

Supporting Information

A new series of cytotoxic pyrazoline derivatives as potential anticancer agents induces cell cycle arrest and apoptosis

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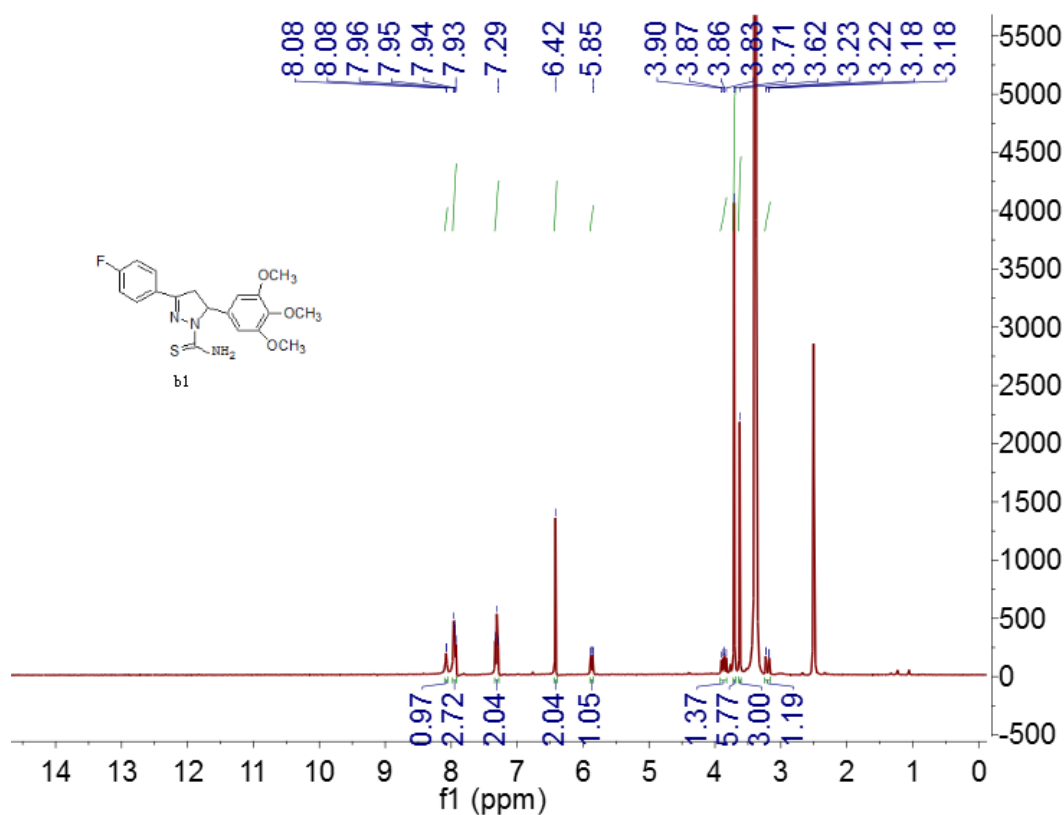
† These authors contributed equally to this work.

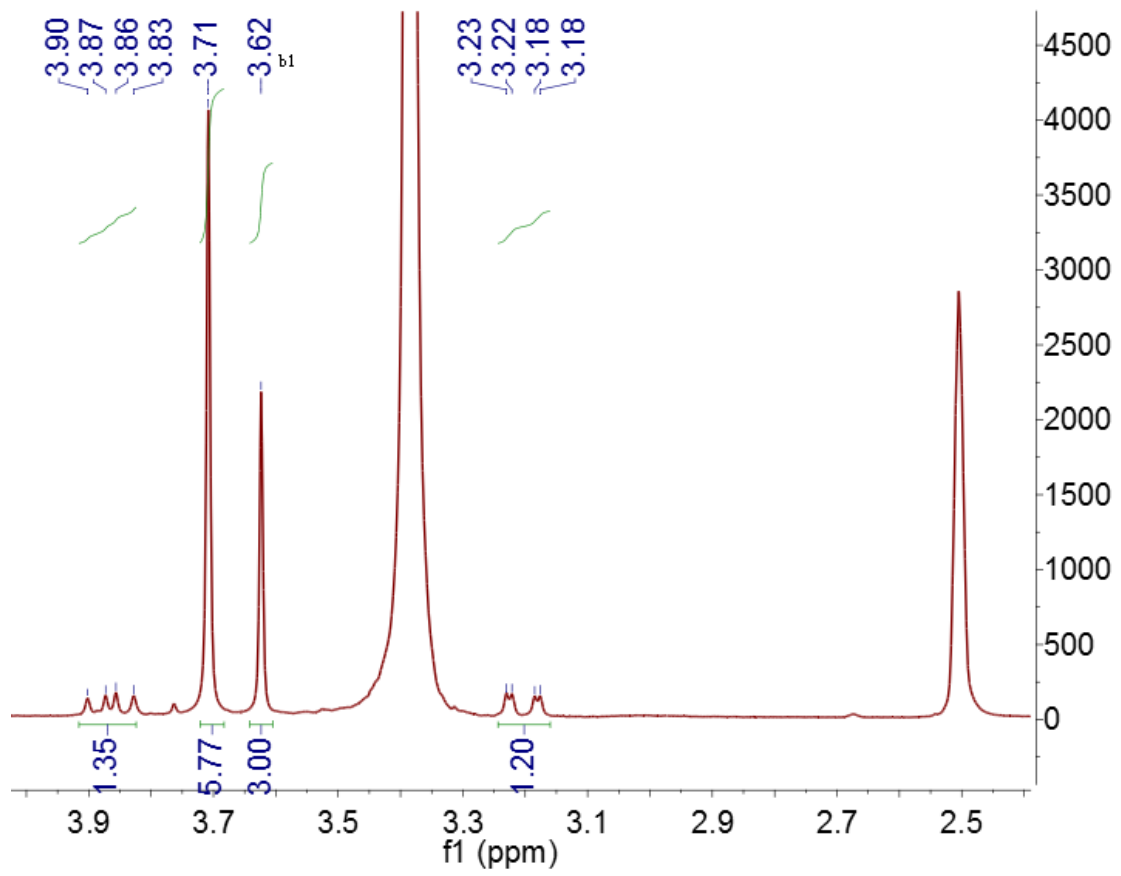
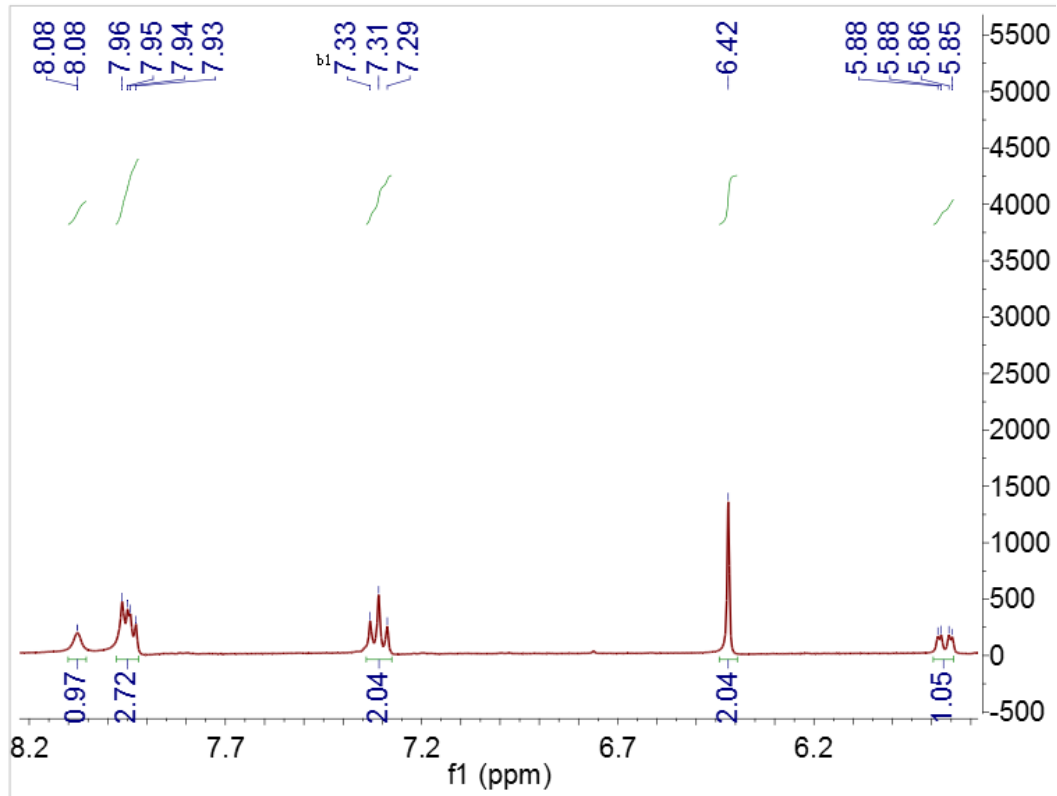
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Figure S1. The representative ¹H NMR of all compounds **1b-12b**.

