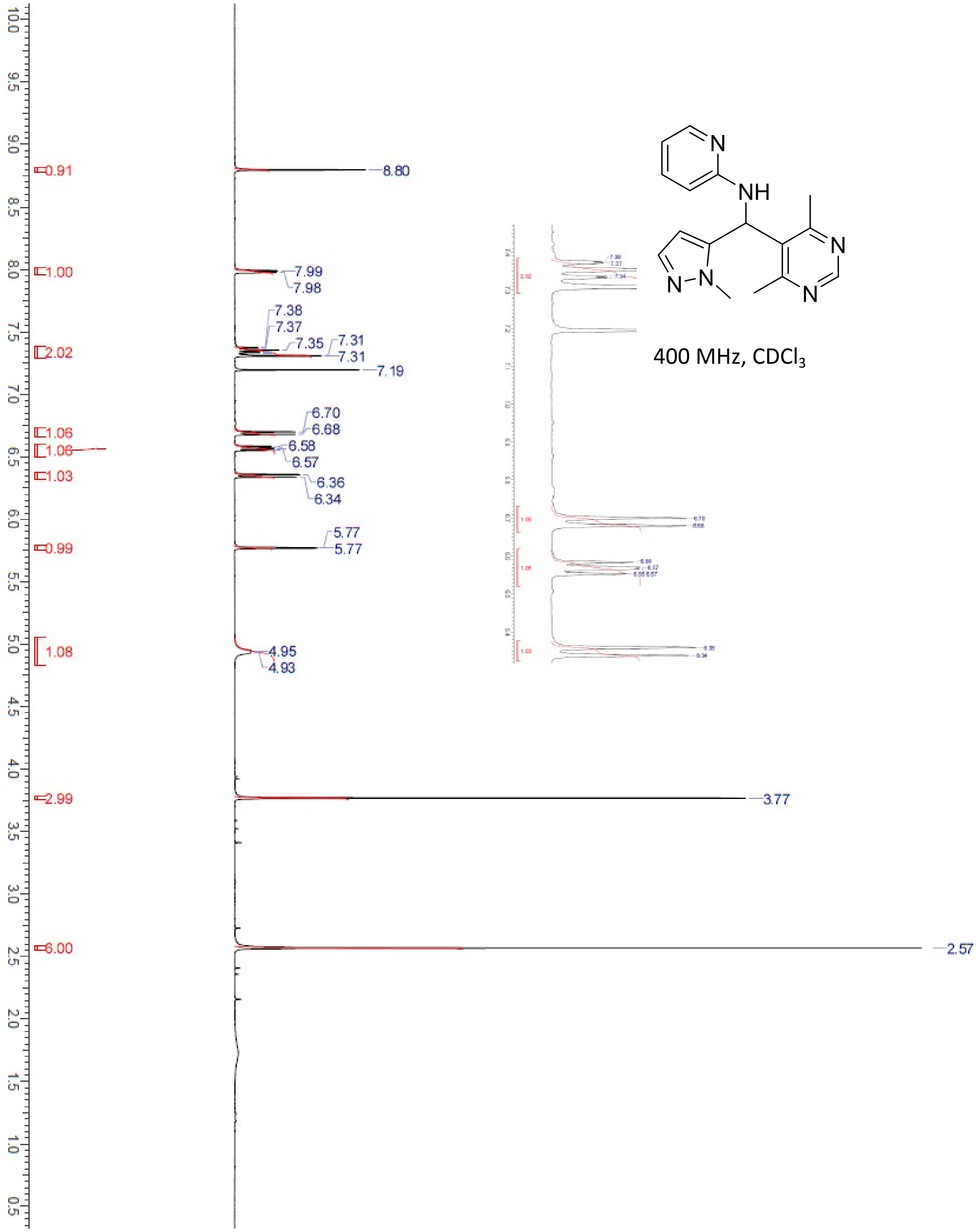


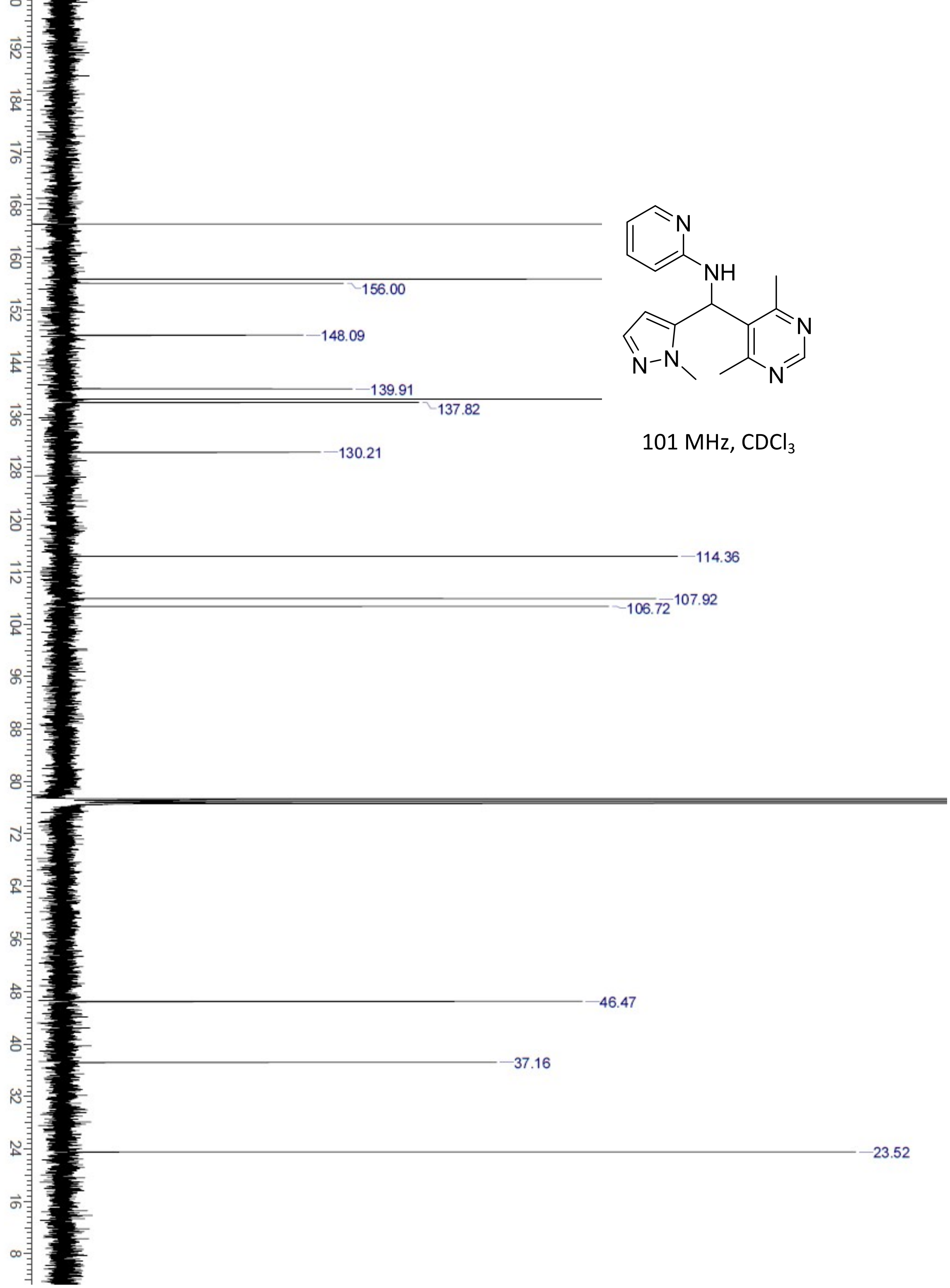
400 MHz, $CDCl_3$

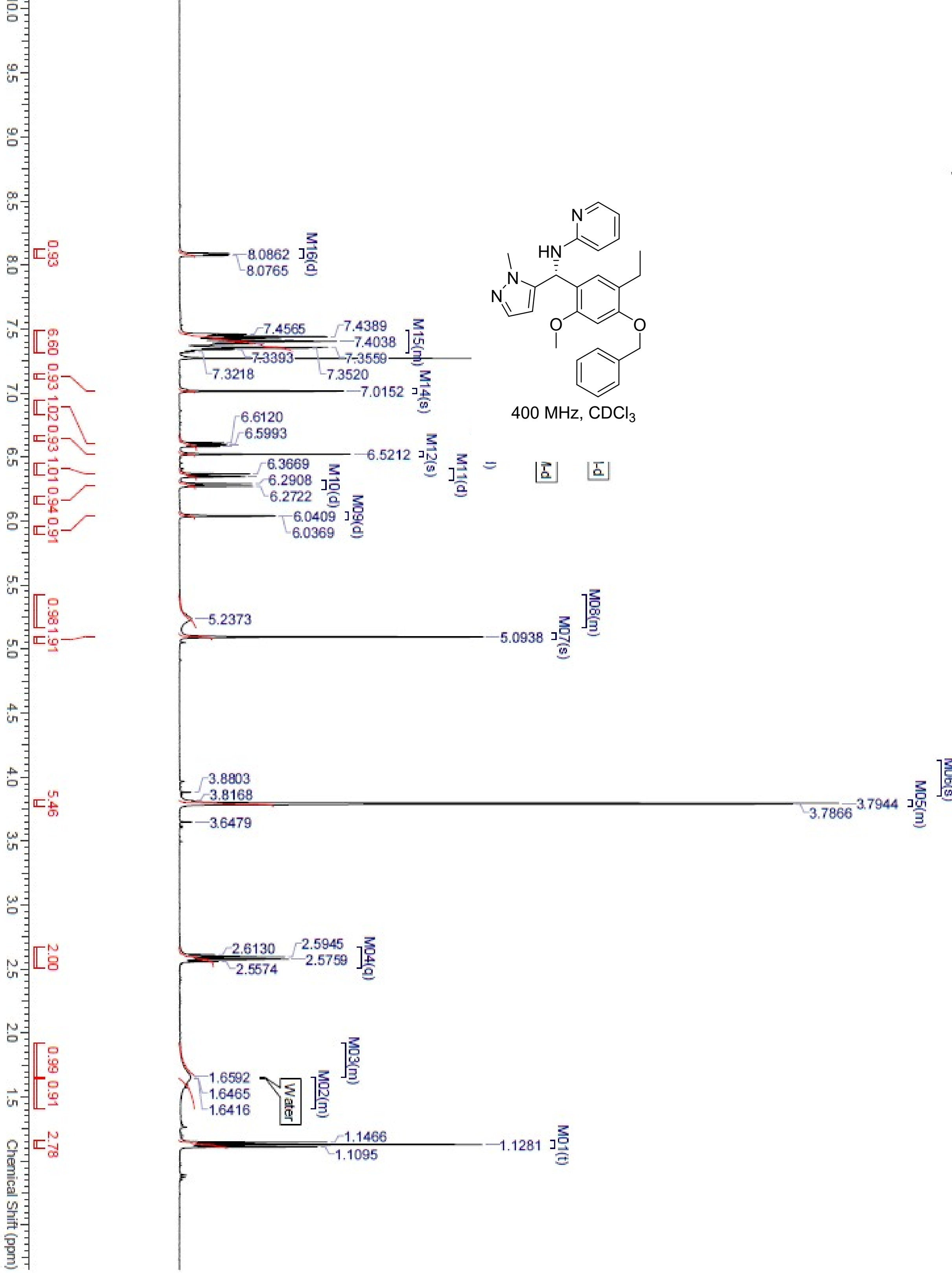

101 MHz, $CDCl_3$
158.68
157.23
149.
142.98
136.96
122.74
122.03
113.84
108.44
105.73
CHLOROFORM-d
52.48
37.15

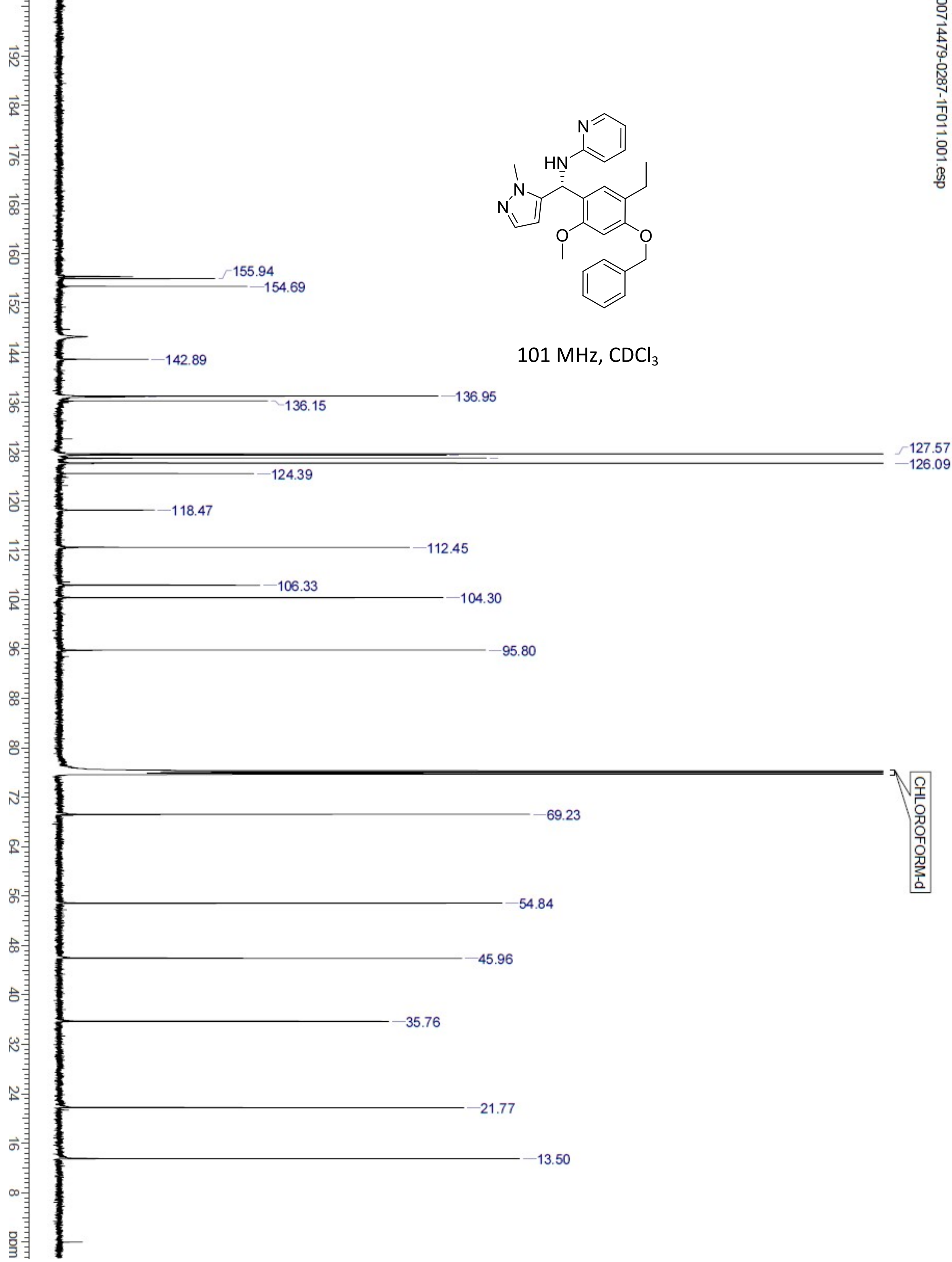

400 MHz, CDCl3
CHLOROFORM-d
Chemical Shift (ppm)


101 MHz, $CDCl_3$
156.70
149.31
148.13
142.86
138.57
138.12
135.05
123.83
114.61
108.45
106.33
77.50
49.68
37.23

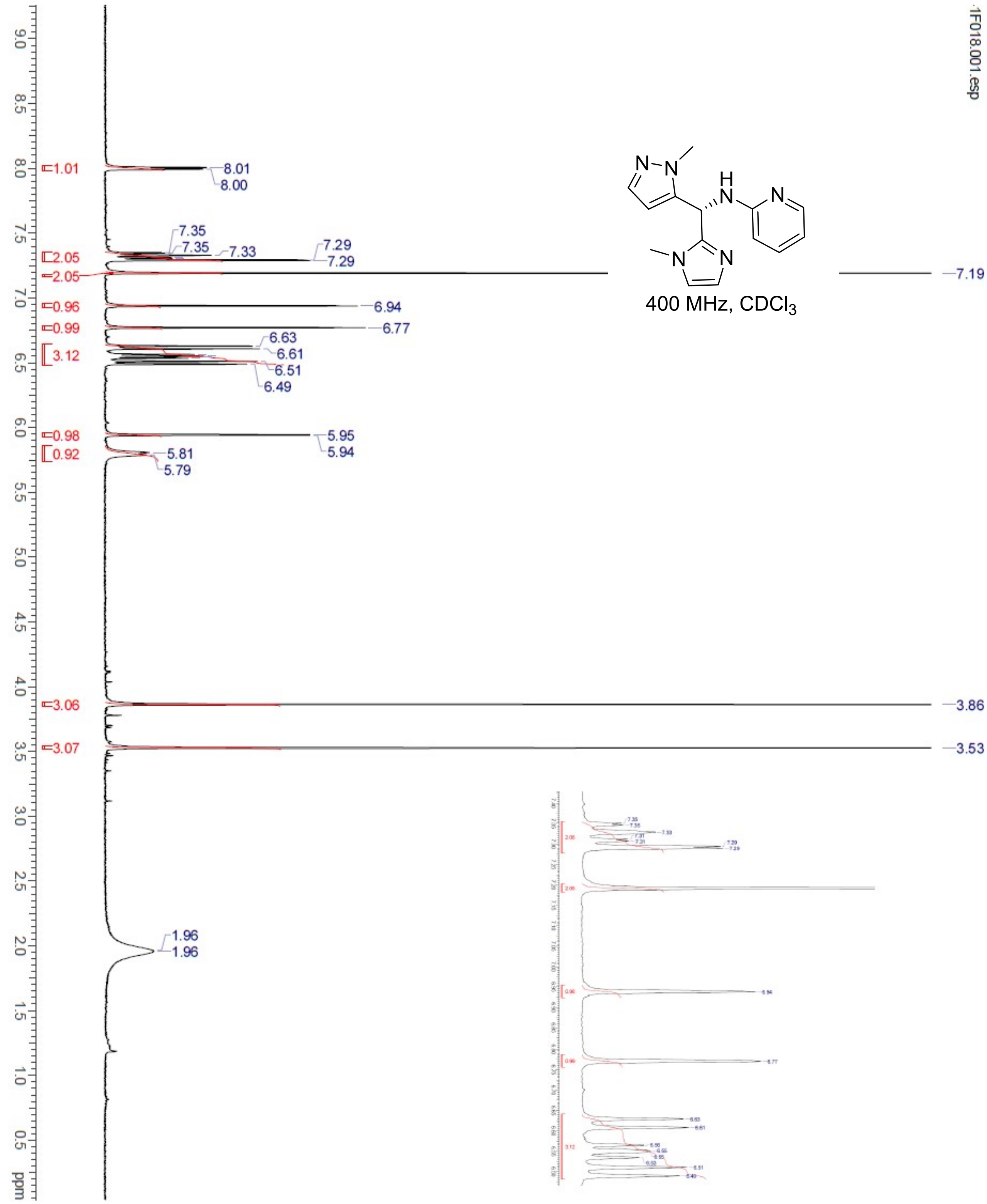

N
NH
N
N
N
N
400 MHz, $CDCl_3$

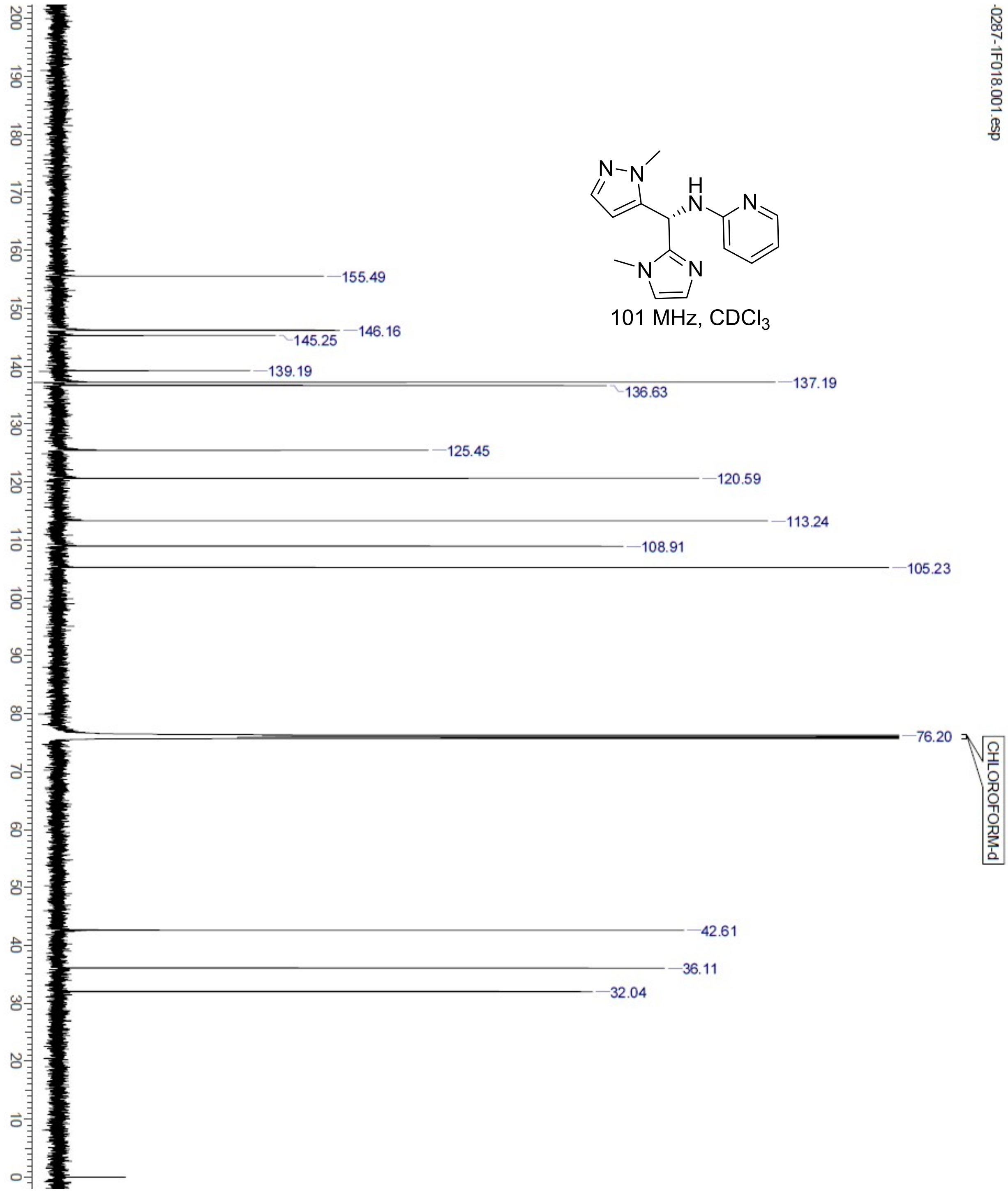

156.00
148.09
139.91
137.82
130.21
114.36