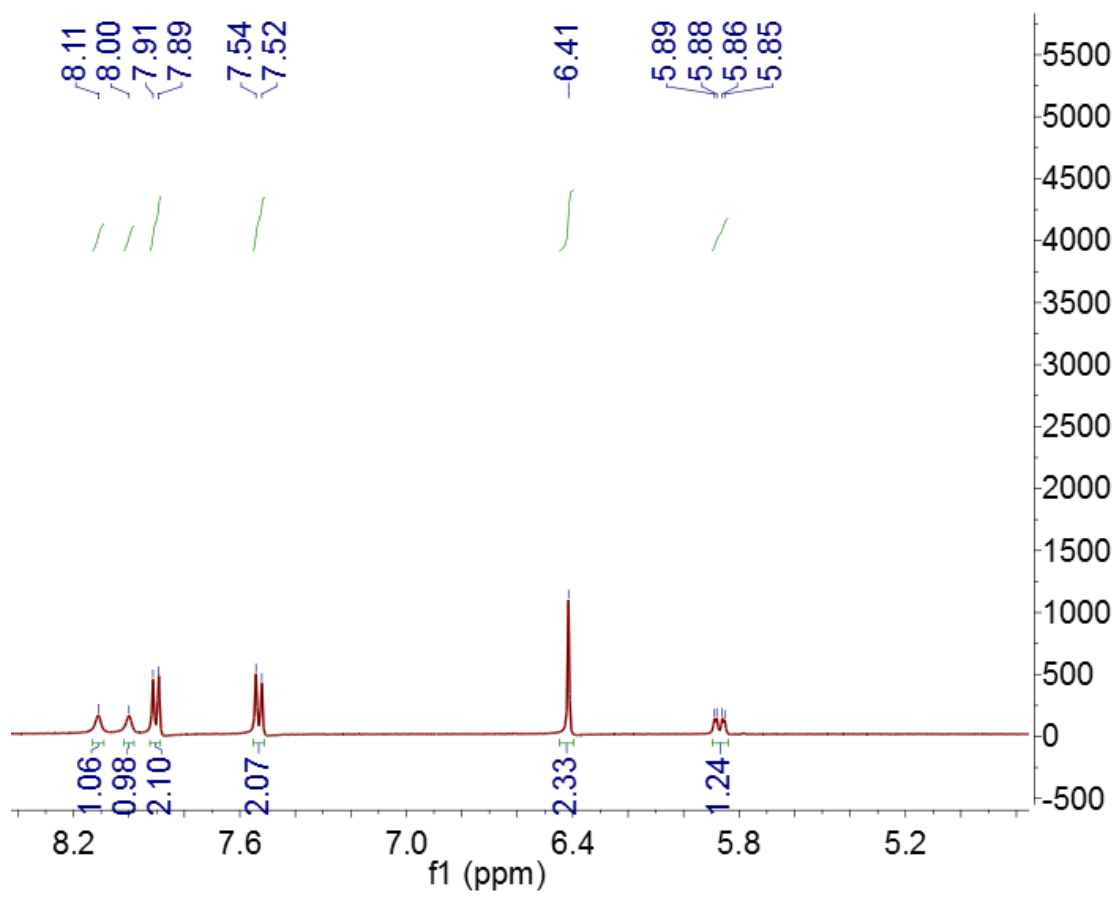
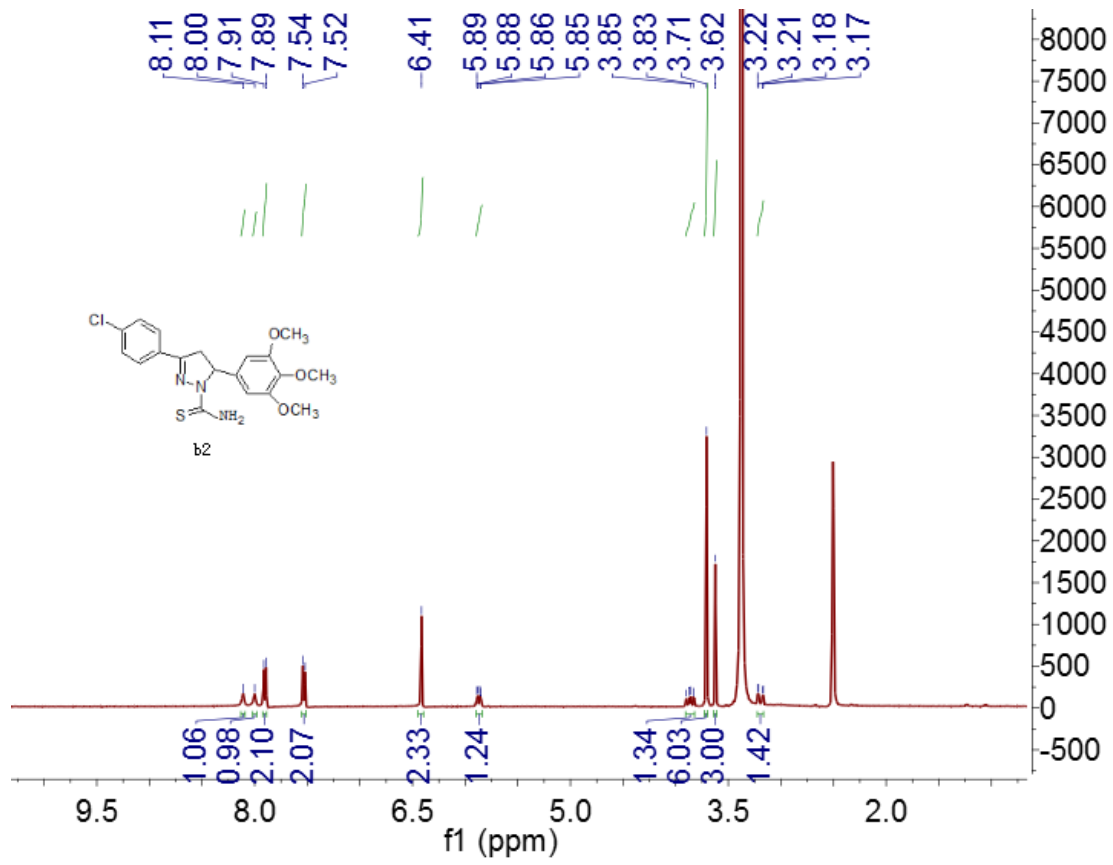
¹H NMR spectrum of compounds **1b-12b** (400 MHz, DMSO)

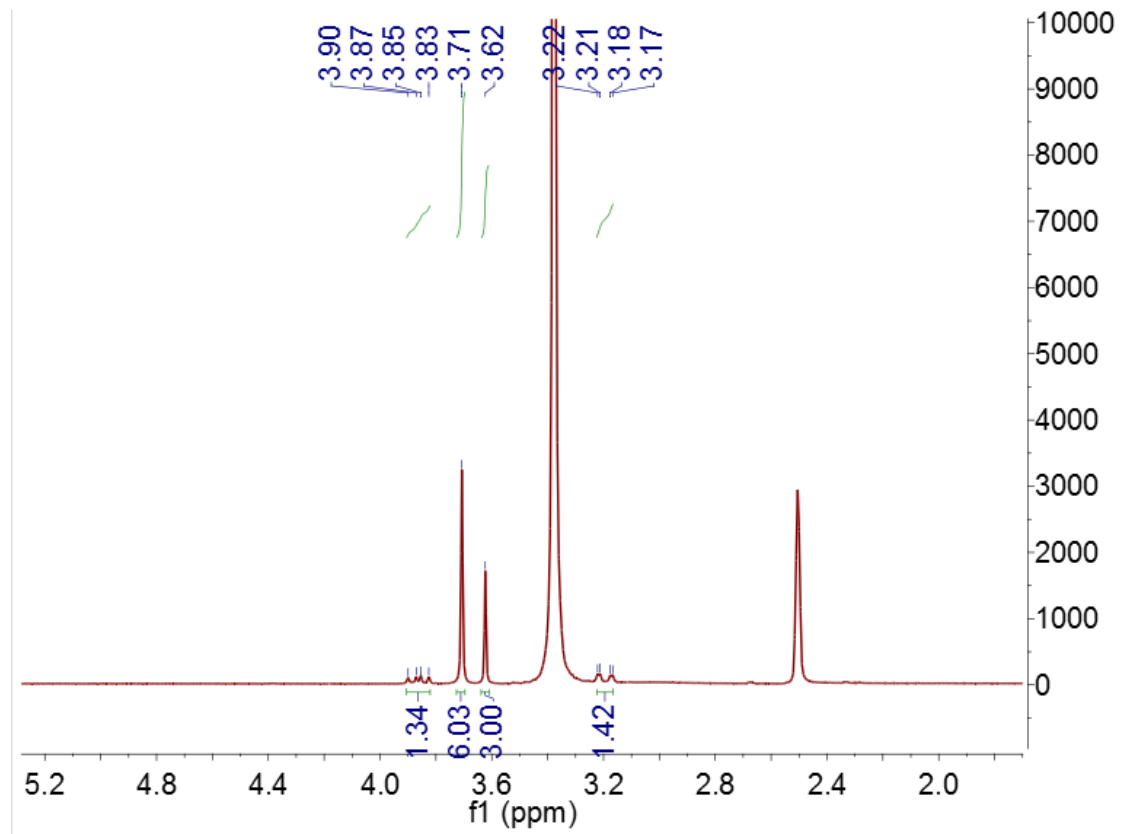
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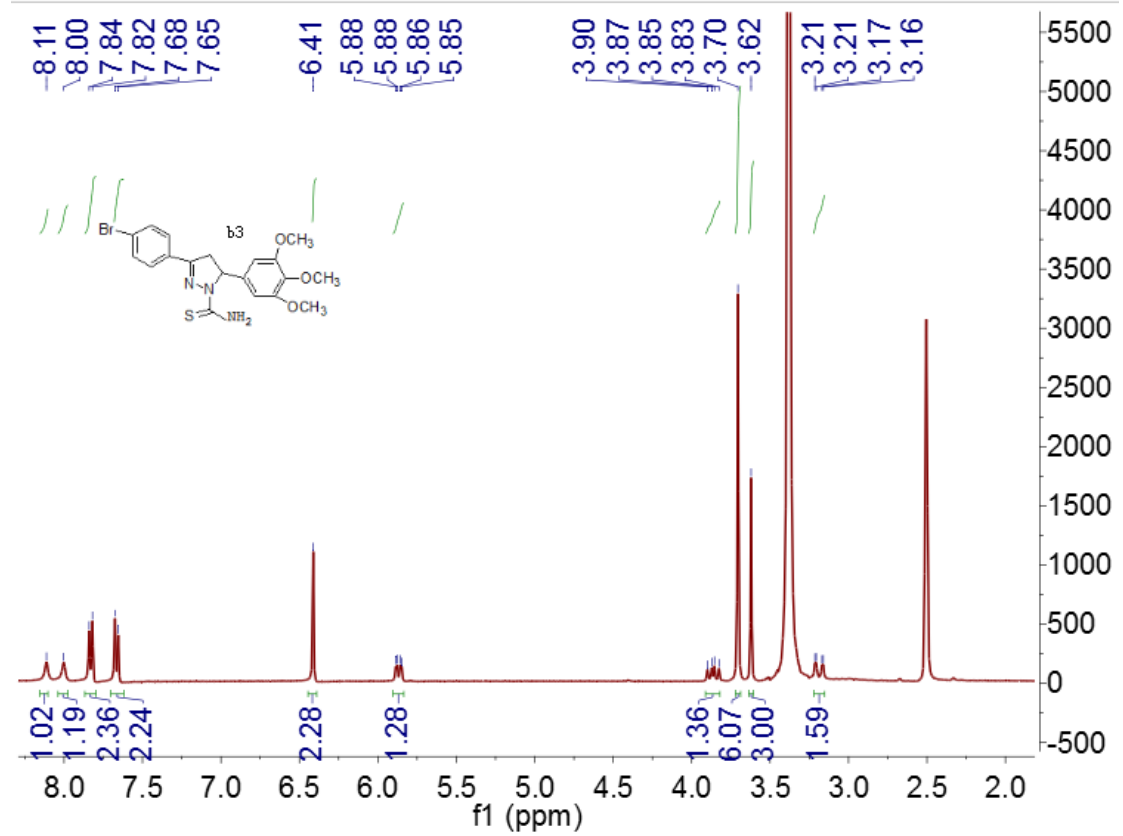


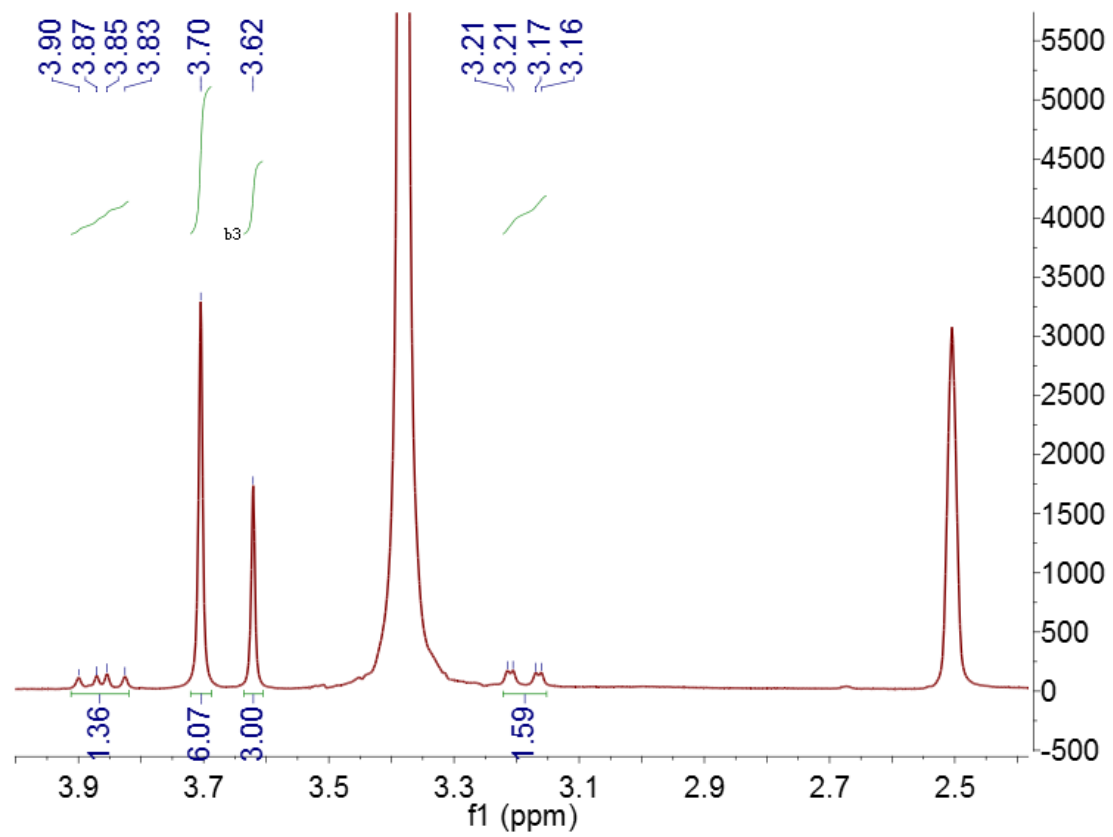
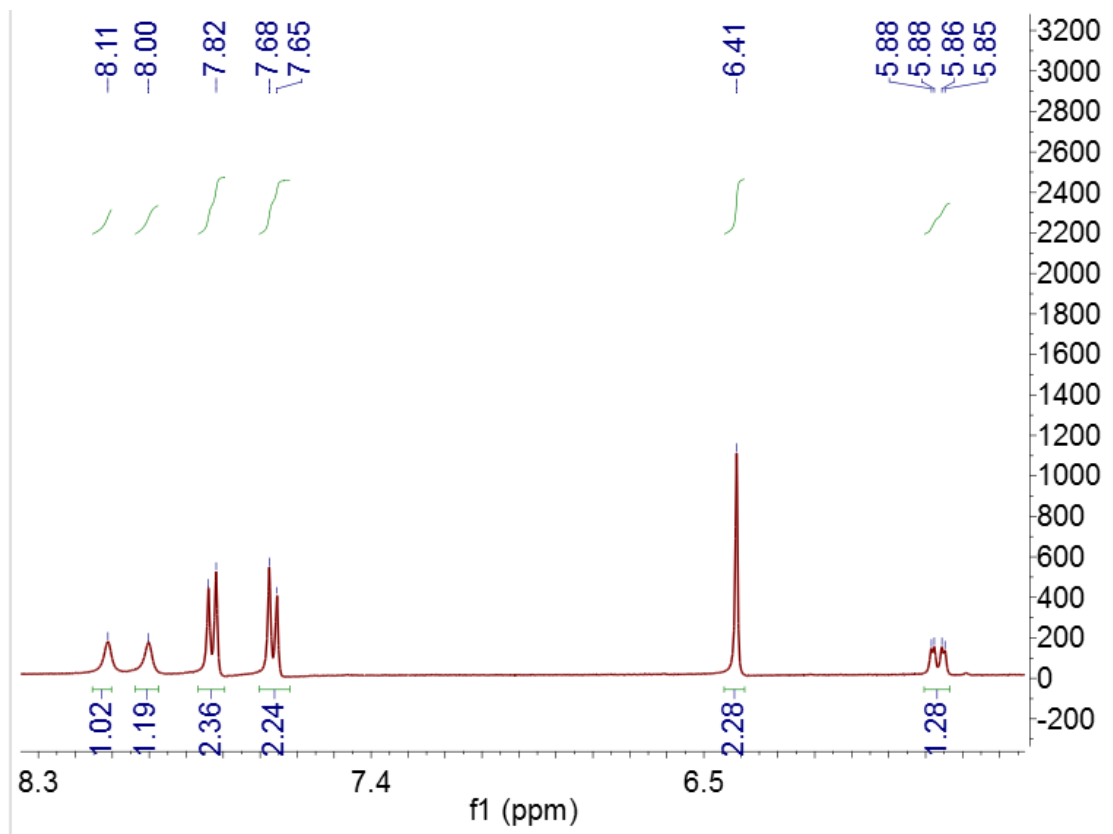
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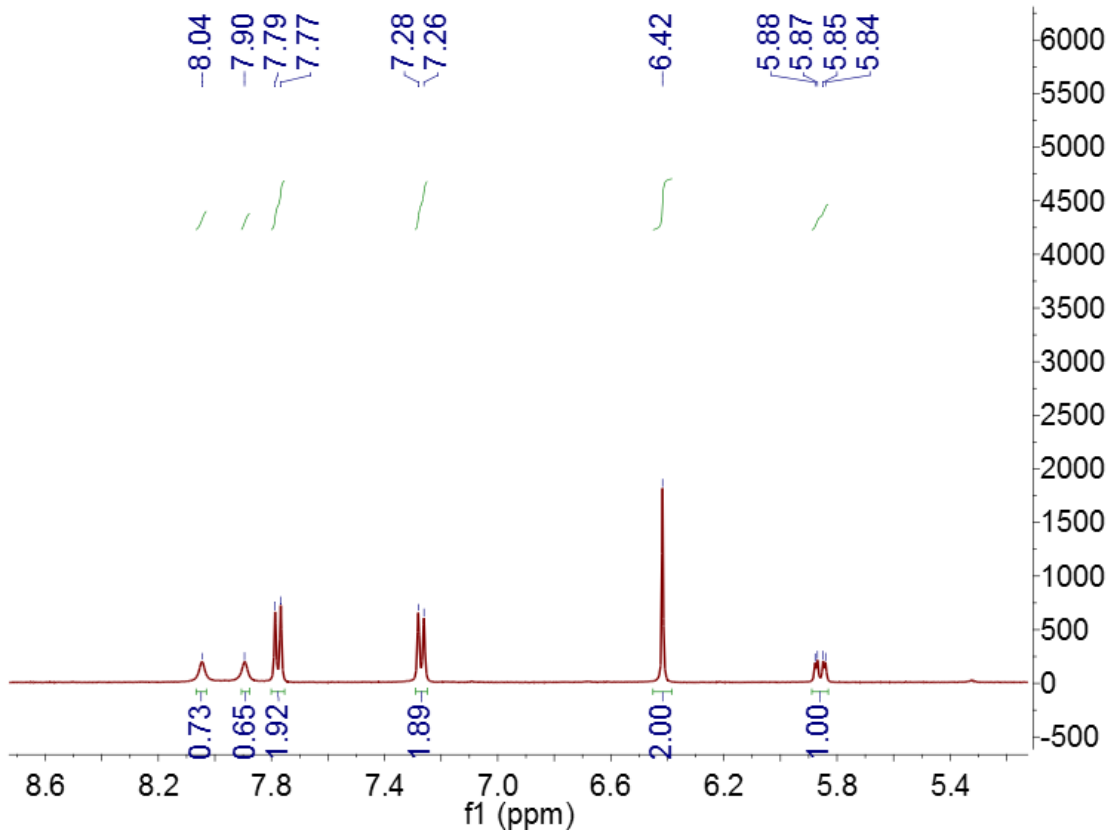