107.92
106.72
46.47
37.16
23.52
101 MHz, $CDCl_3$
NH
N
192
184
176
168
160
152
144
136
128
120
112
104
96
88
80
72
64
56
48
40
32
24
16
8


400 MHz, CDCl$_3$
Chemical Shift (ppm)

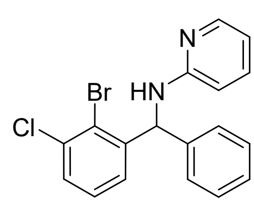


101 MHz, $CDCl_3$
155.94
154.69
142.89
136.95
136.15
127.57
126.09
124.39
118.47
112.45
106.33
104.30
95.80
CHLOROFORM-d
69.23
54.84
45.96
35.76
21.77
13.50
ppm

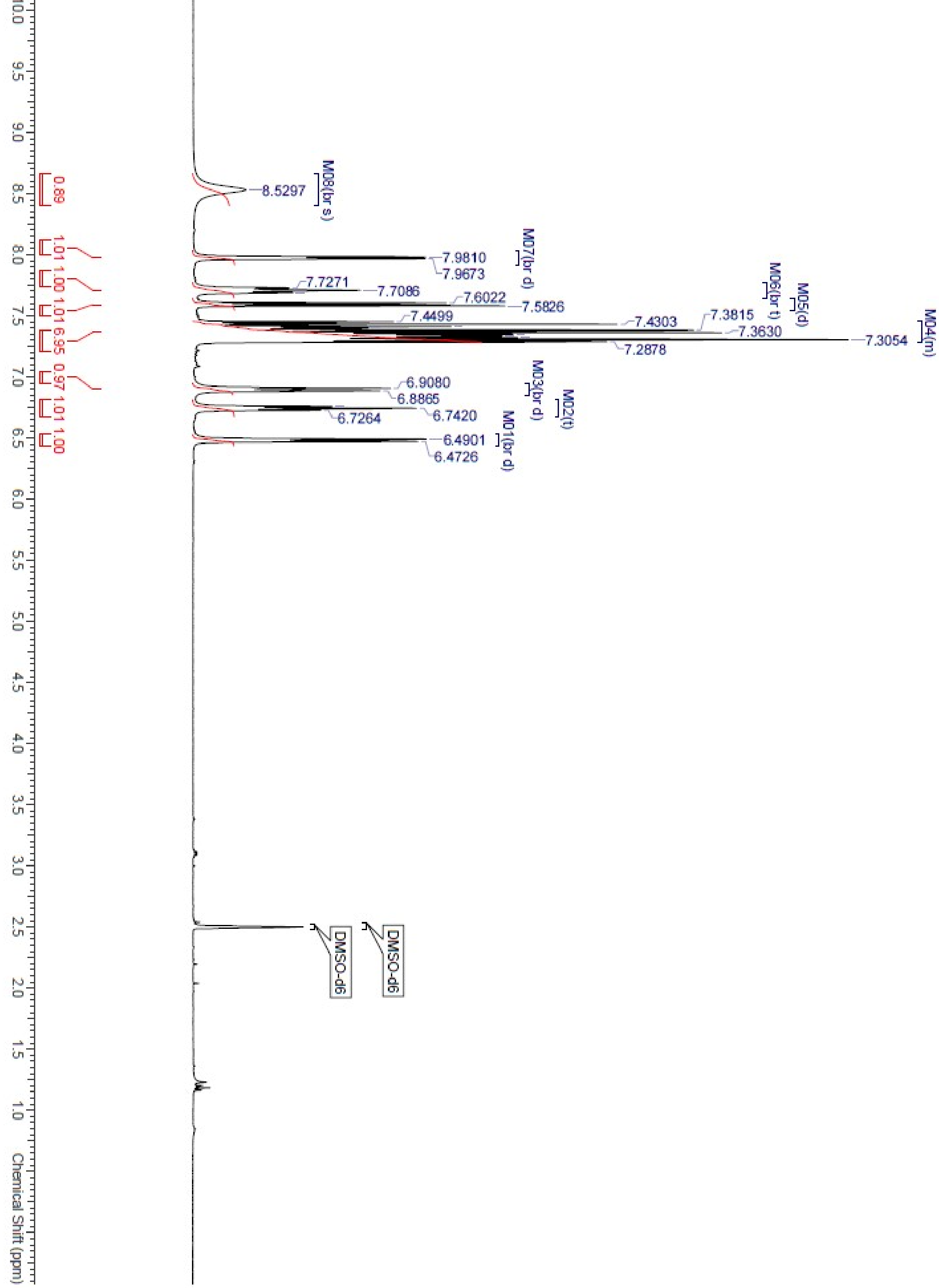

1F018.001.esp
400 MHz, $CDCl_3$
8.01
8.00
7.35
7.35
7.33
7.29
7.29
7.19
6.94
6.77
6.63
6.61
6.51
6.49
5.95
5.94
5.81
5.79
3.86
3.53
1.96
1.96
1.01
2.05
2.05
0.96
0.99
3.12
0.98
0.92
3.06
3.07
ppm



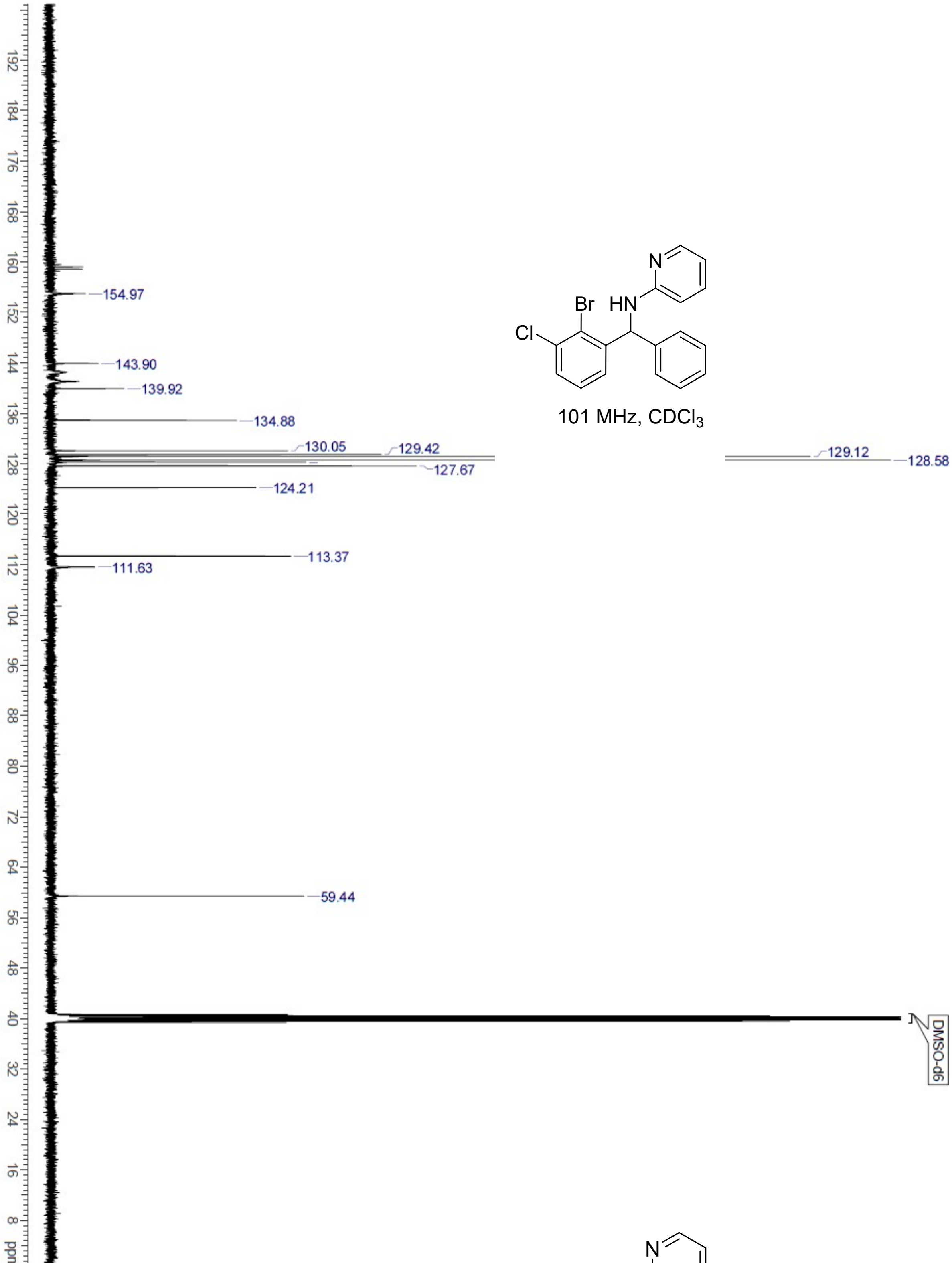
9a



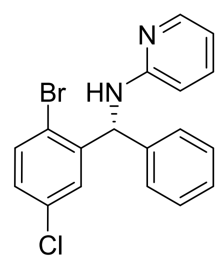
400 MHz, DMSO-d6

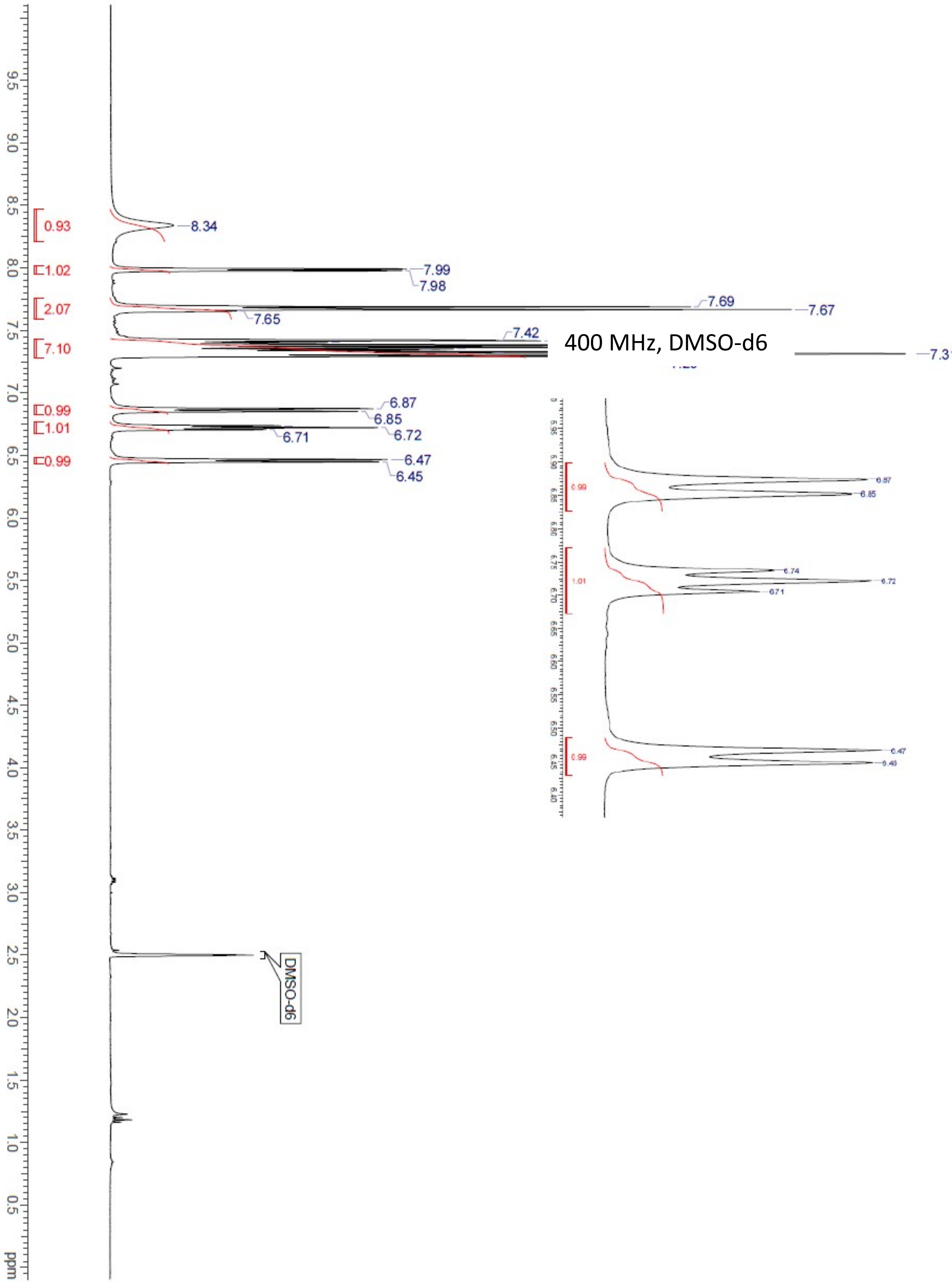


8.5297
M08(br s)
7.9810
7.9673
M07(br d)
7.7271
7.7086
7.6022
7.5826
7.4499
7.4303
7.3815
7.3630
7.3054
7.2878
M06(br t)
M05(d)
M04(m)
6.9080
6.8865
6.7420
6.7264
M03(br d)
M02(t)
6.4901
6.4726
M01(br d)
DMSO-d6
DMSO-d6
0.89
1.01
1.00
1.01
6.95
0.97
1.01
1.00
Chemical Shift (ppm)

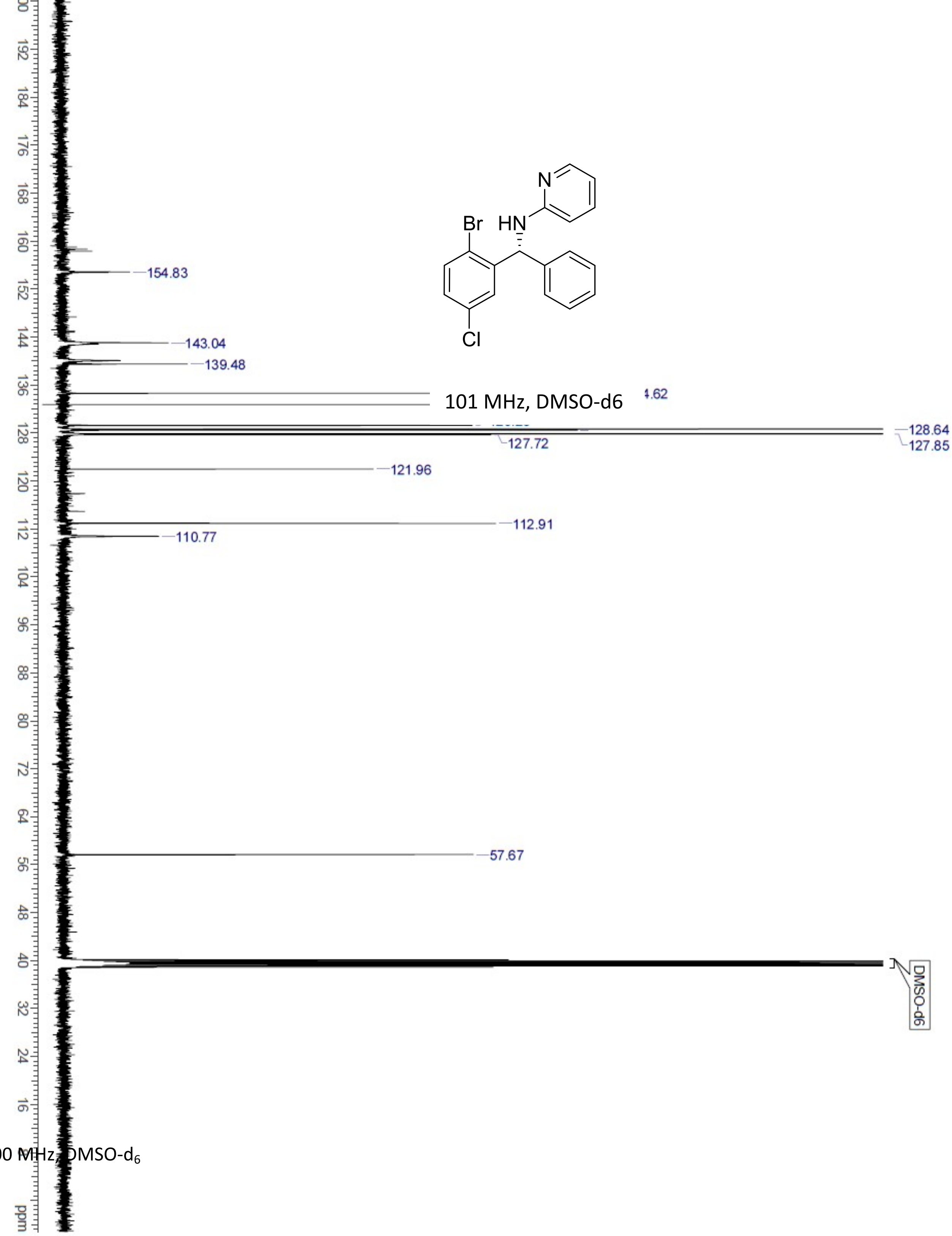

Br
HN
N
Cl
101 MHz, CDCl3
154.97
143.90
139.92
134.88
130.05
129.42
129.12
128.58
127.67
124.21
113.37
111.63
59.44
DMSO-d6
192
184
176
168
160
152
144
136
128
120
112
104
96
88
80
72
64
56
48
40
32
24
16
8
ppm