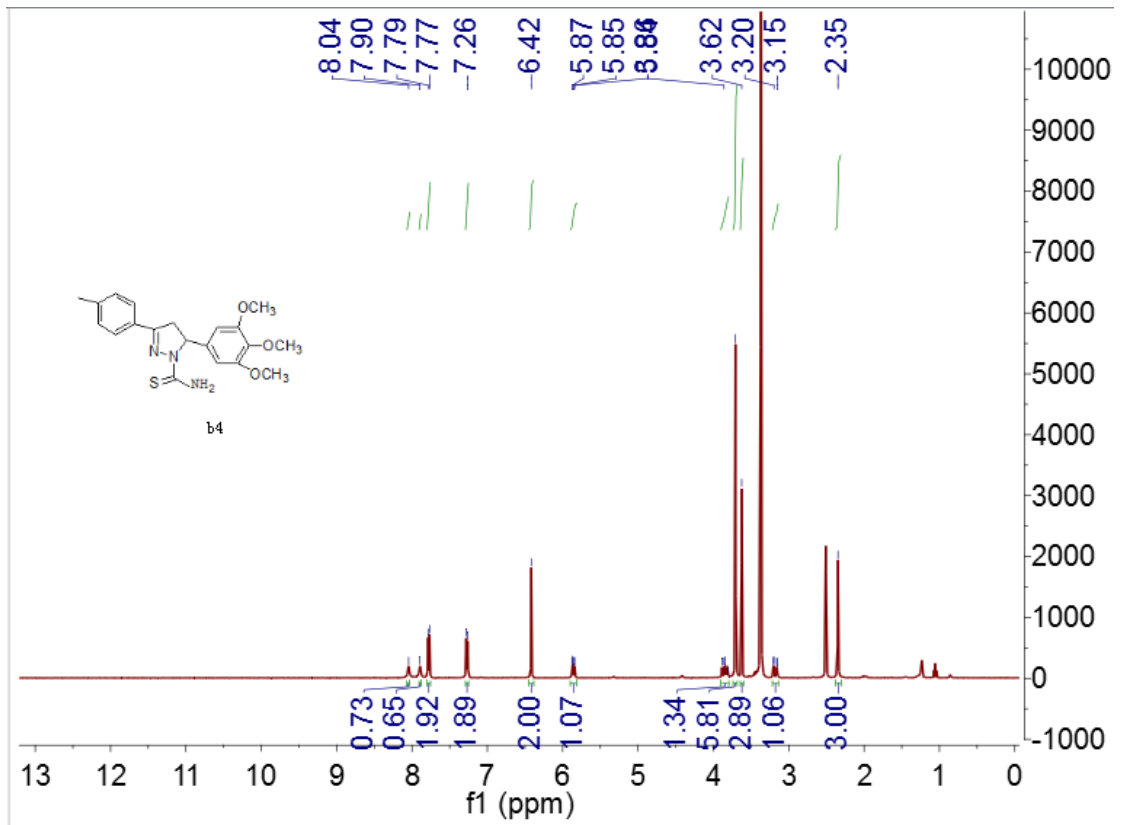


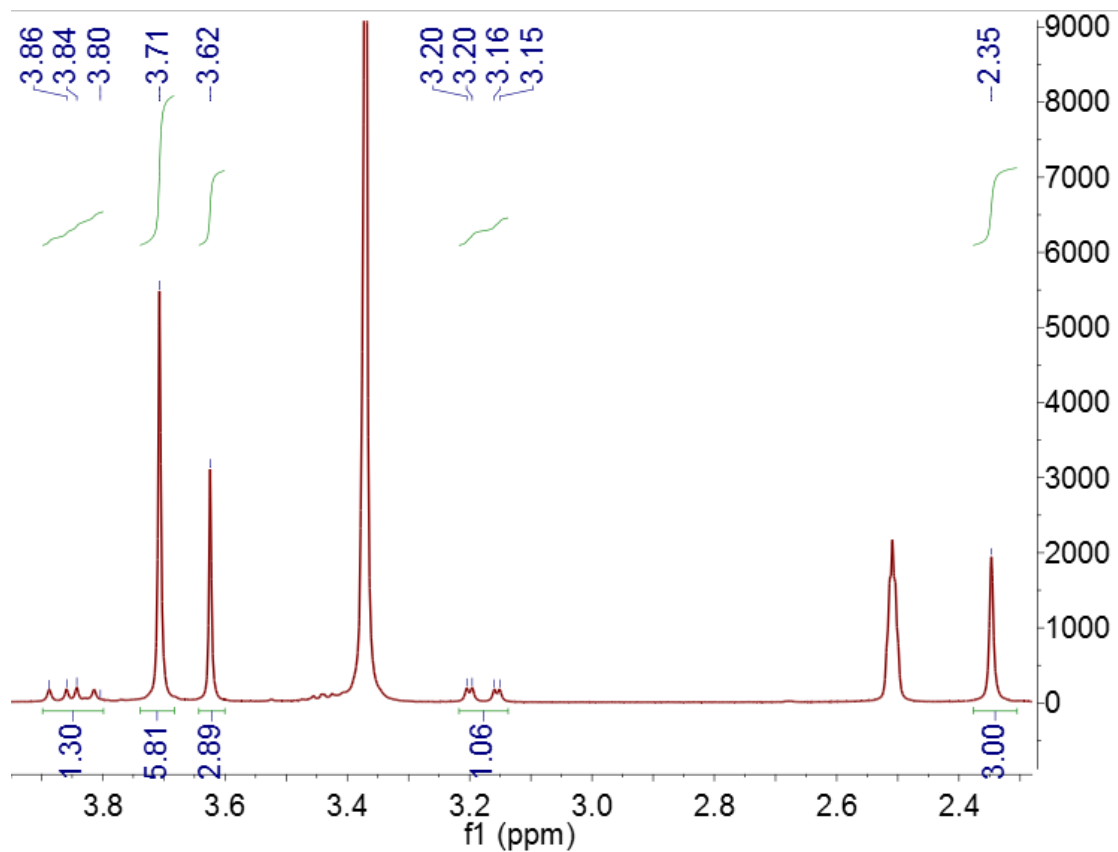
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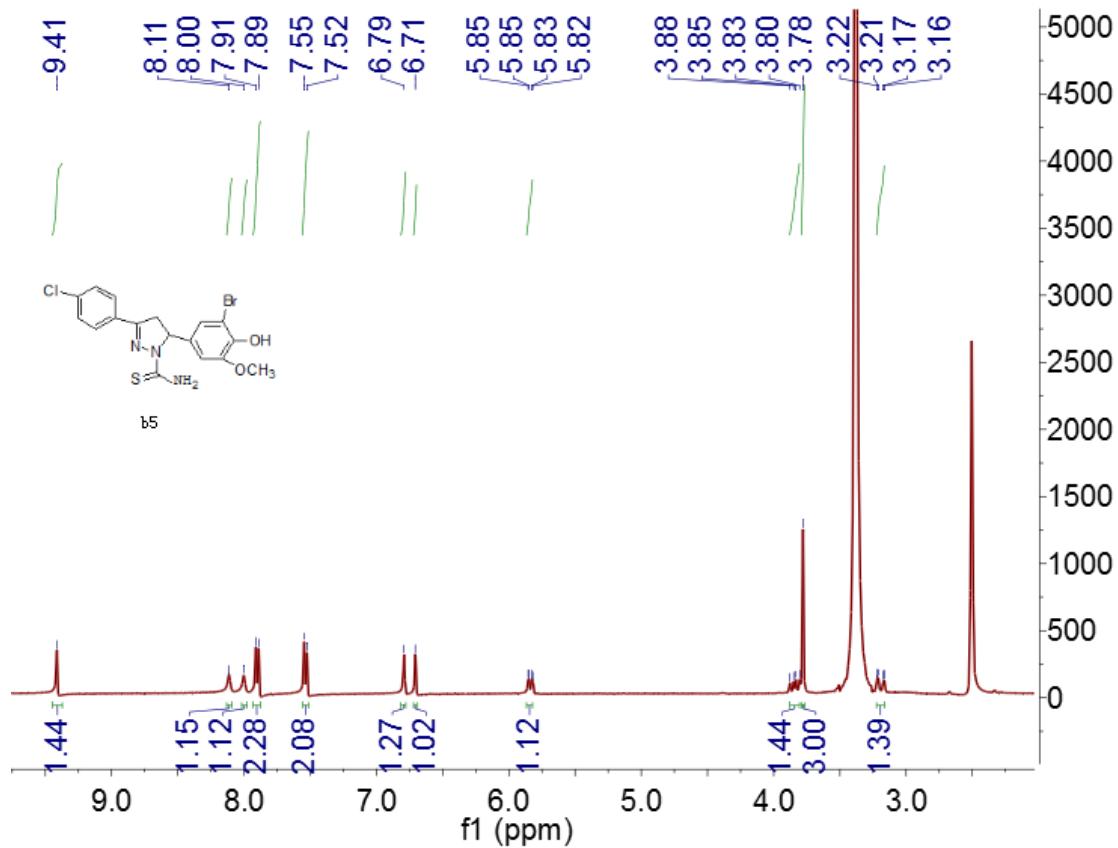