9b

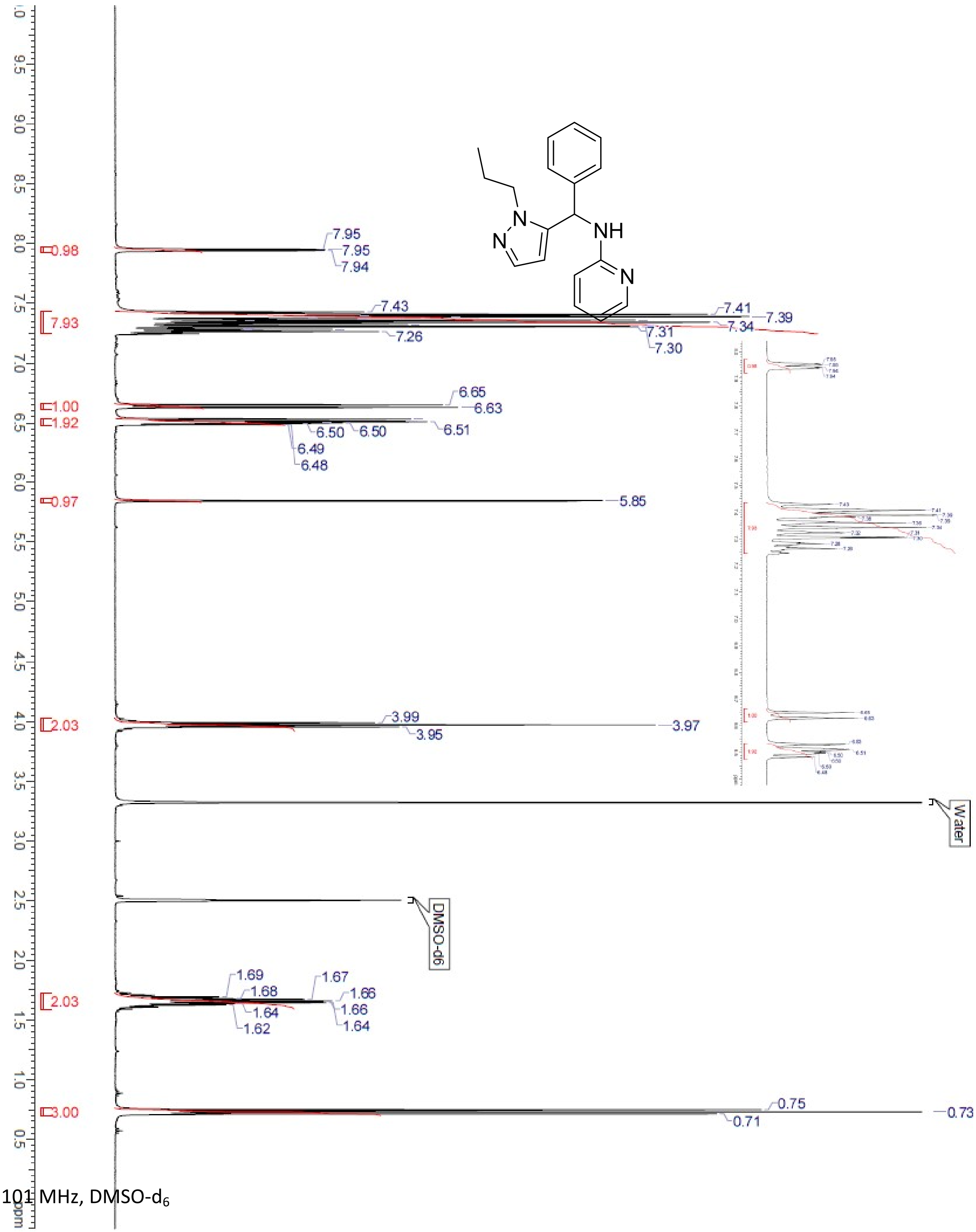

N
Br
HN
Cl



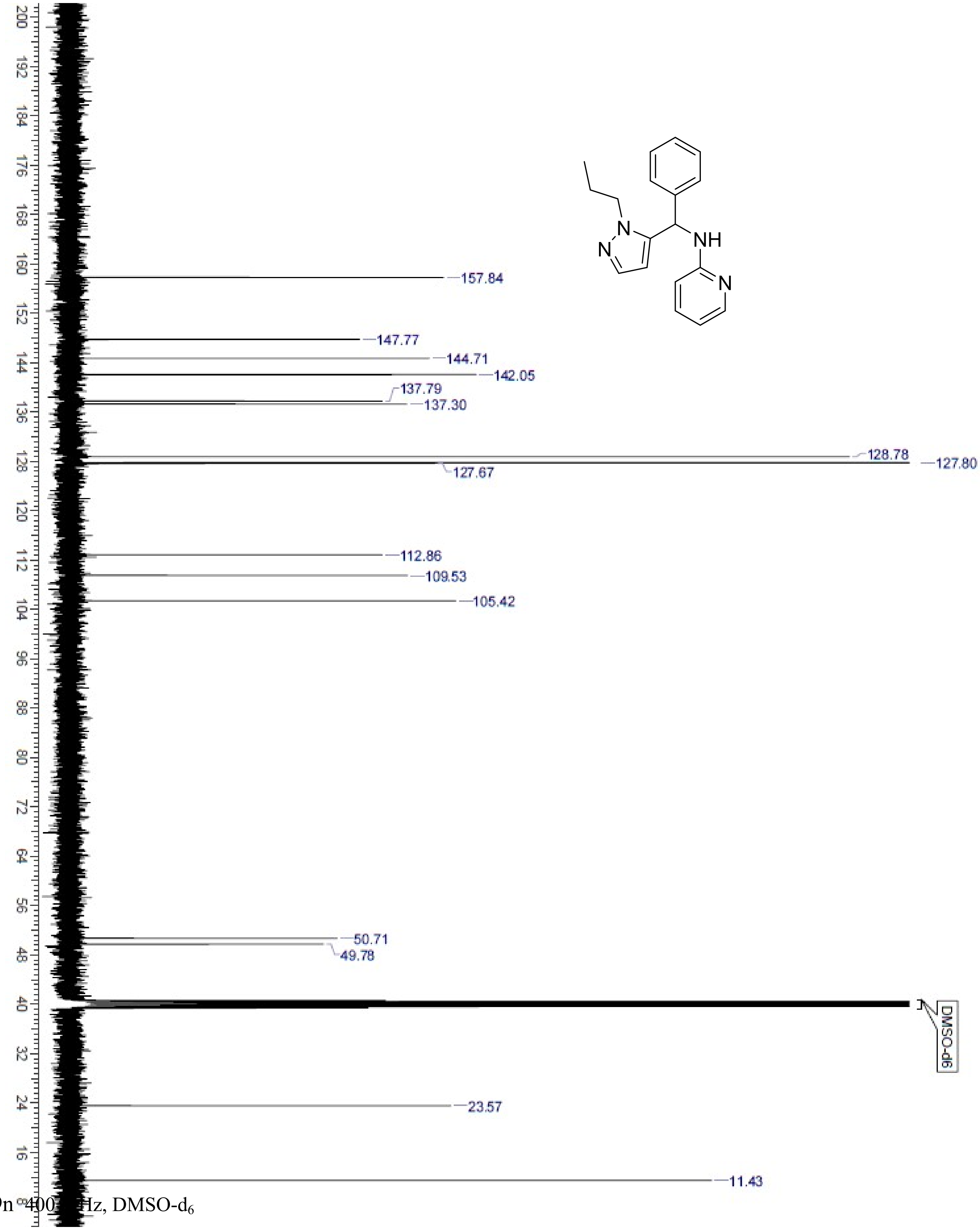
400 MHz, DMSO-d6



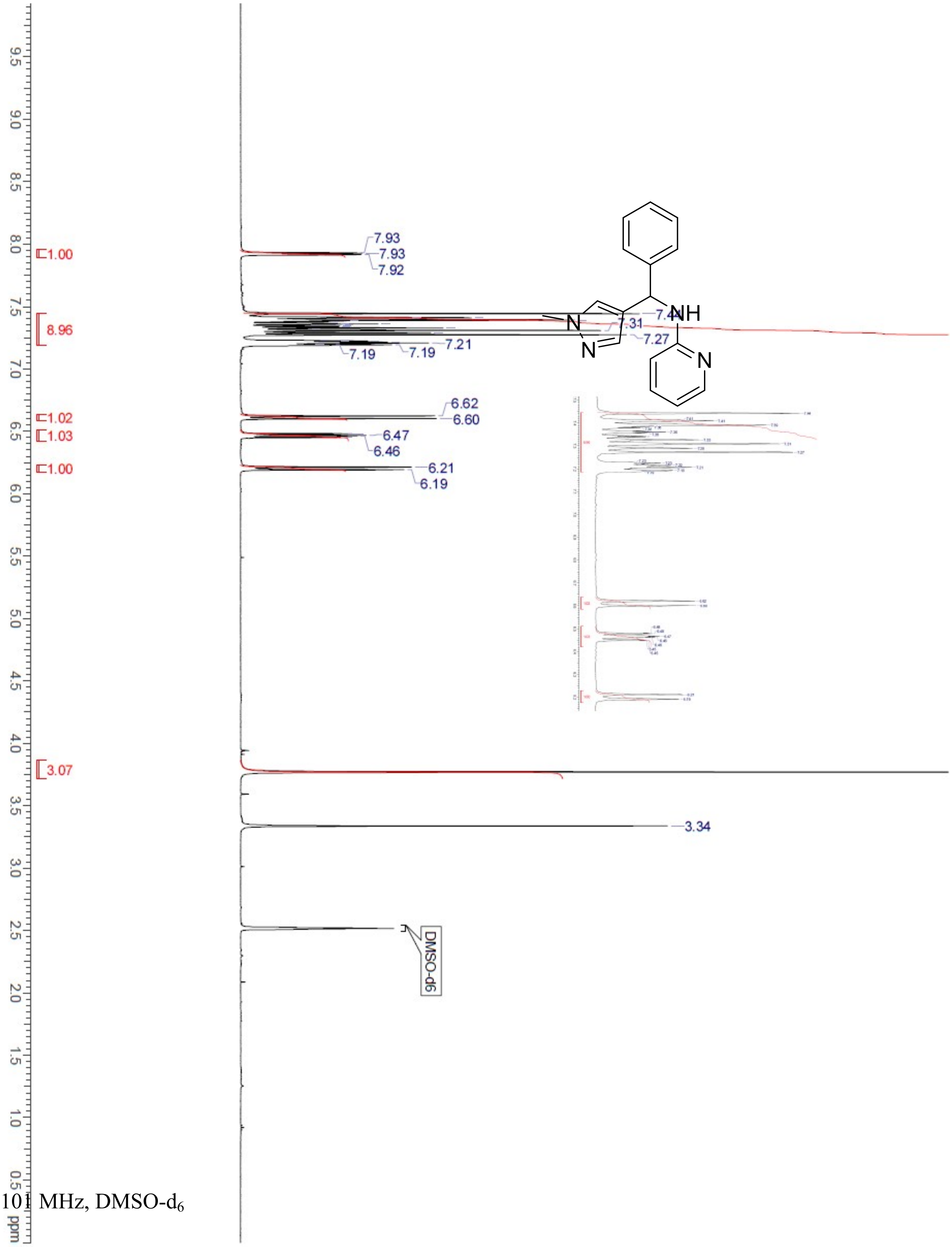
Compound 9l 400 MHz, DMSO-d_6



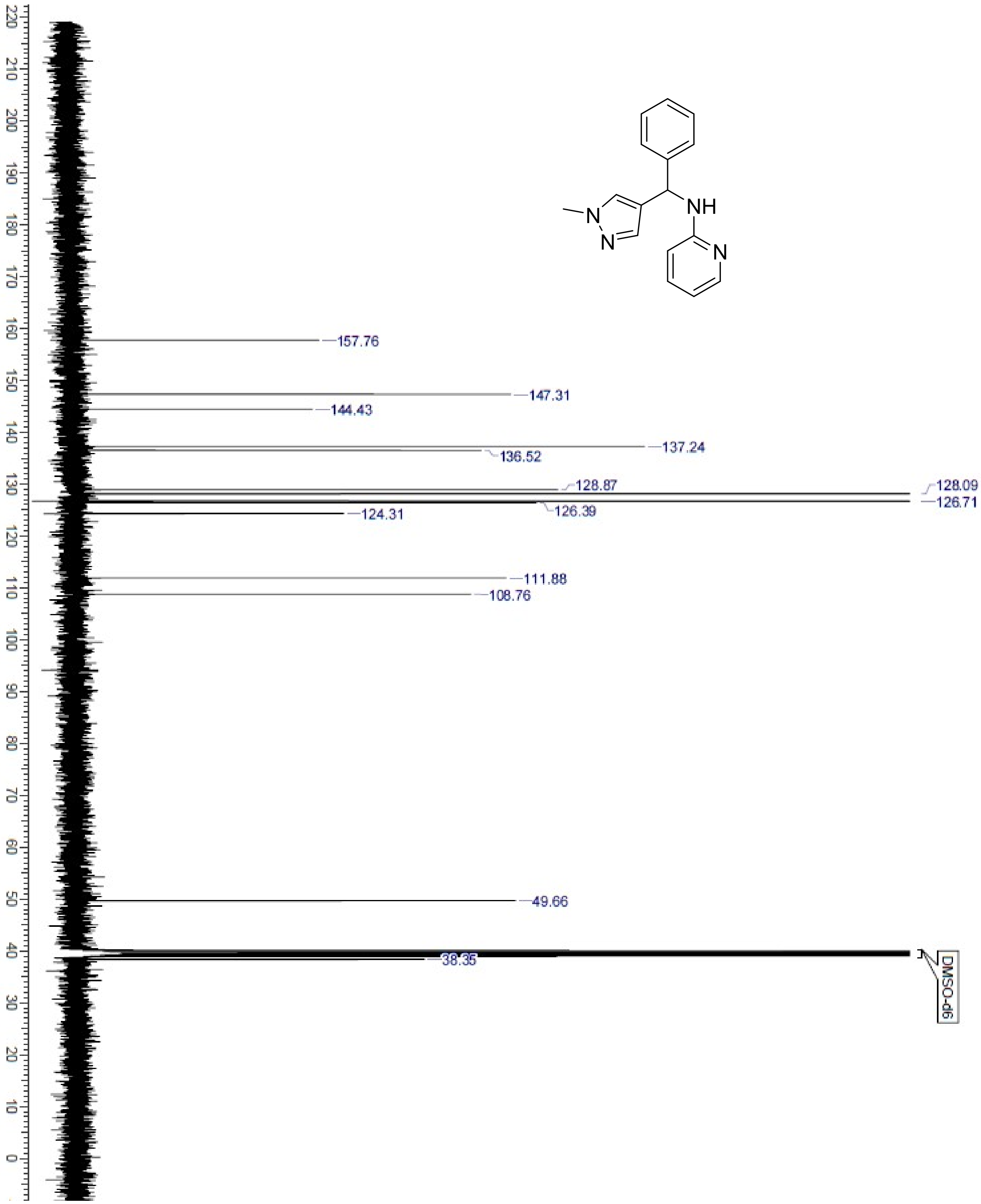
Compound 9l 101 MHz, DMSO-d$_6$



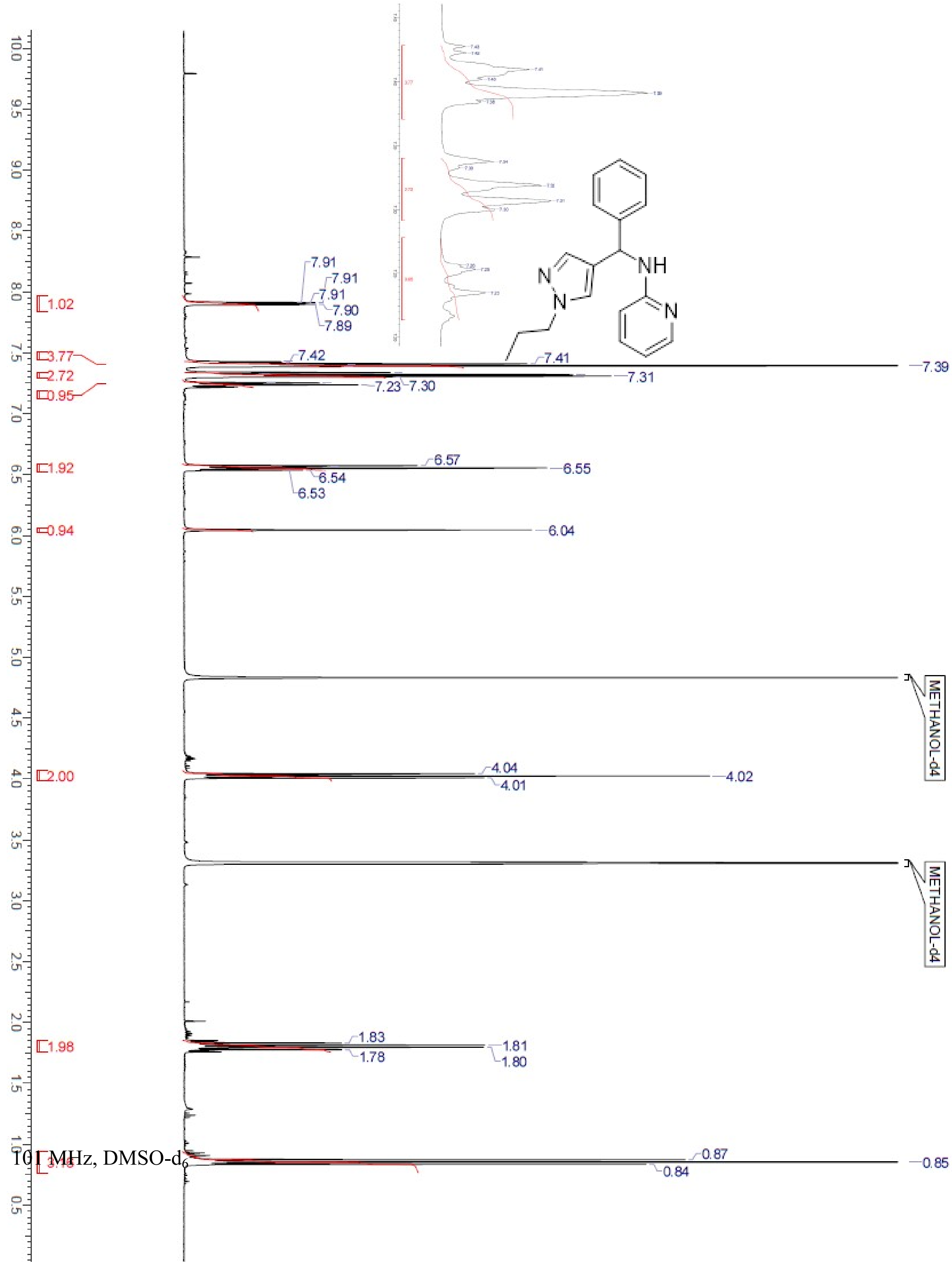
Compound 9n 400 MHz, DMSO-d_6



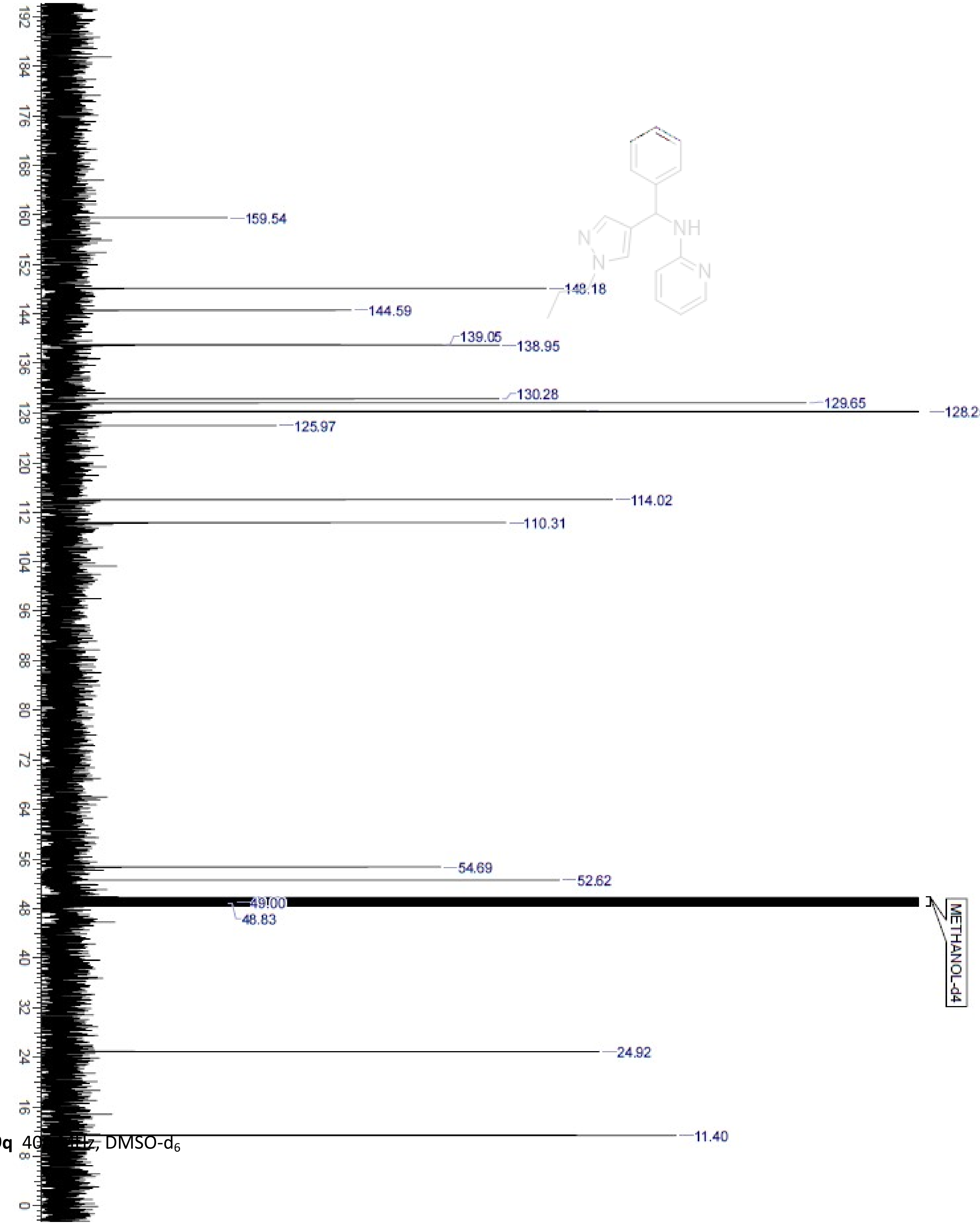
Compound 9n 101 MHz, DMSO-d_6



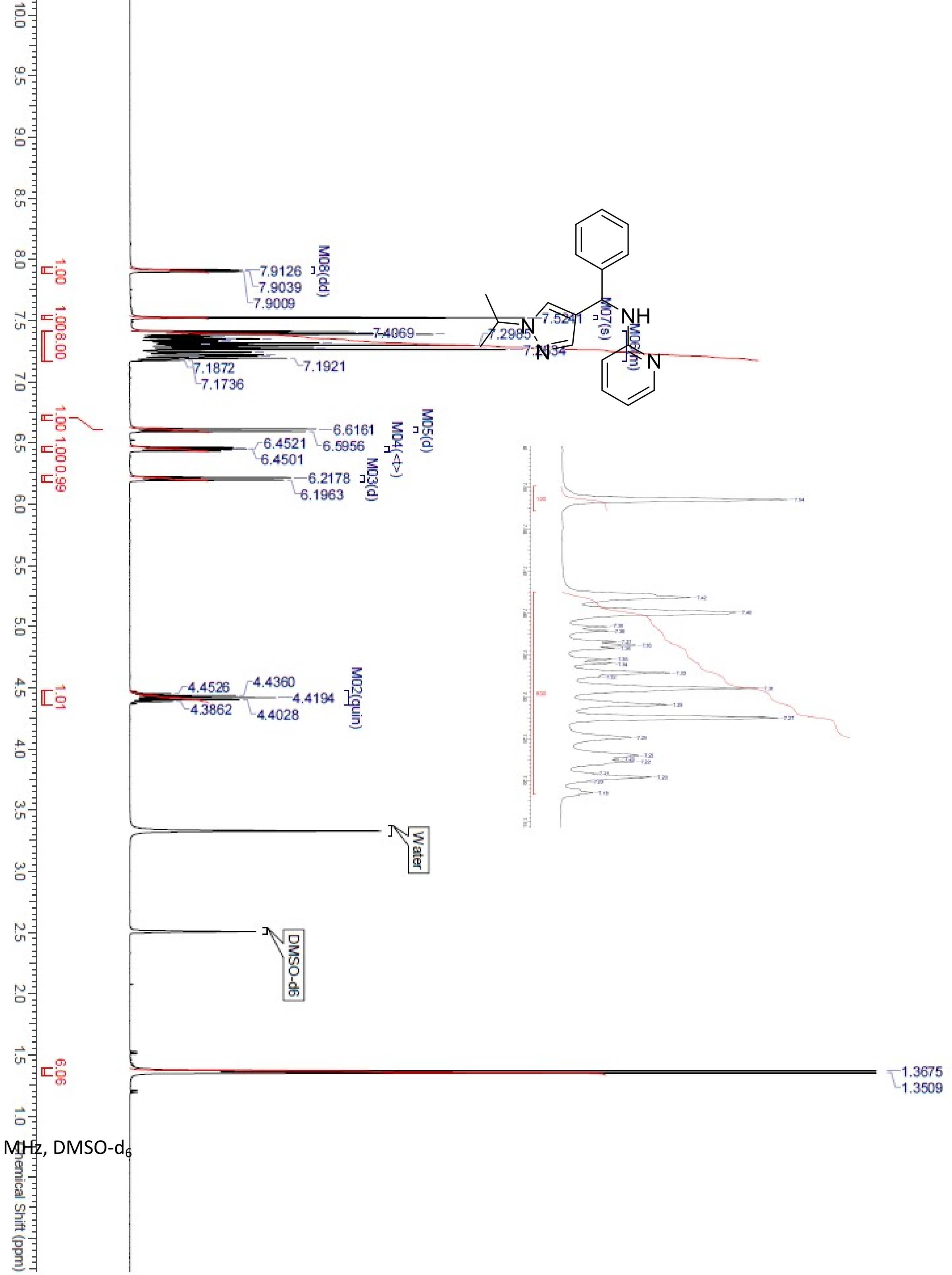
Compound 9o 400 MHz, DMSO-d_6



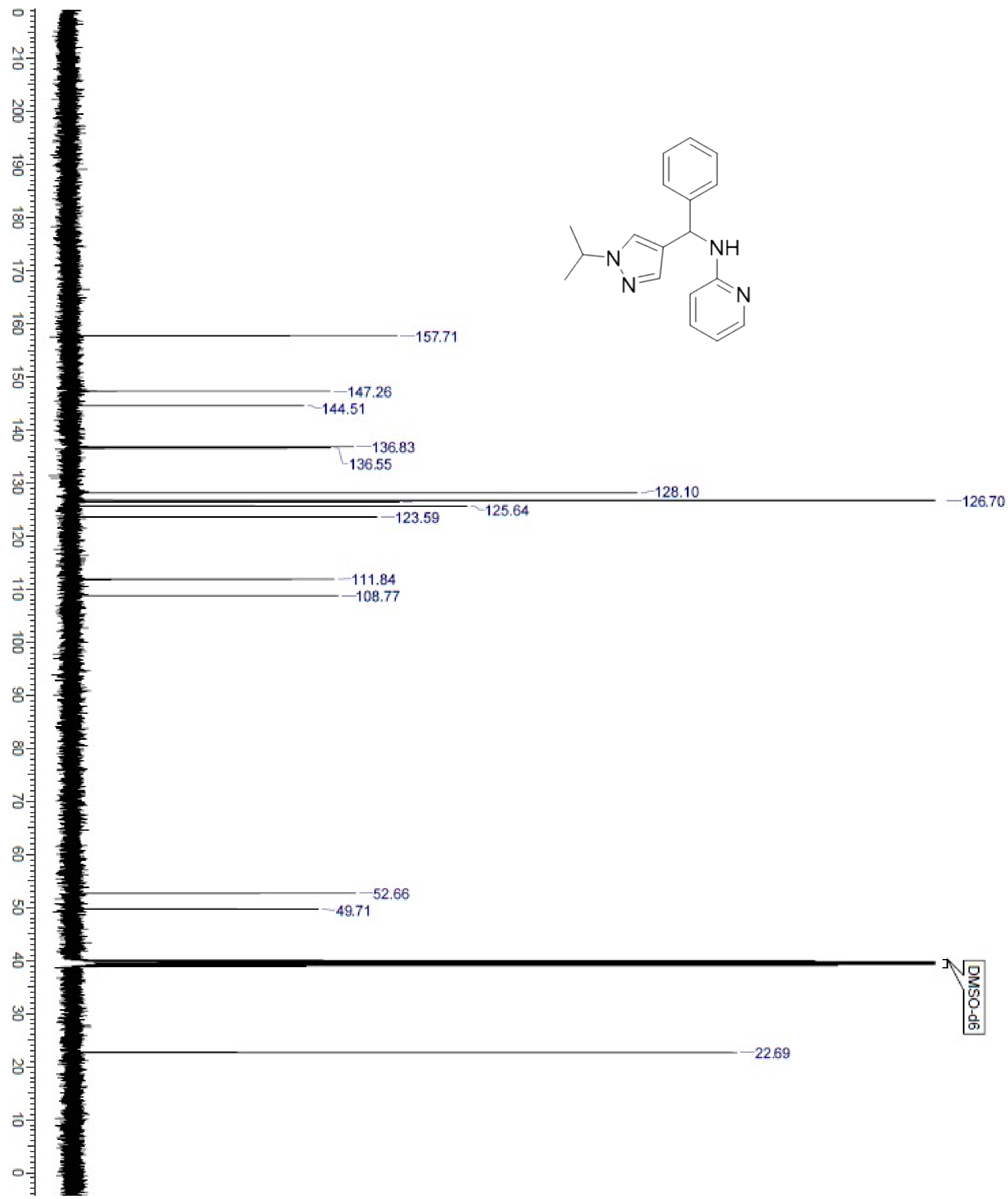
Compound 9o 101 MHz, DMSO-d6



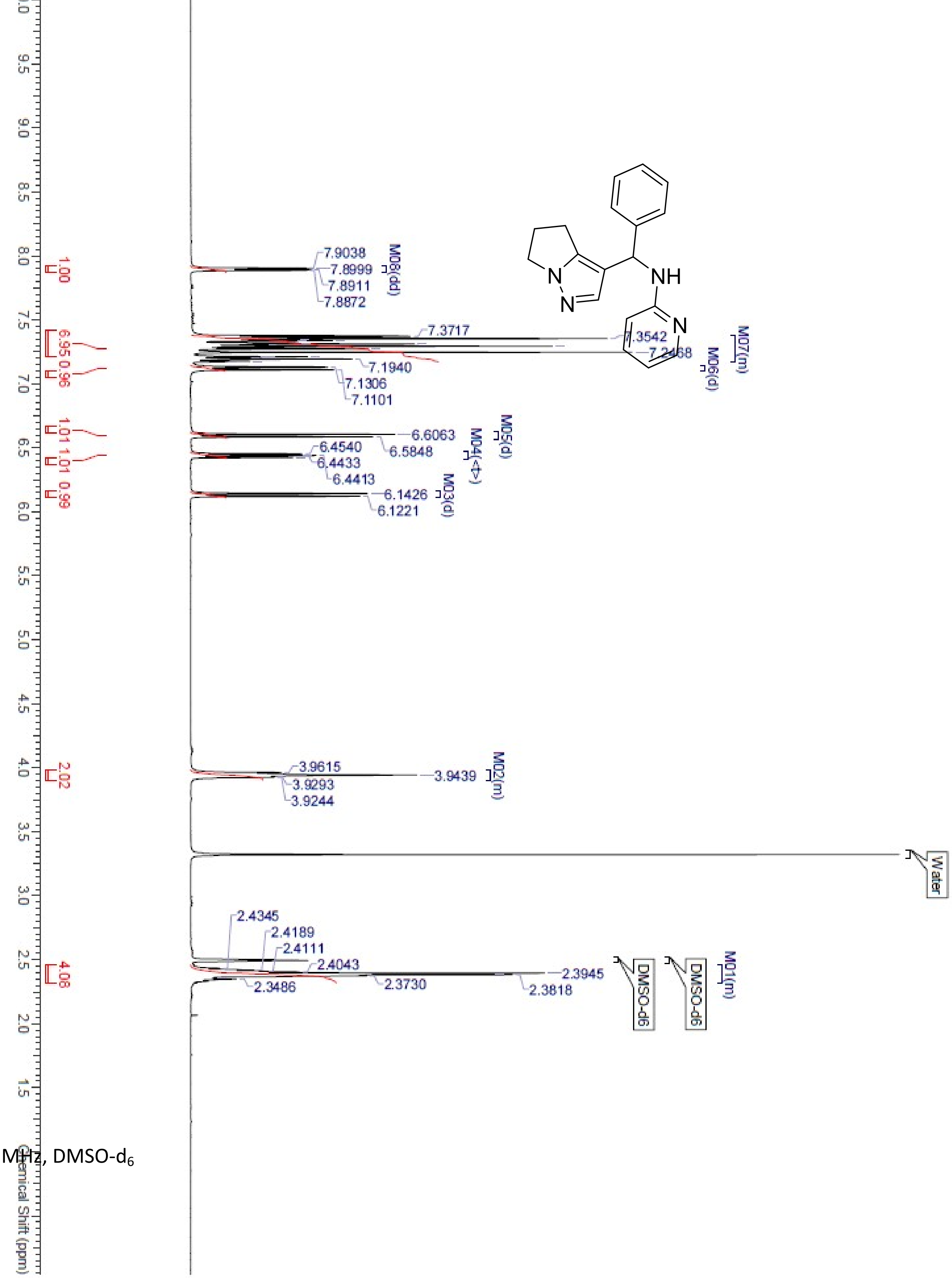
Compound 9q 400 MHz, DMSO-d_6



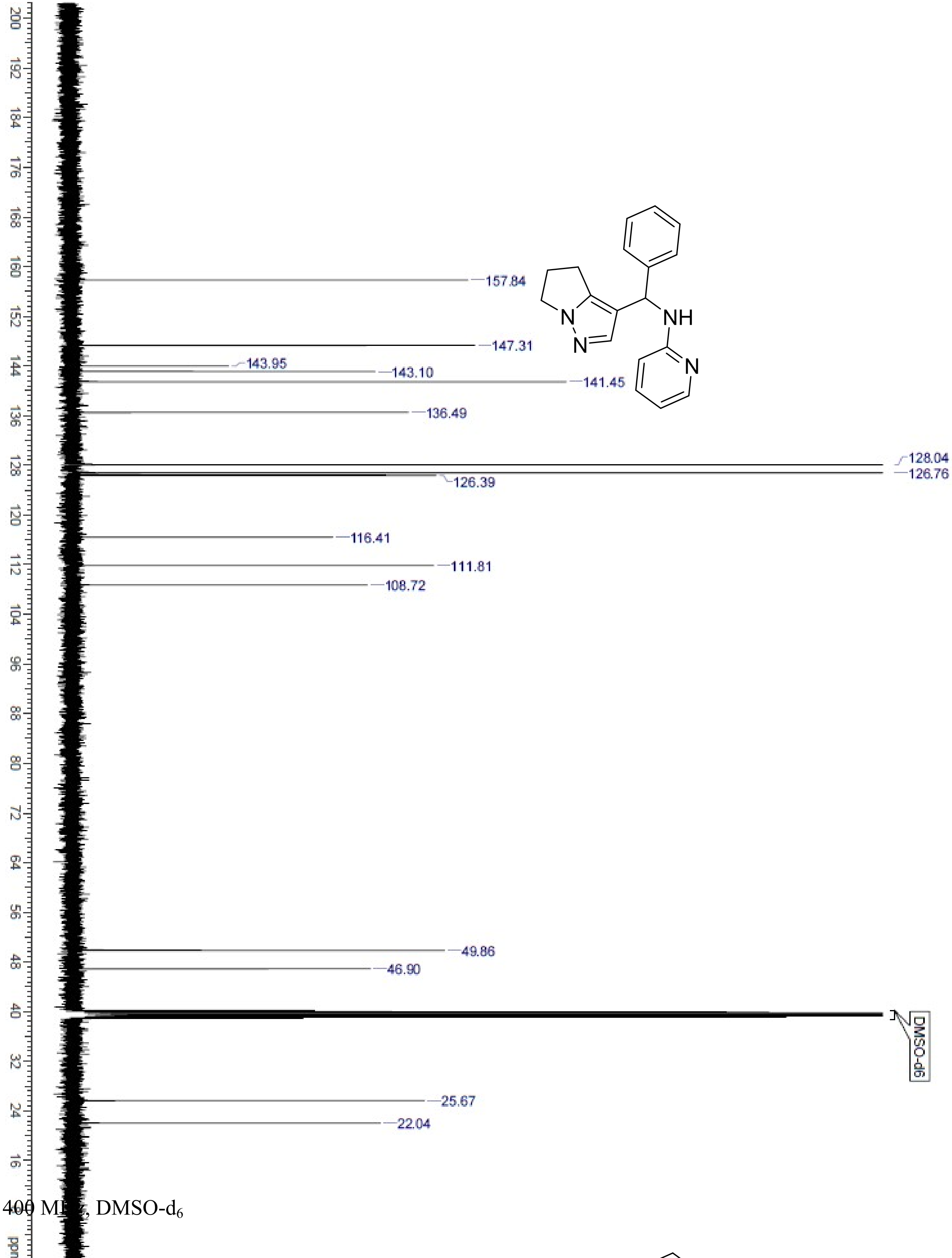
Compound 9q 101 MHz, DMSO-d_6



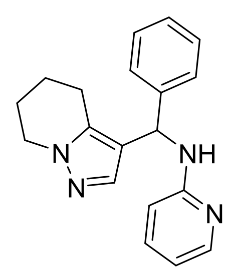
Compound 9s 400 MHz, DMSO-d_6

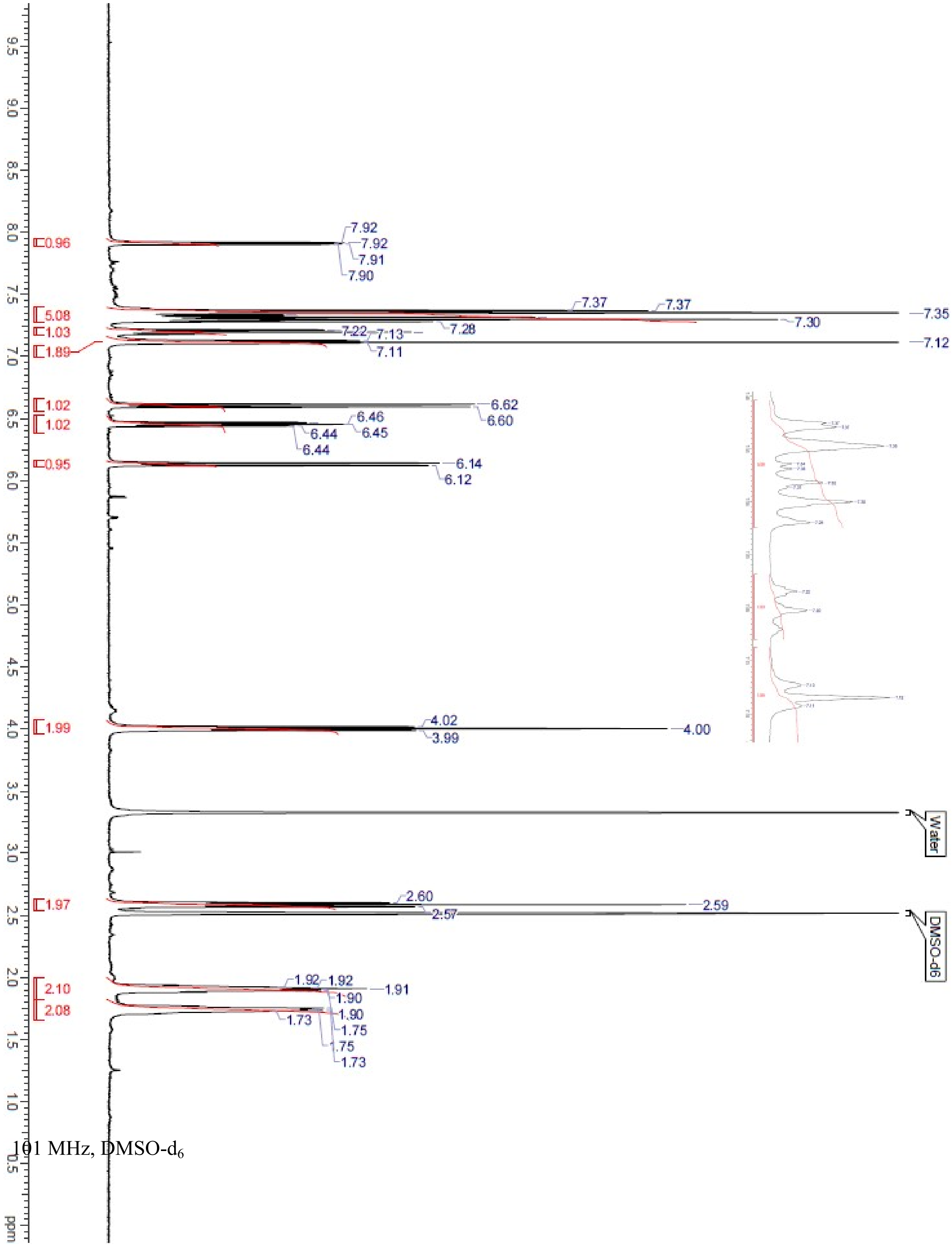