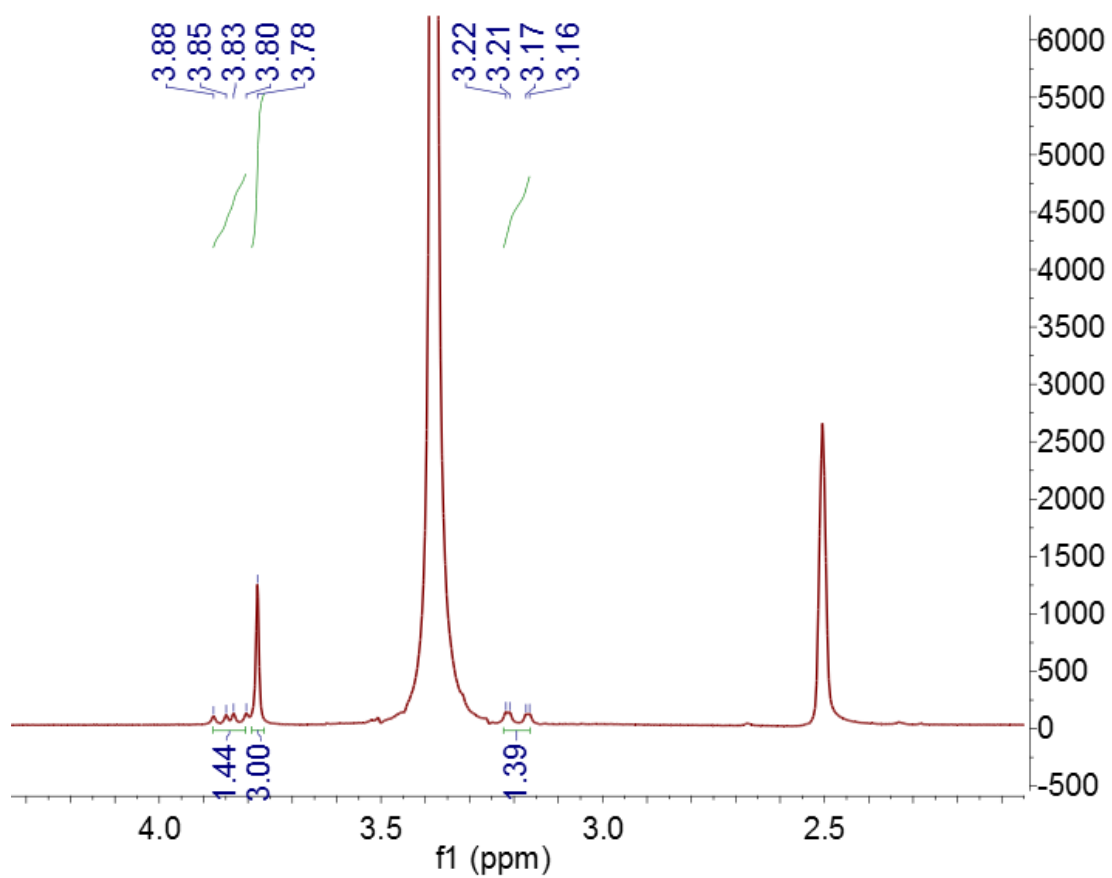
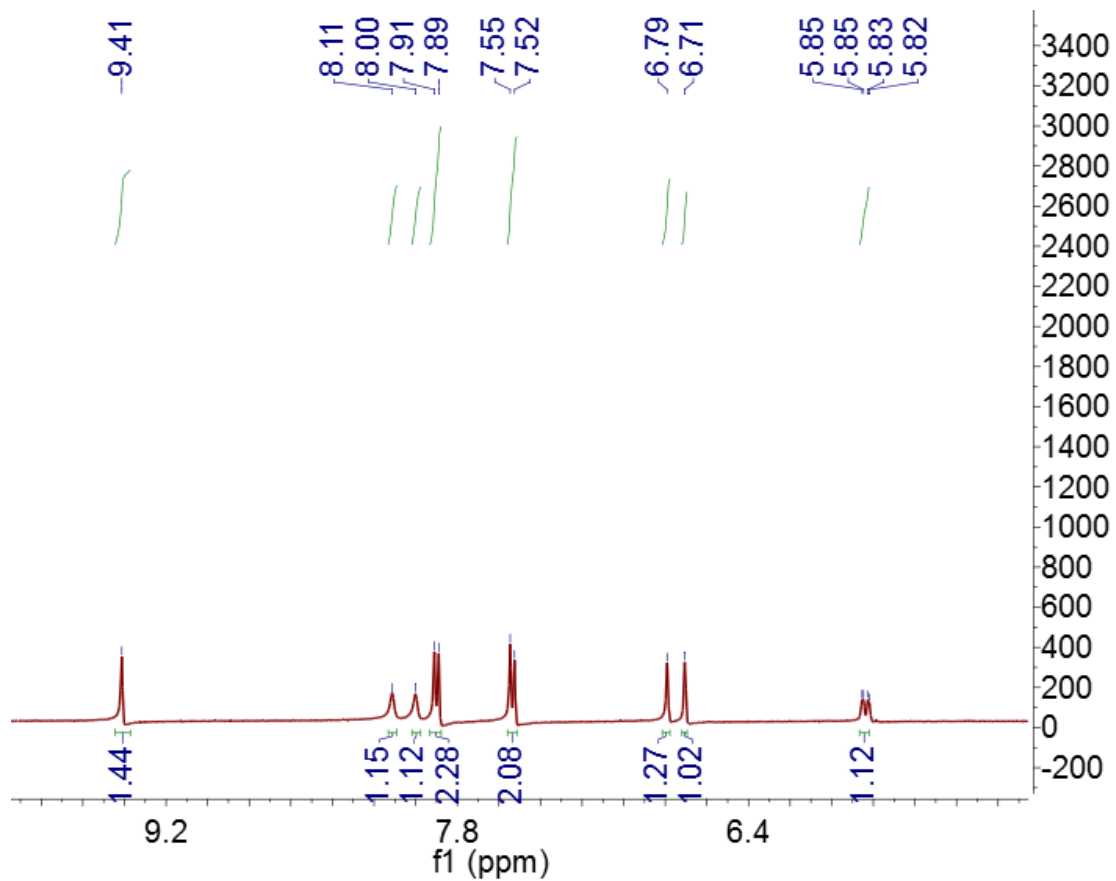
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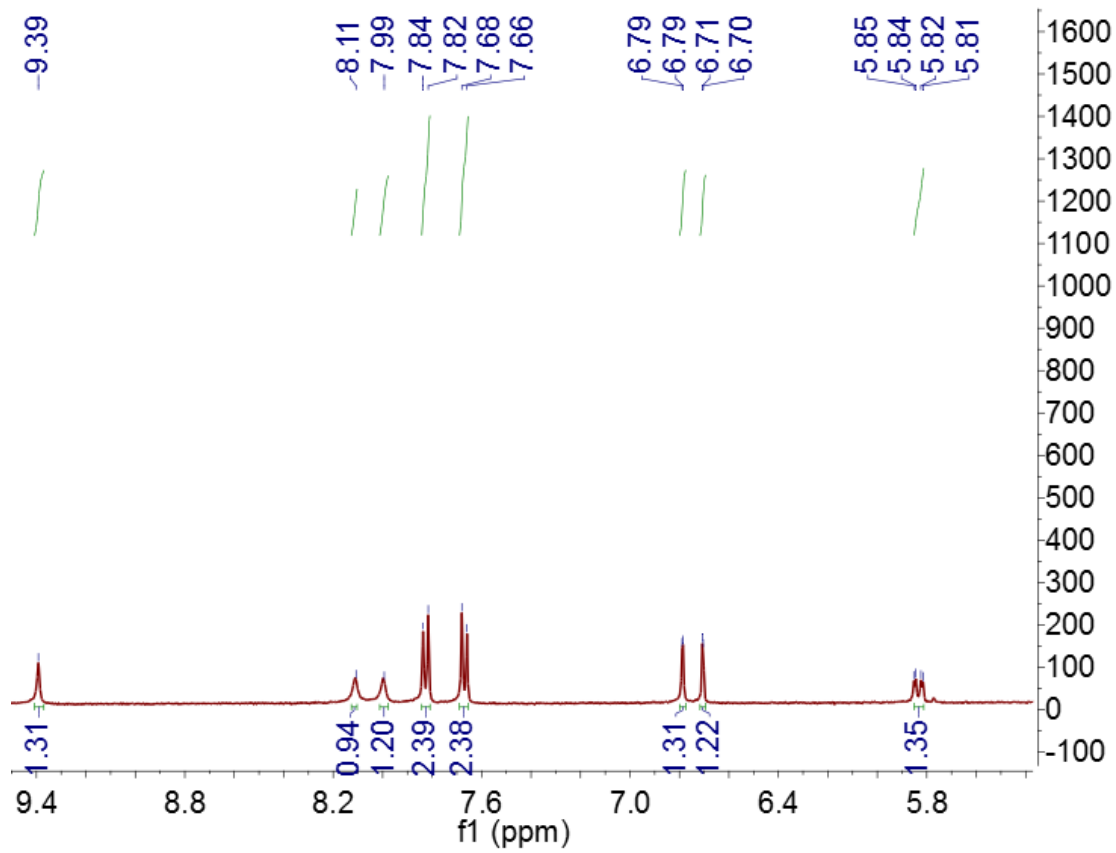
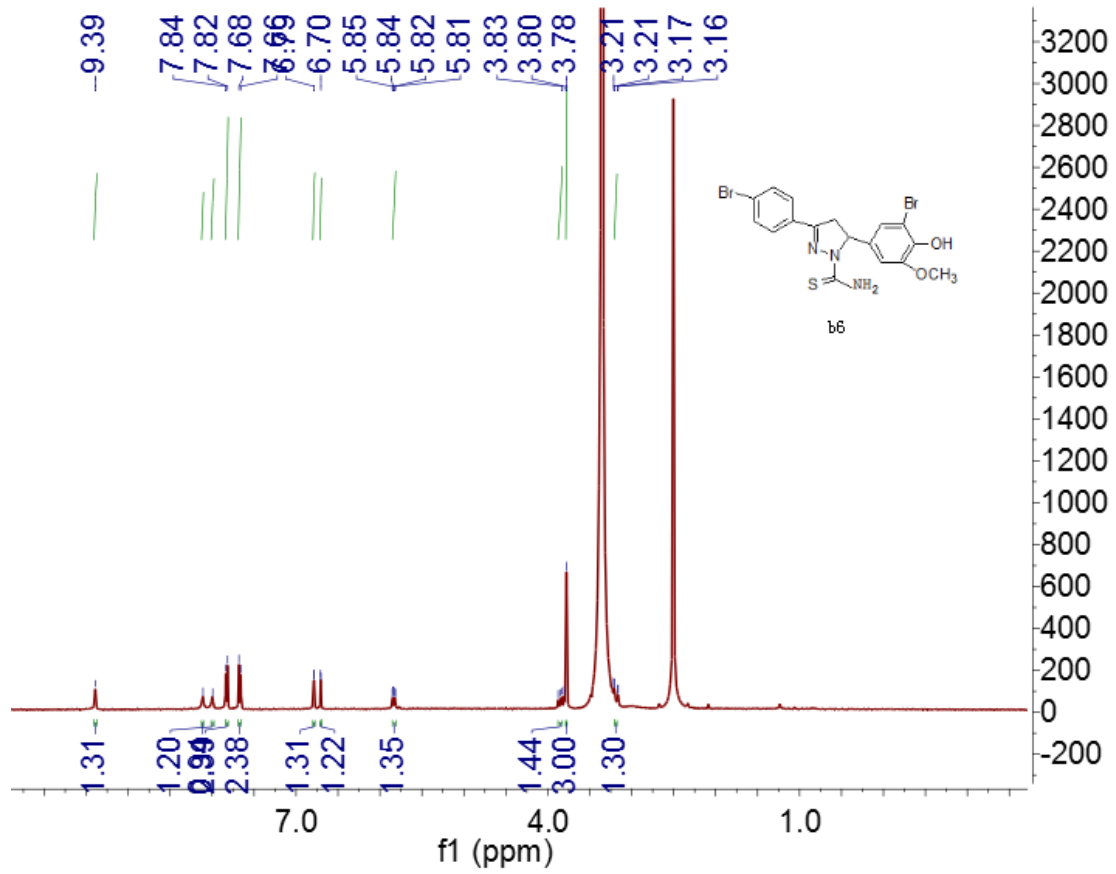


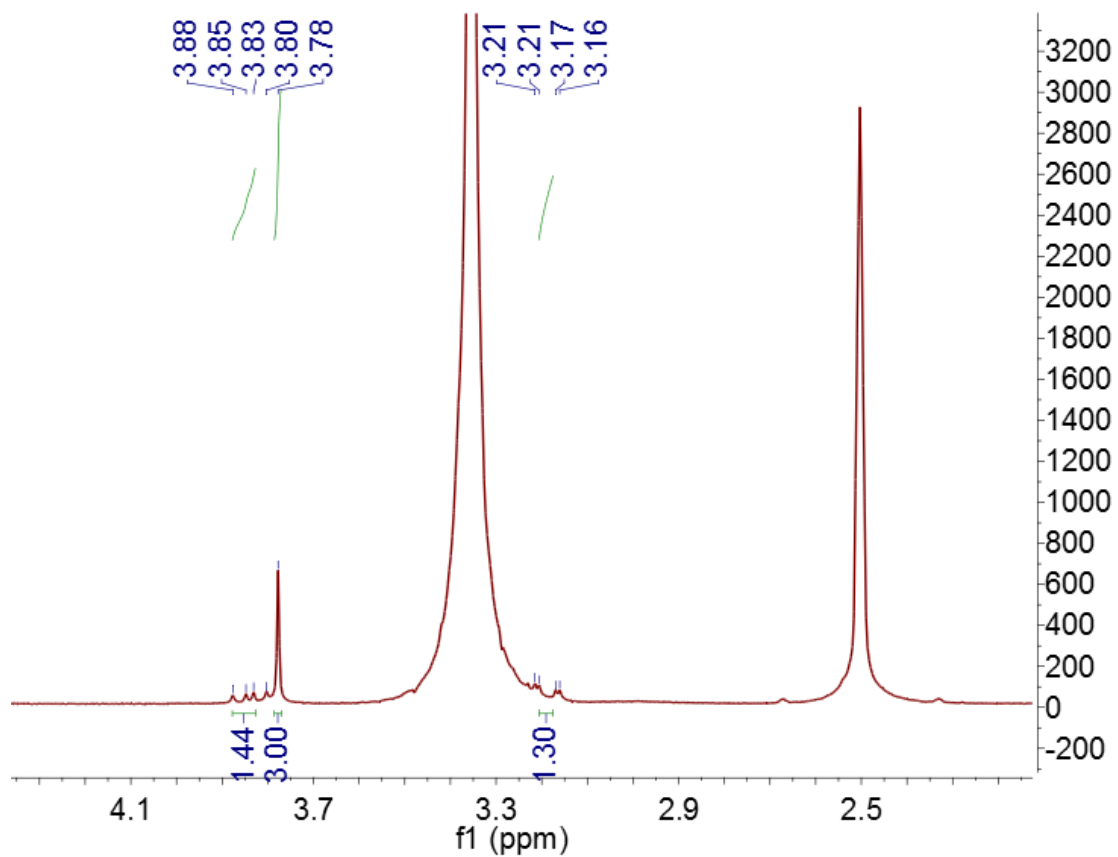
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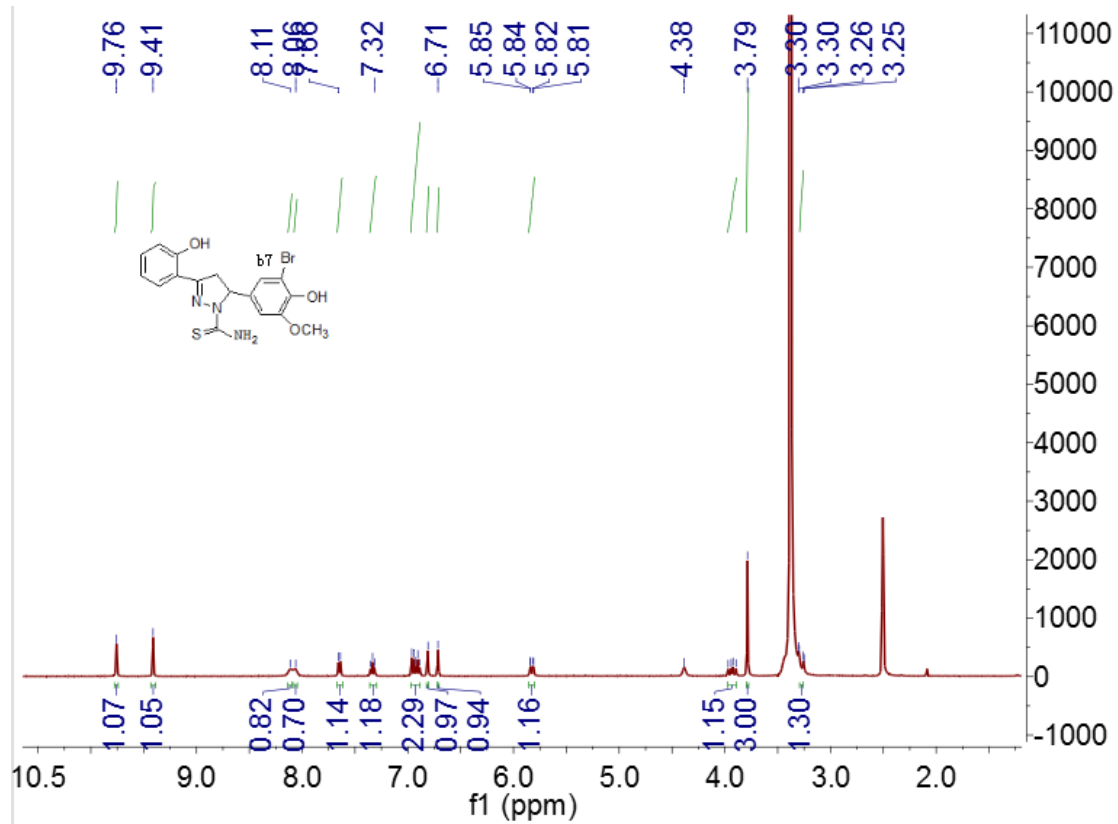


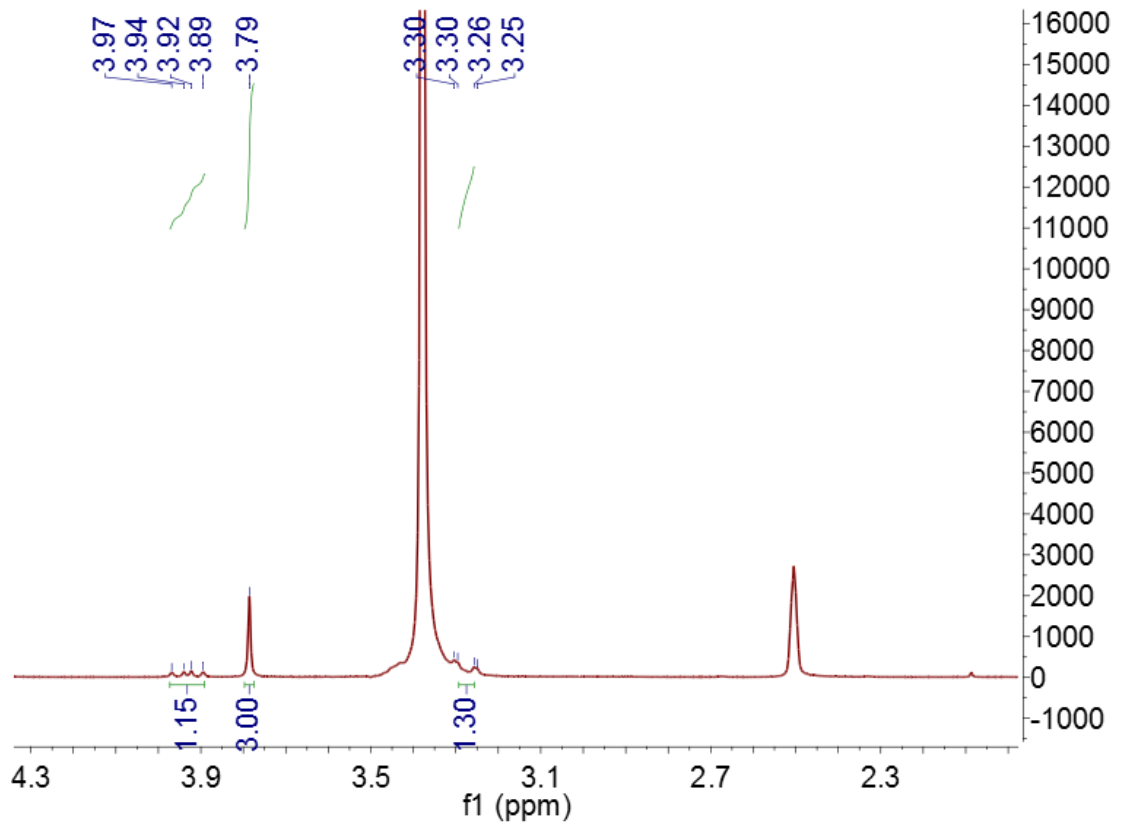
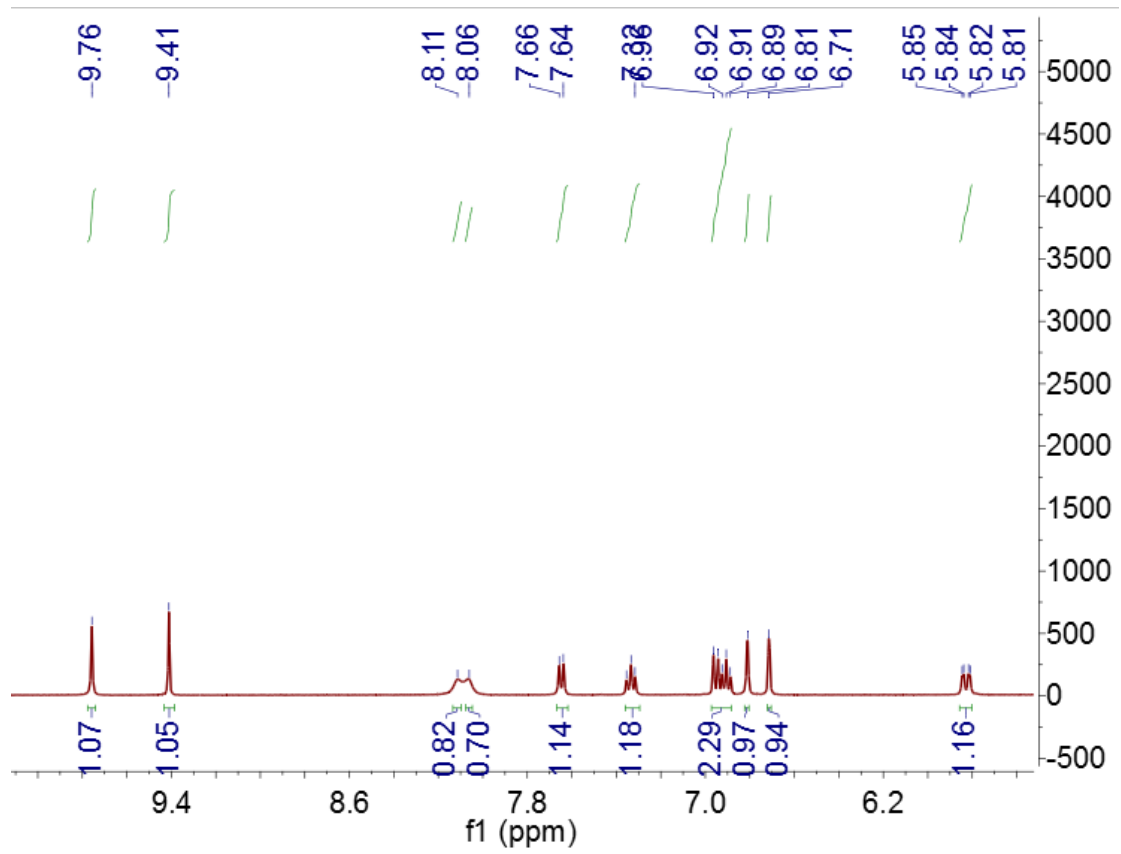