Compound 9s 101 MHz, DMSO-d_6

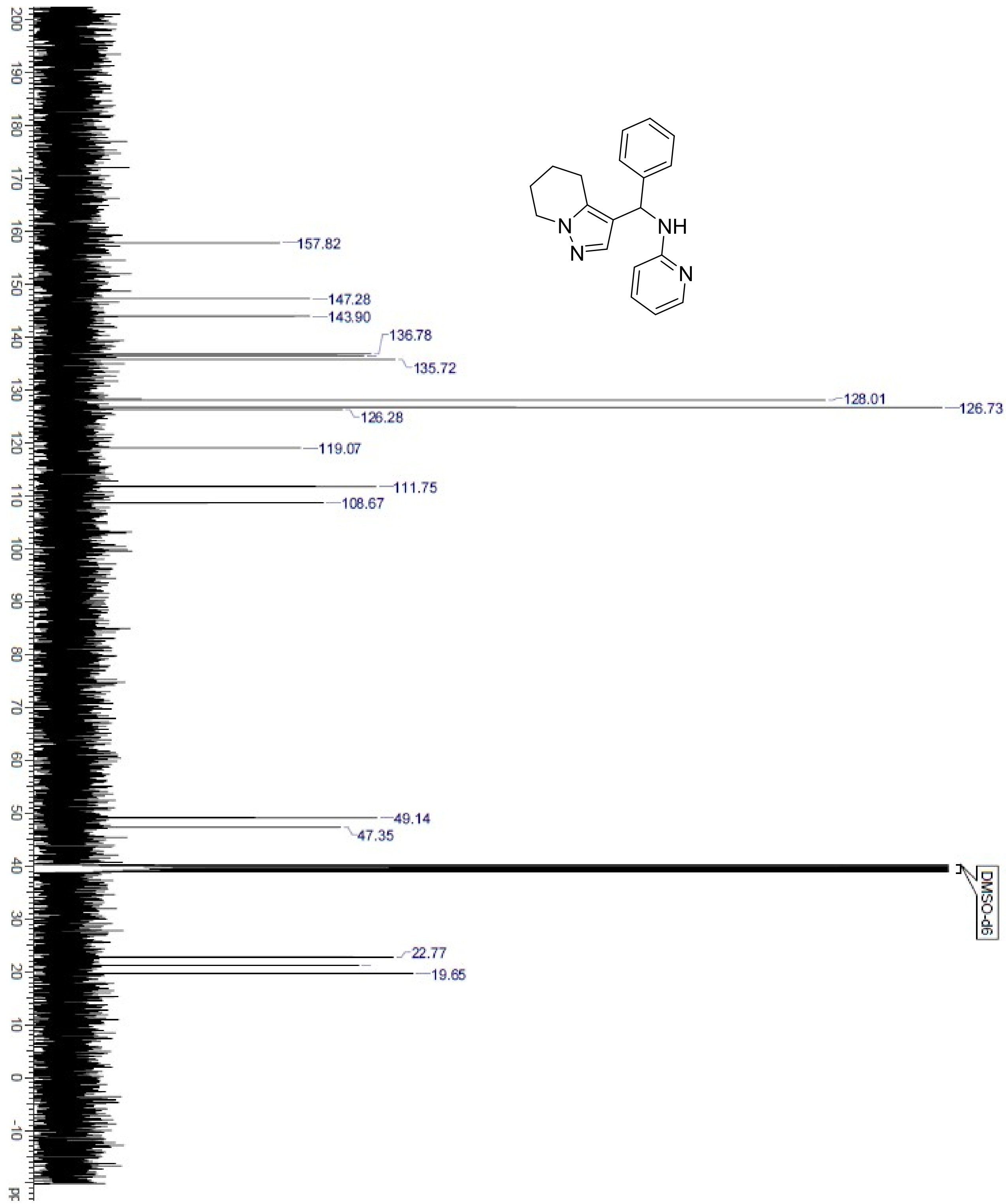


Compound 9t 400 MHz, DMSO-d$_6$

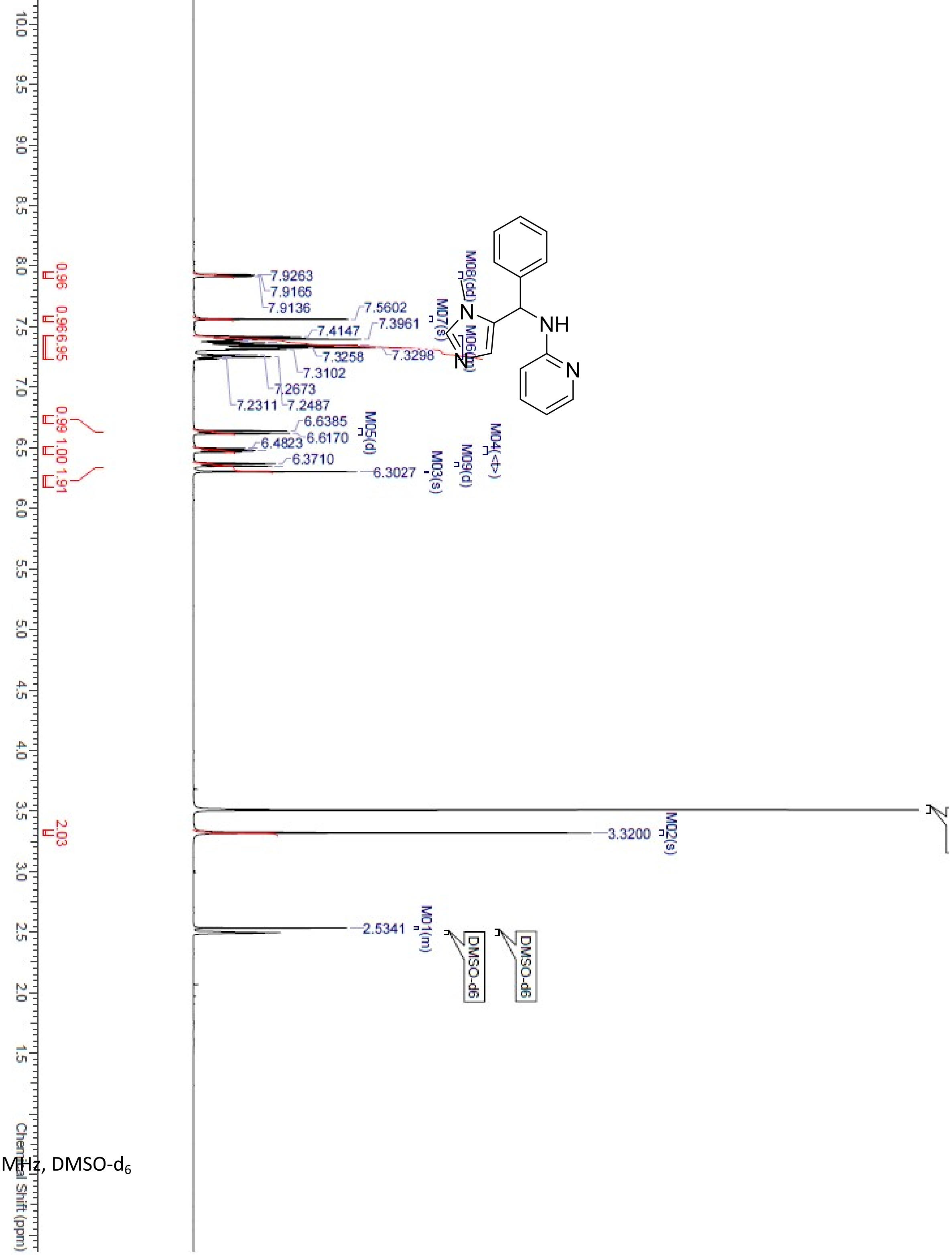




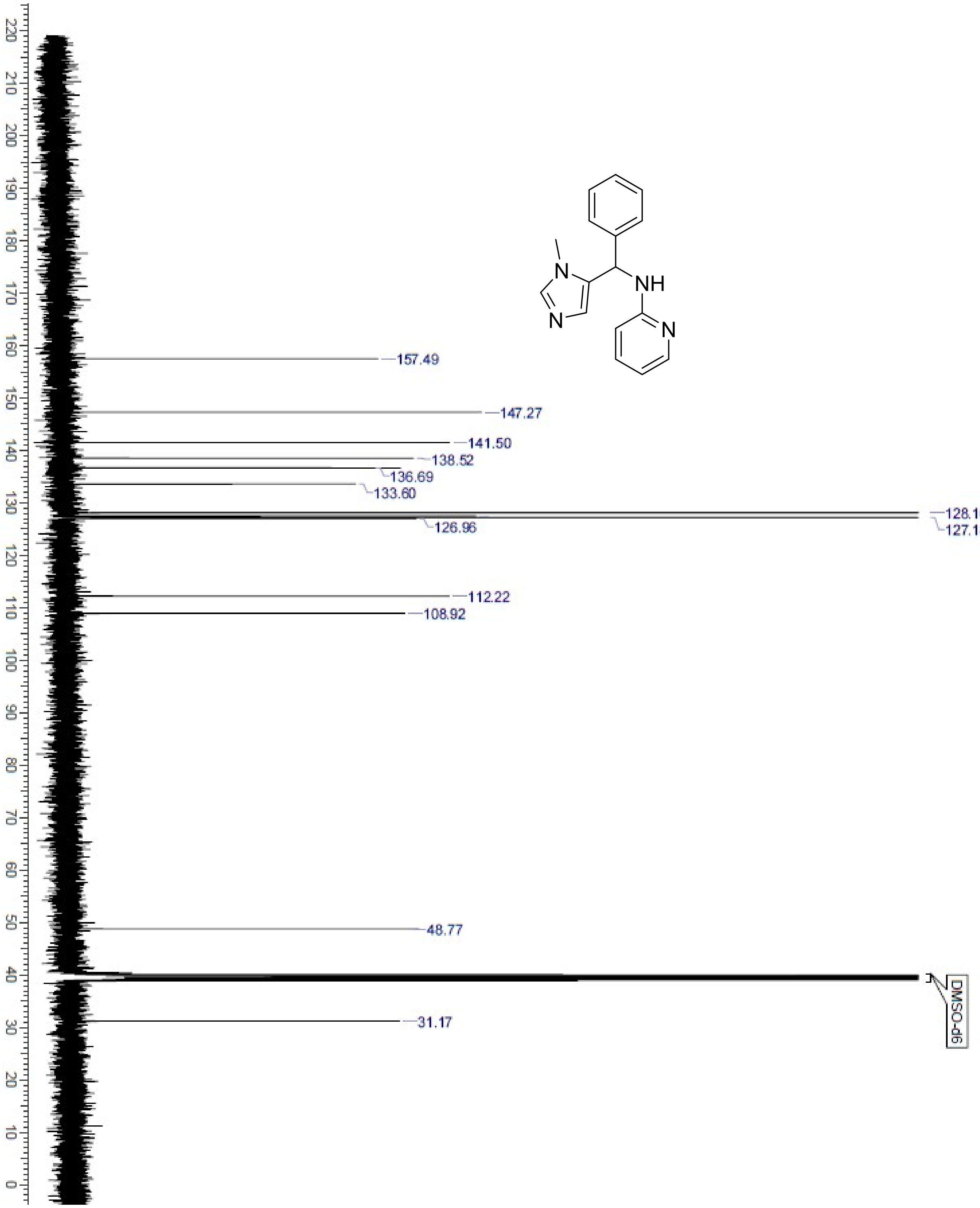
Compound 9t 101 MHz, DMSO-d_6



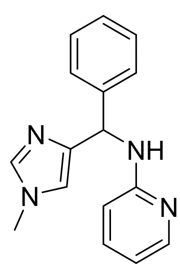
Compound 9u 400 MHz, DMSO-d_6

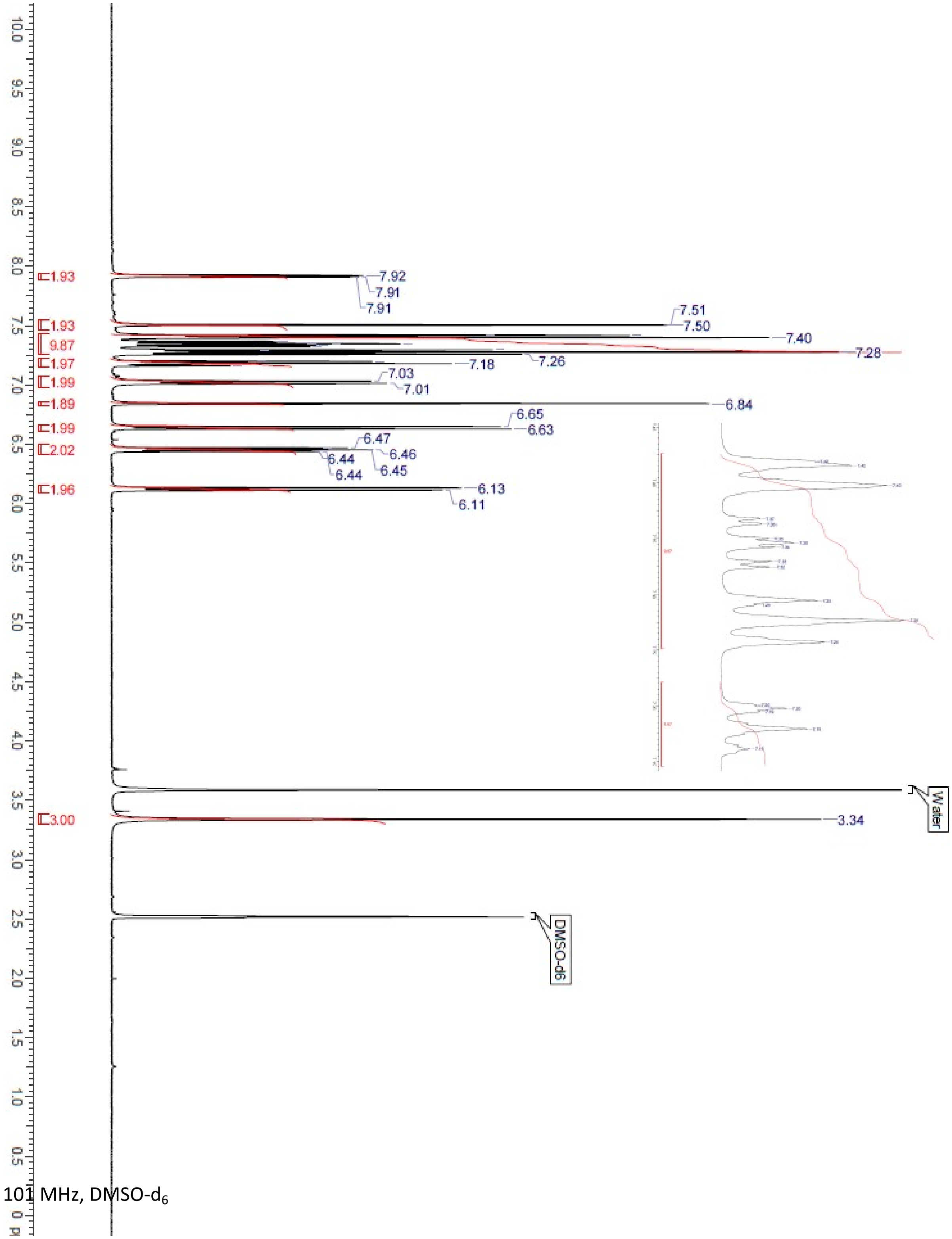


Compound 9u 101 MHz, DMSO-d_6

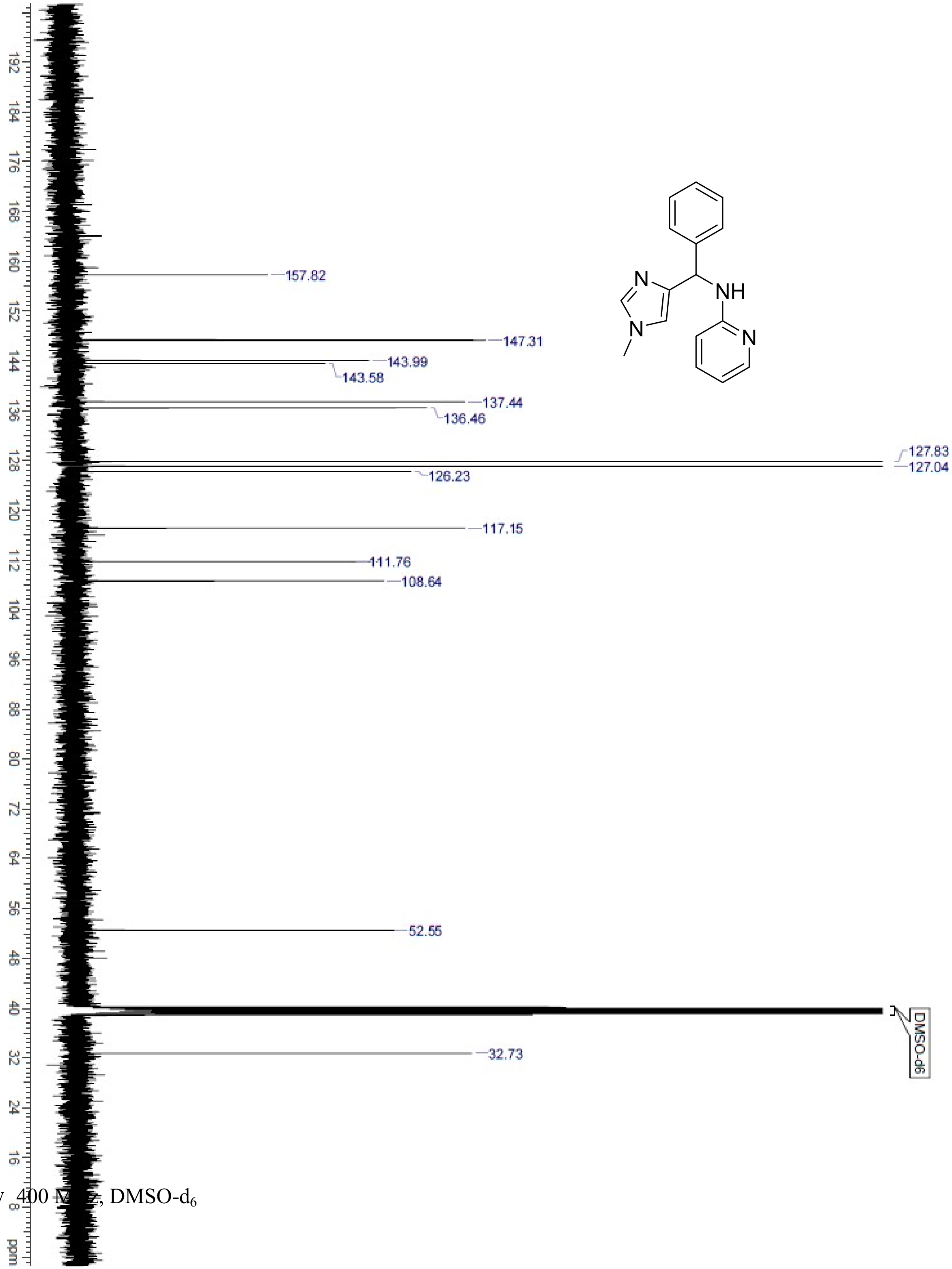


Compound 9v 400 MHz, DMSO-d_6

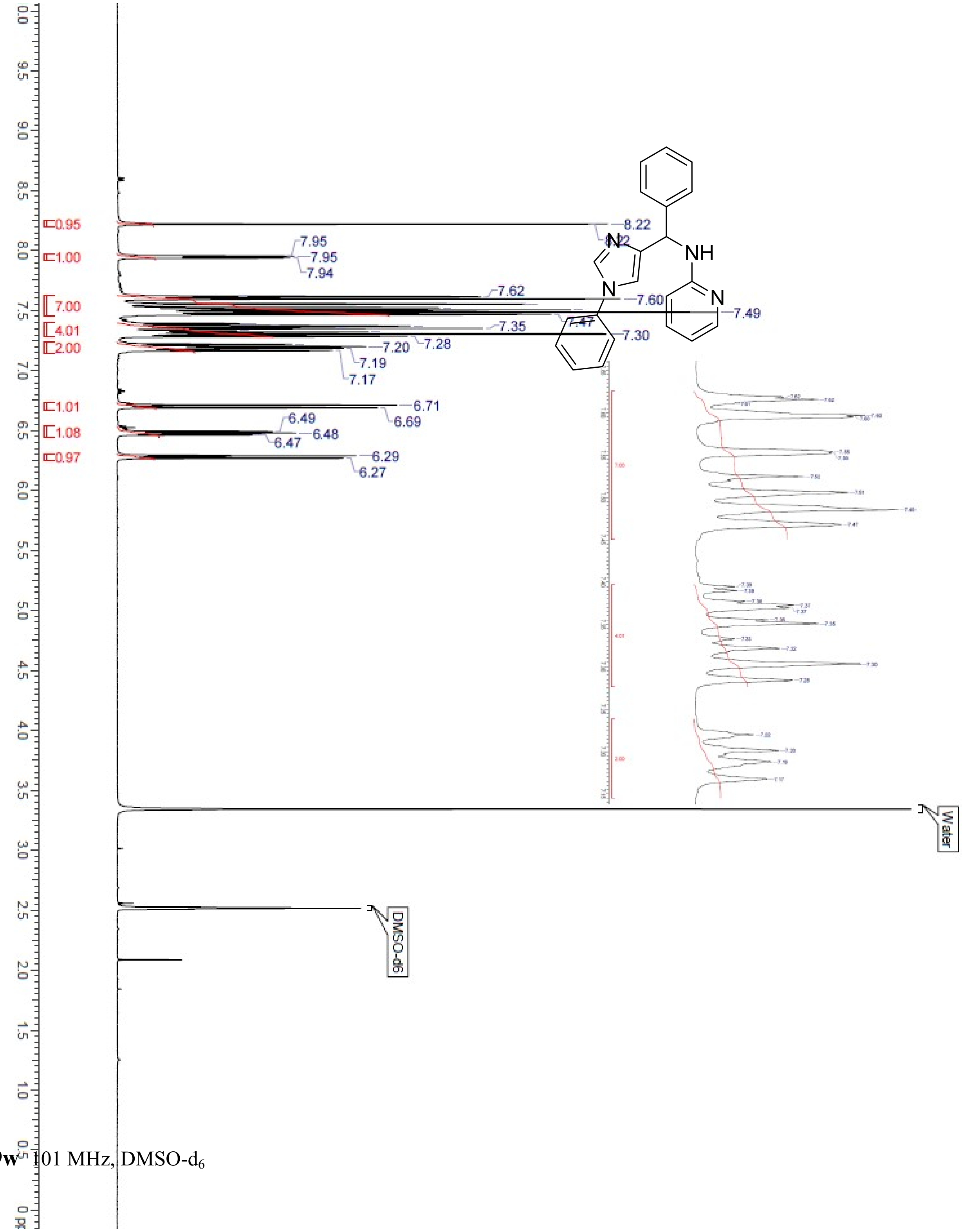




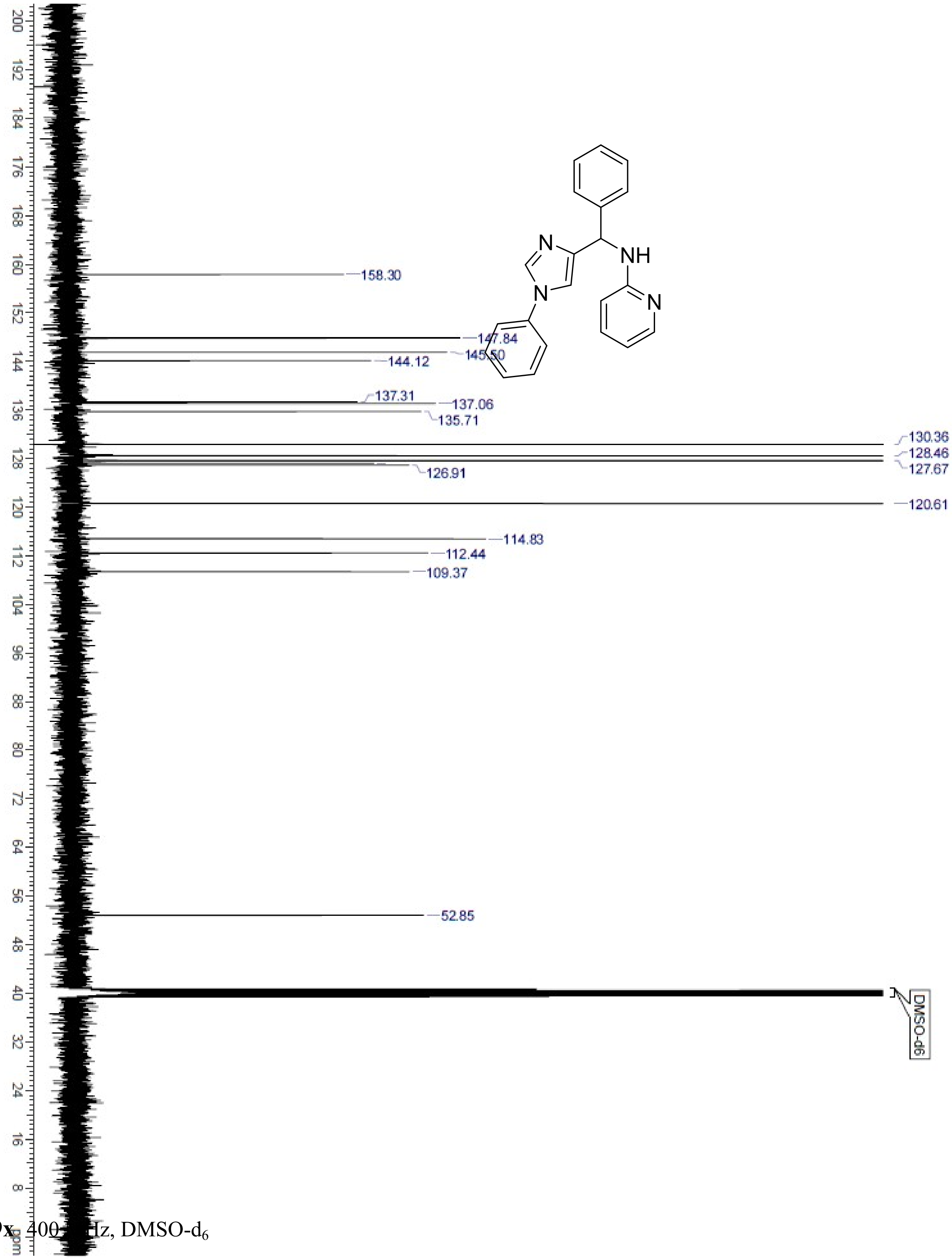
Compound 9v 101 MHz, DMSO-d$_6$



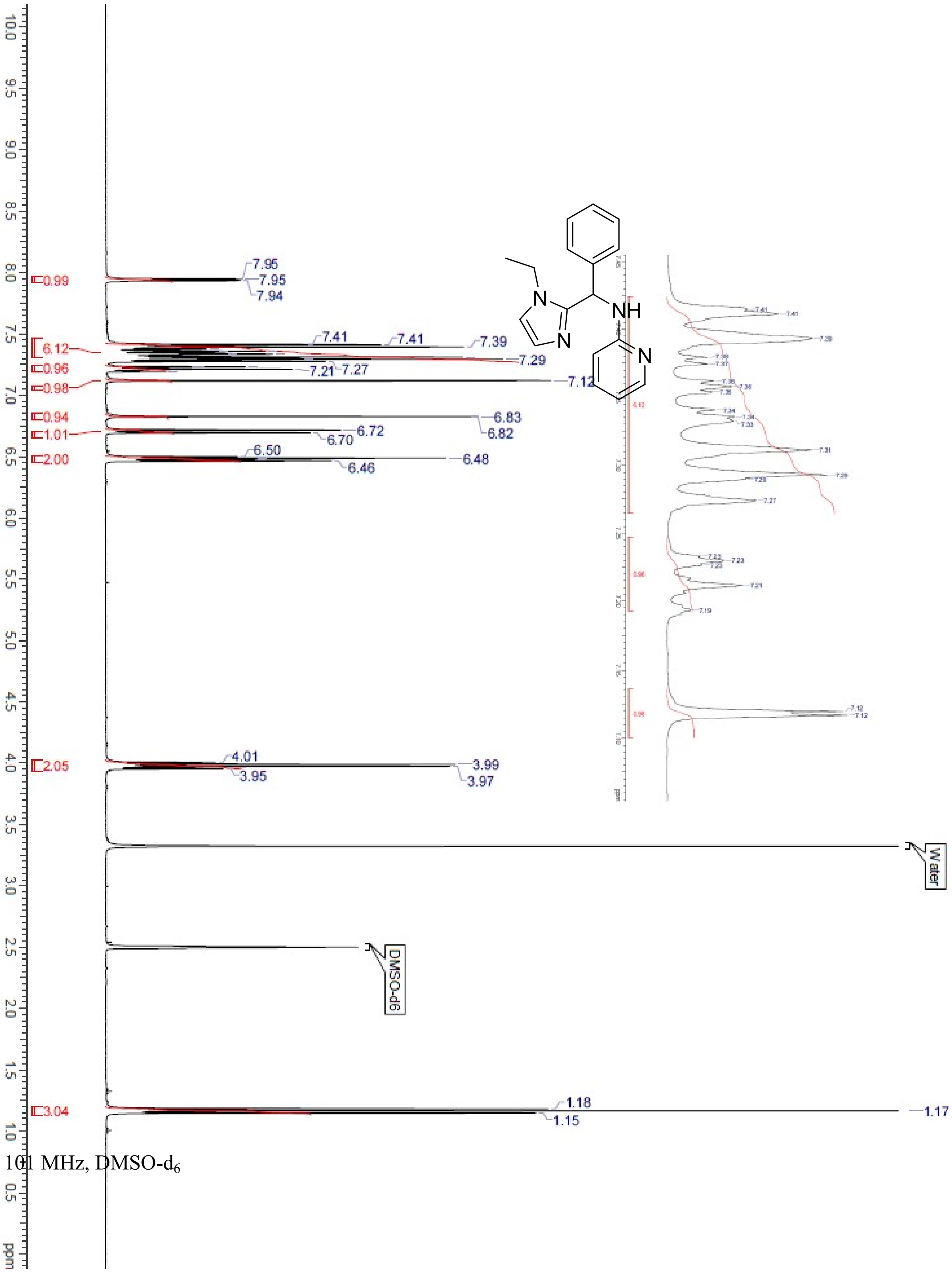
Compound 9w 400 MHz, DMSO-d_6



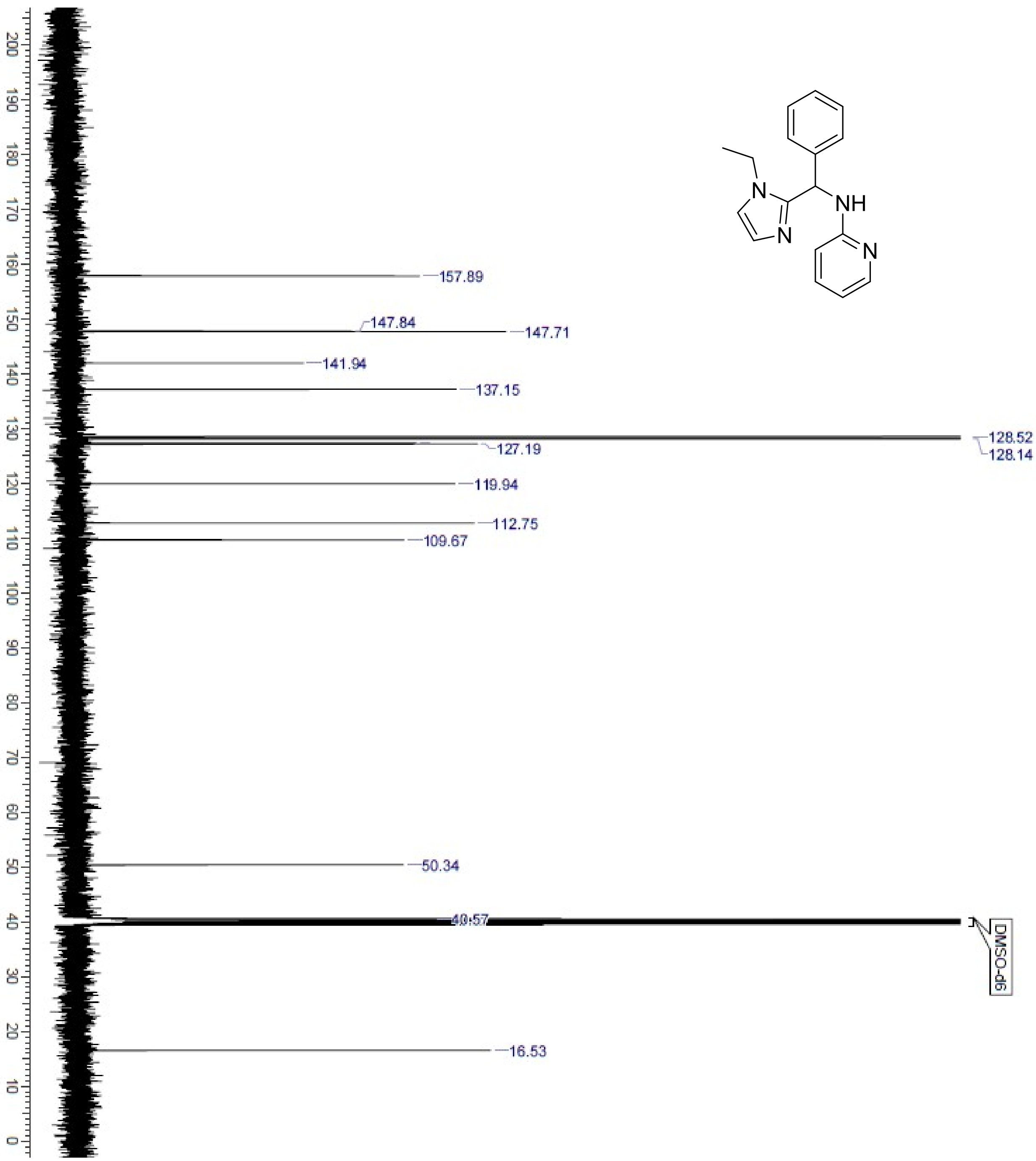
Compound 9w 101 MHz, DMSO-d$_6$



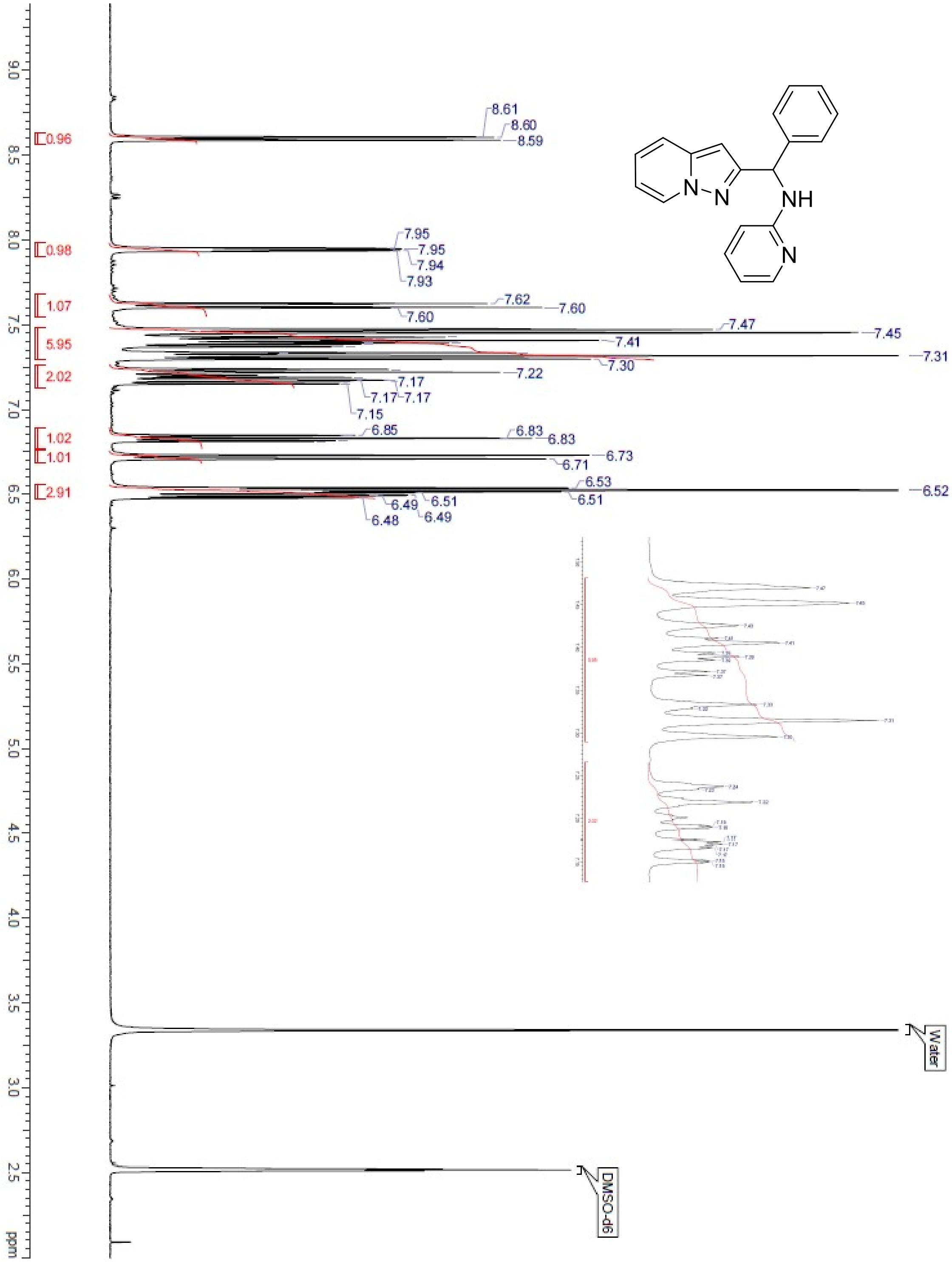
Compound 9x, 400 MHz, DMSO-d_6