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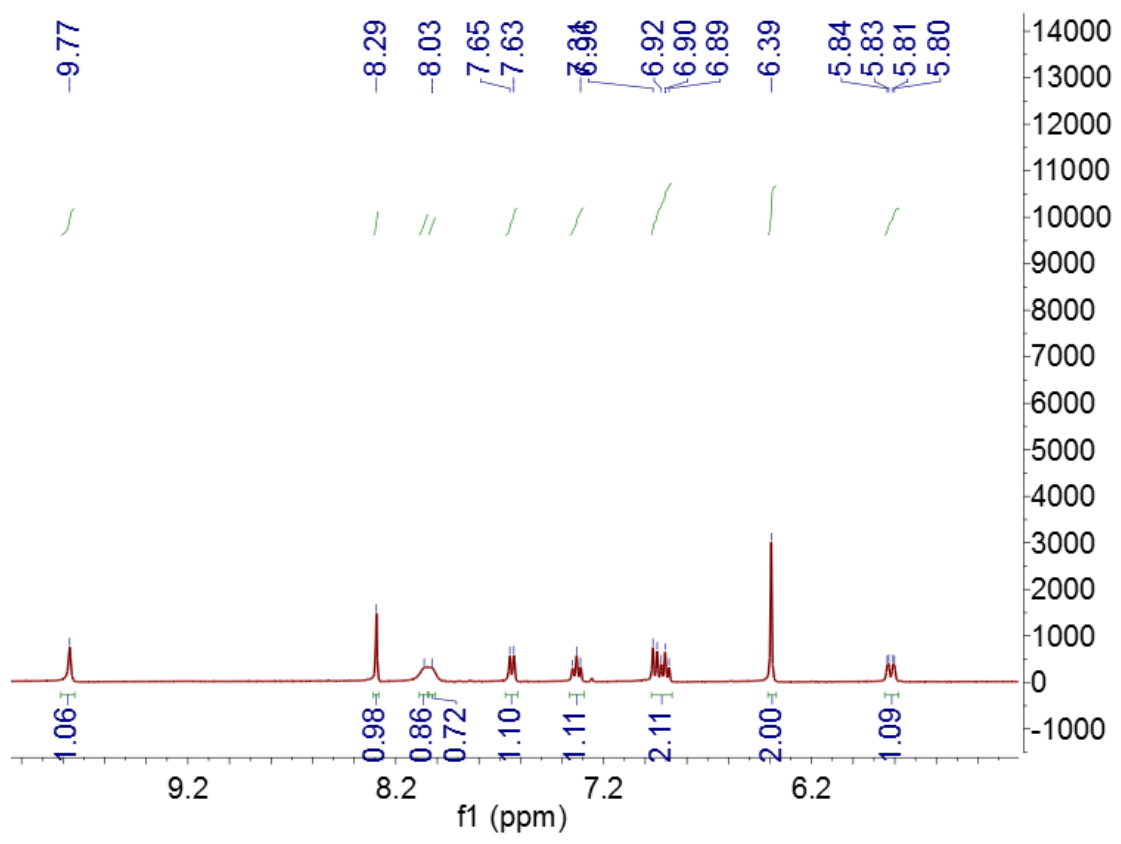
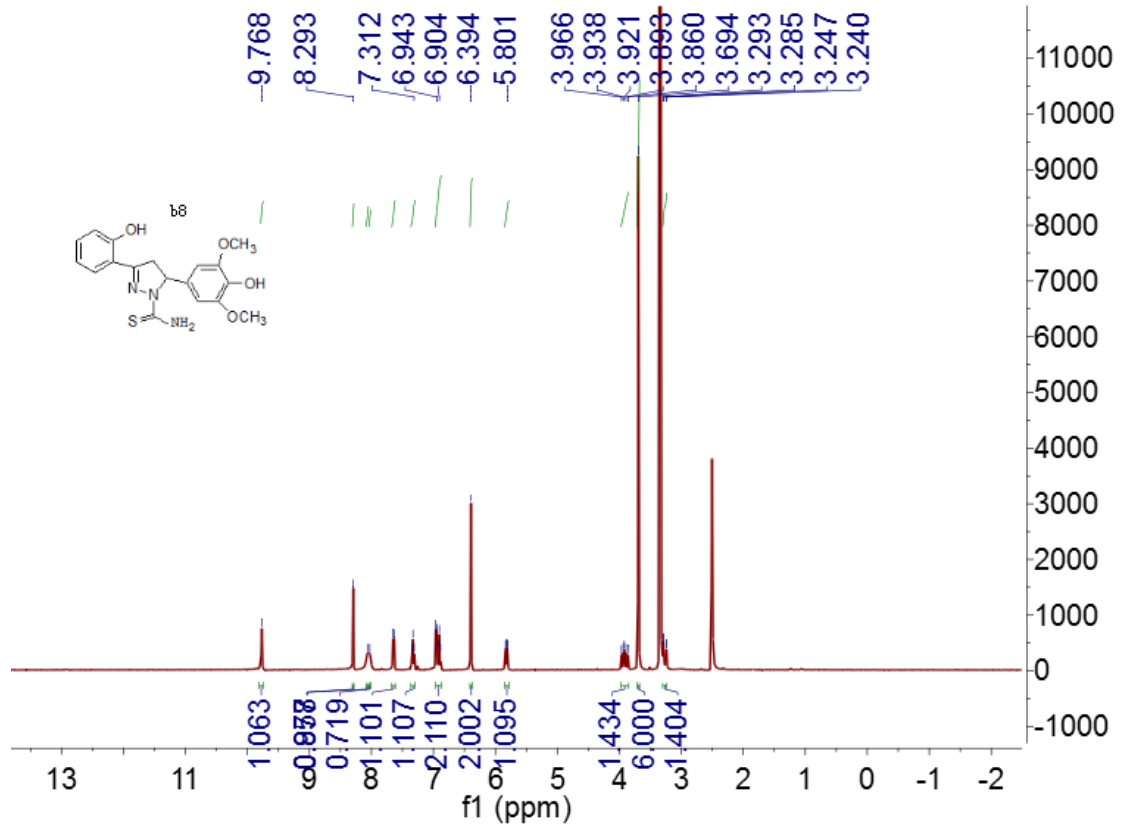


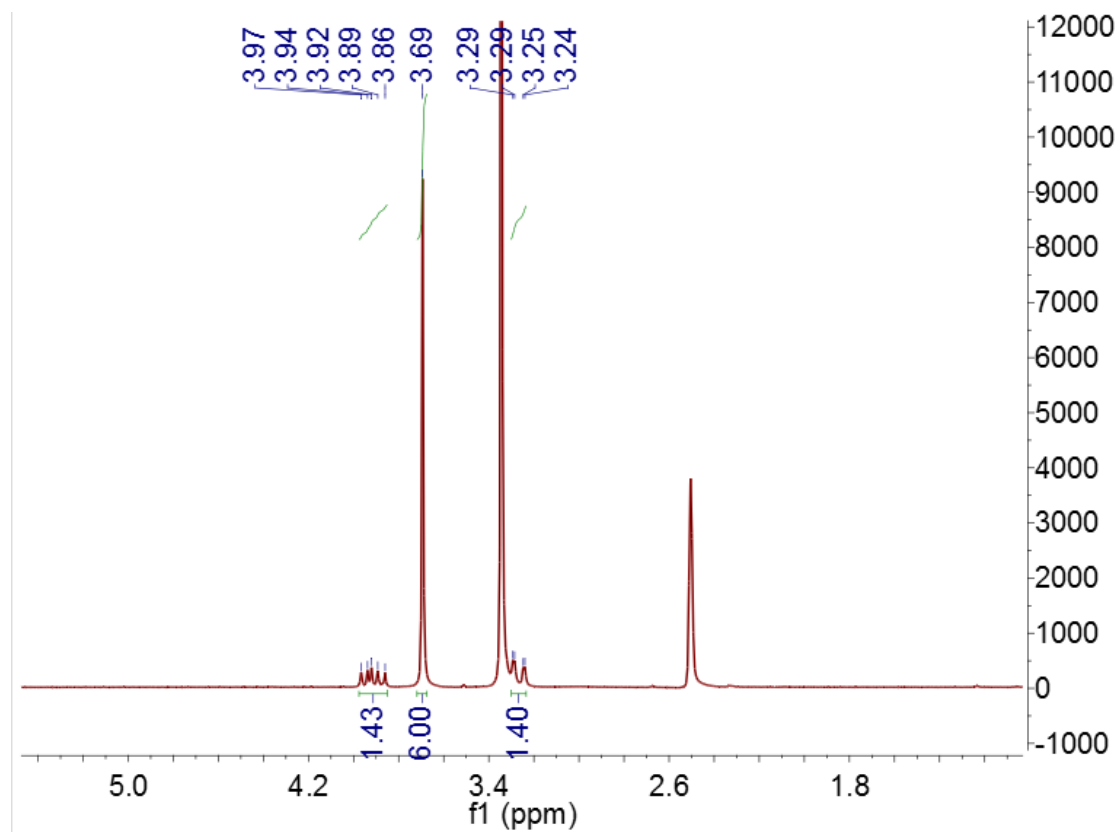
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