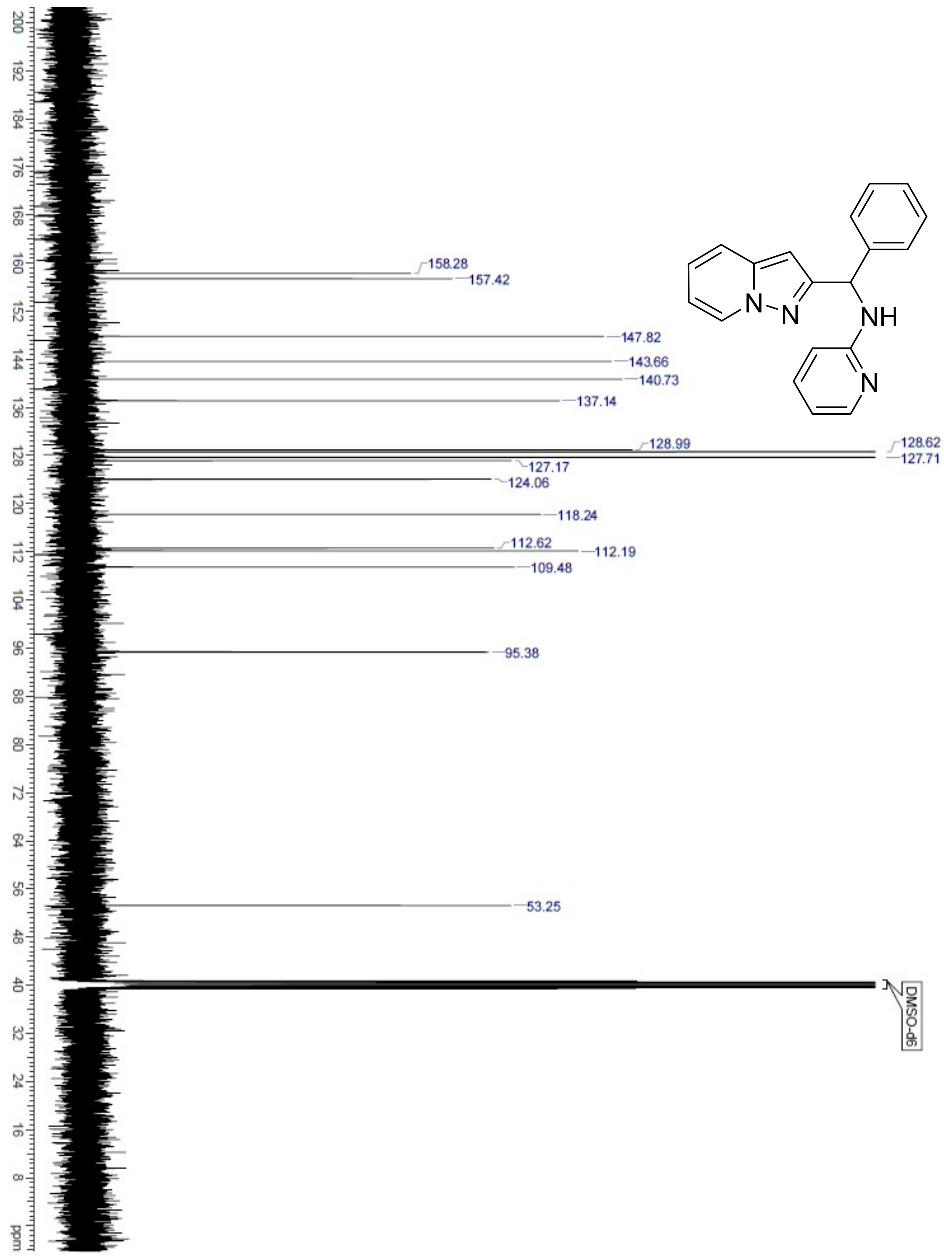
Compound 9x 101 MHz, DMSO-d_6



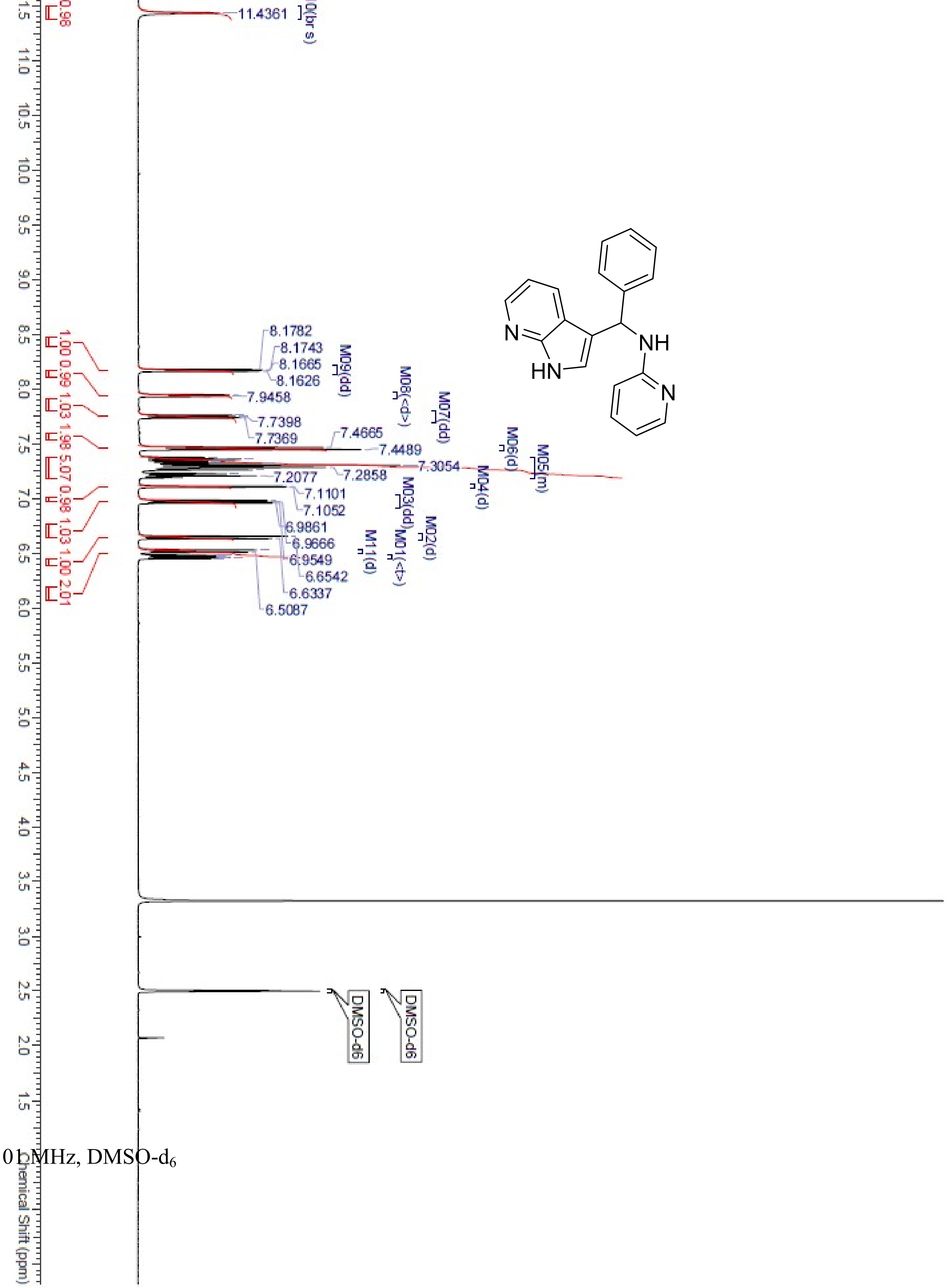
Compound 9aa 400 MHz, DMSO-d_6



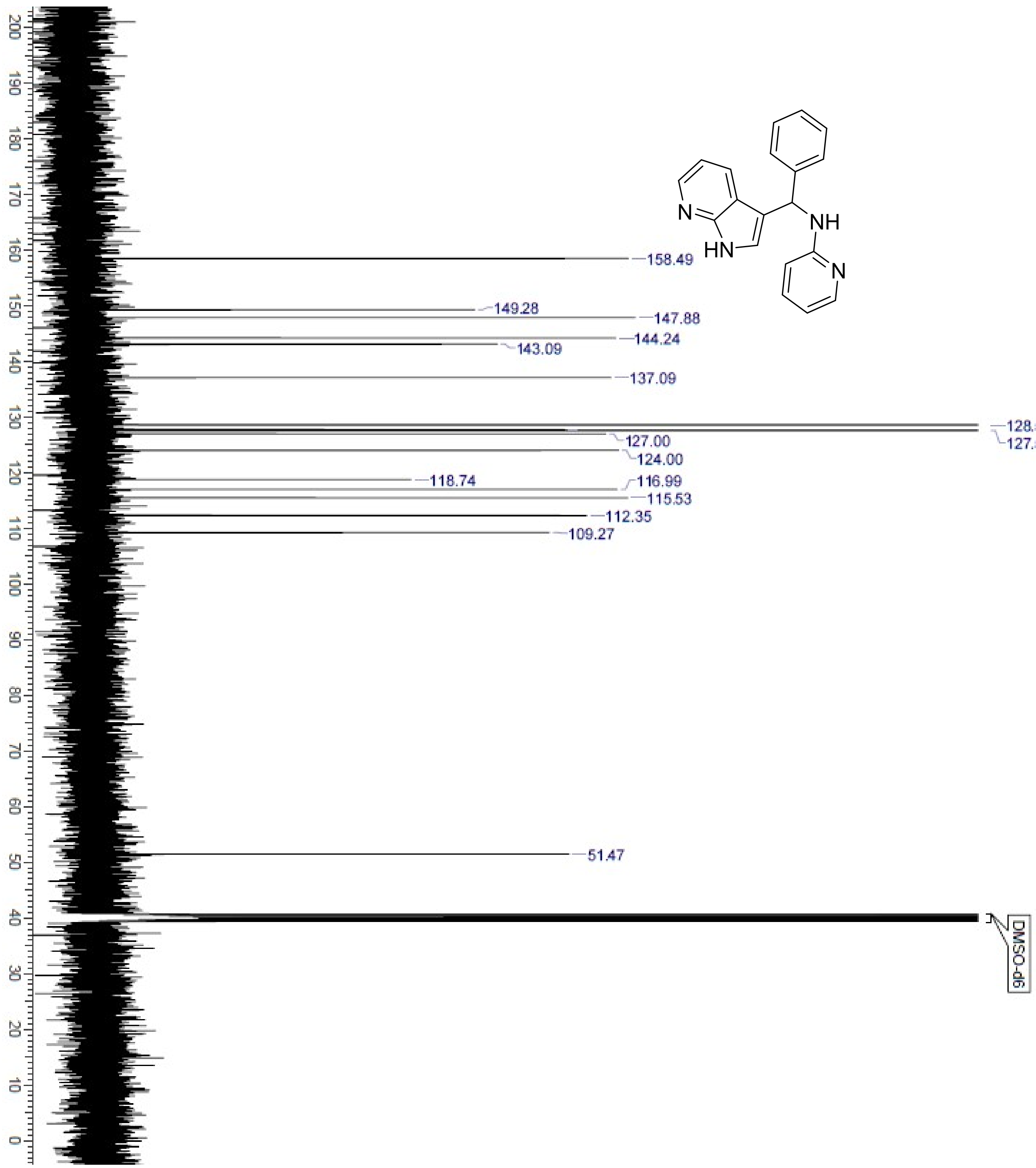
Compound 9aa 101 MHz, DMSO-d$_6$



Compound 9ac 400 MHz, DMSO-d_6



Compound 9ac 101 MHz, DMSO-d_6



N
HN
NH
N
158.49
149.28
147.88
144.24
143.09
137.09
128.56
127.59
127.00
124.00
118.74
116.99
115.53
112.35
109.27
51.47
DMSO-d6