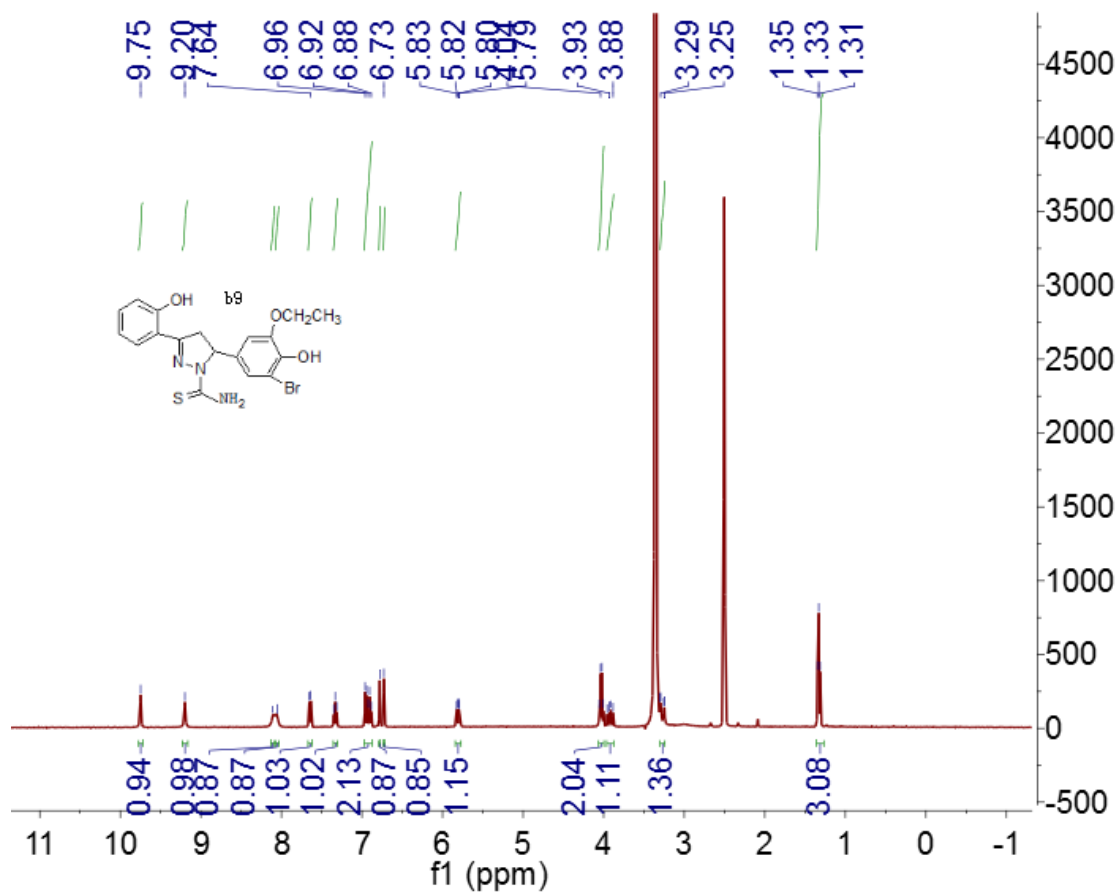


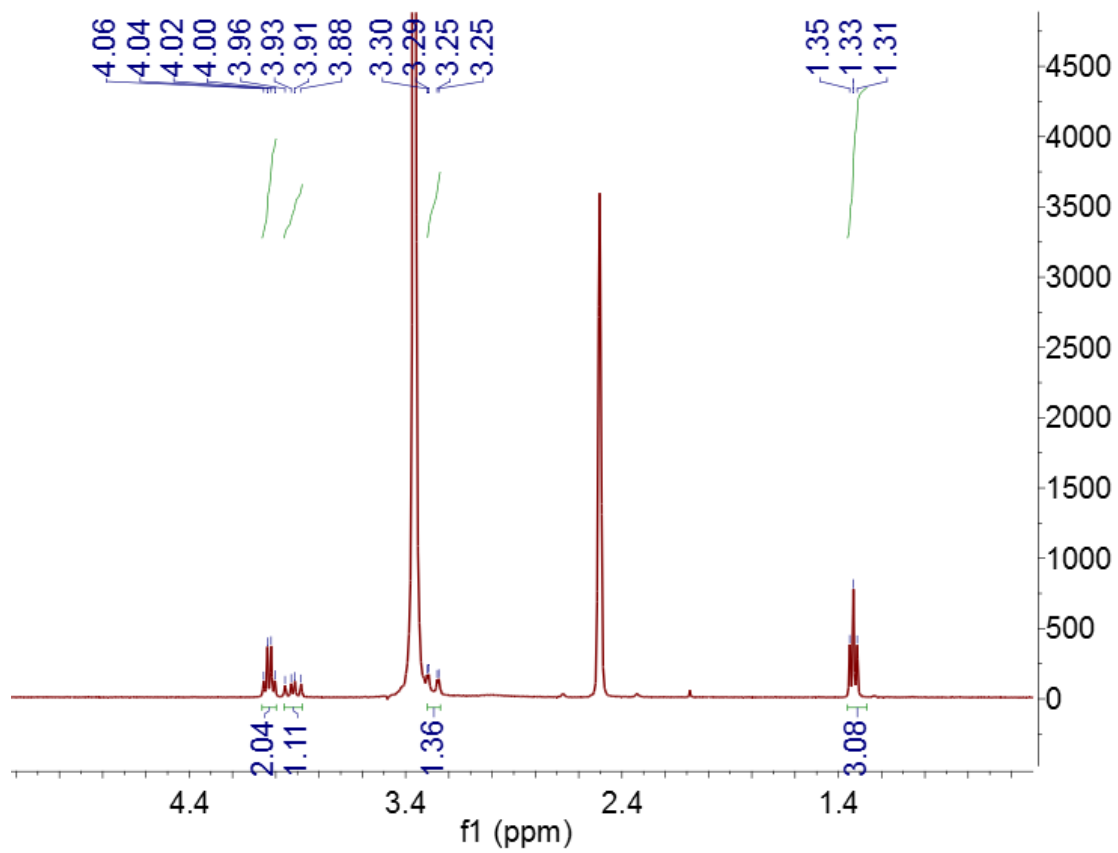
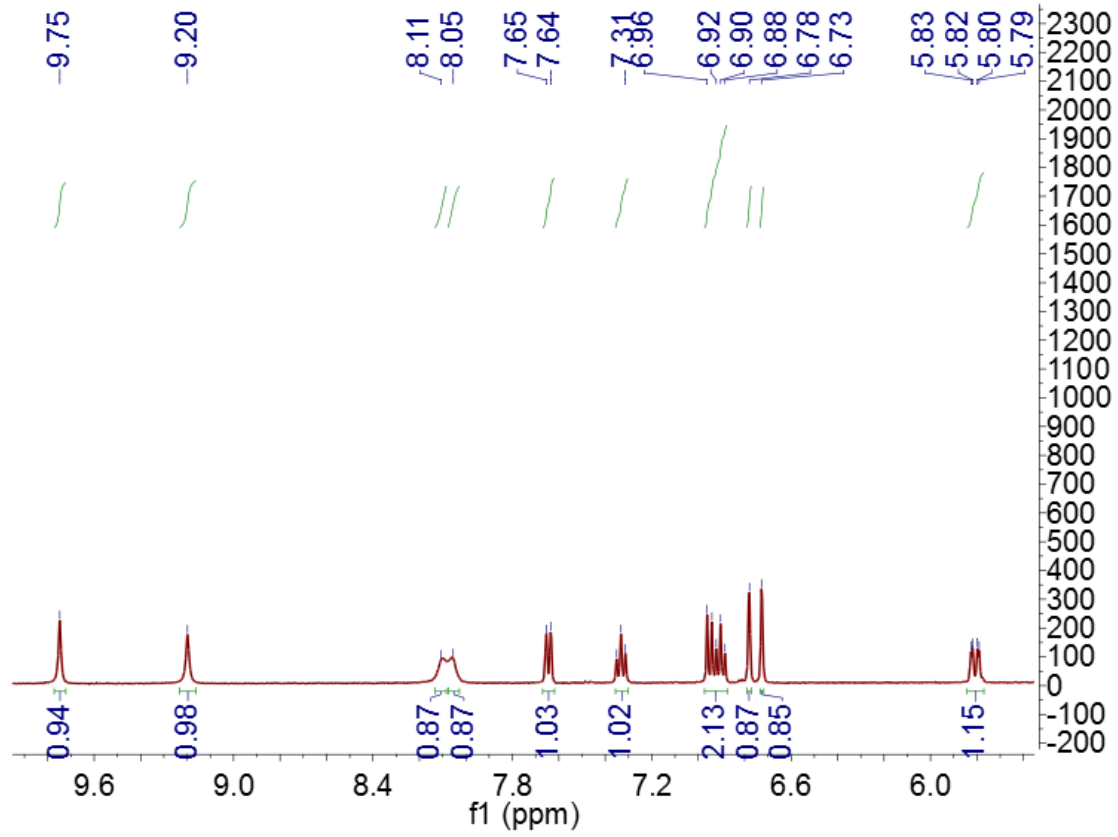
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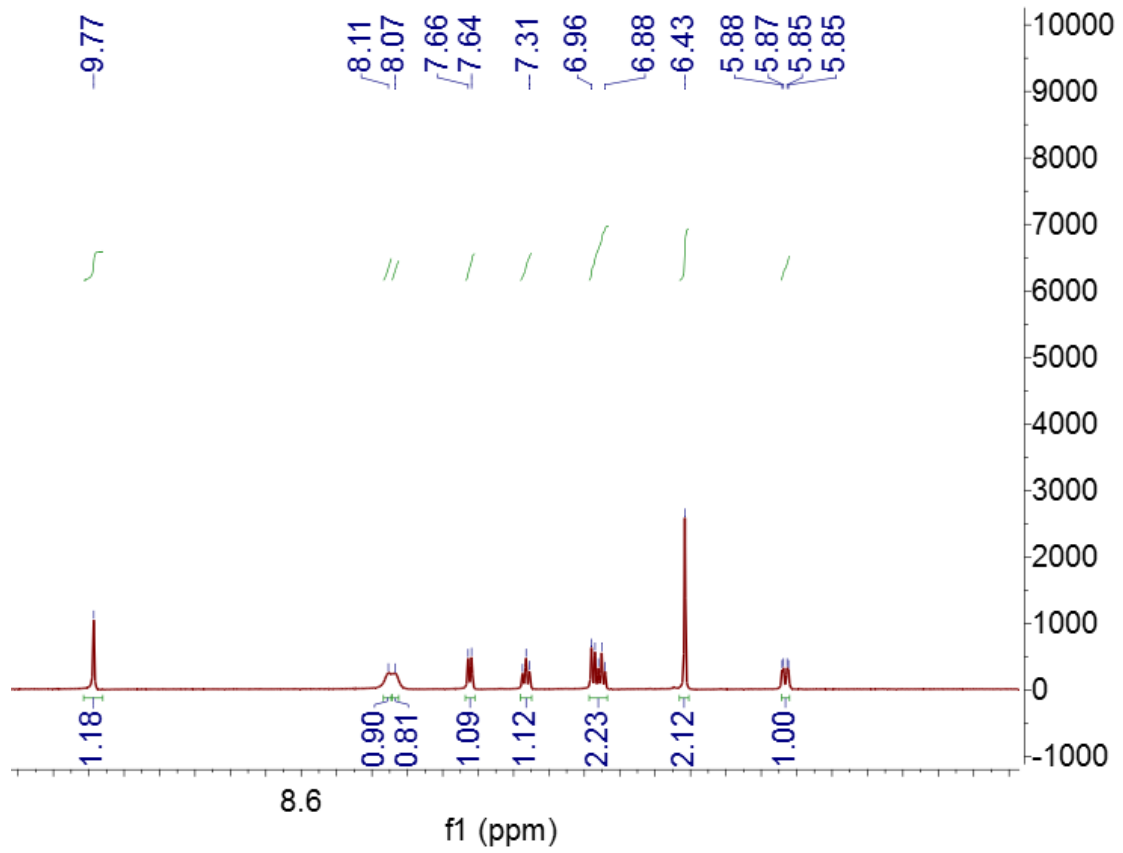
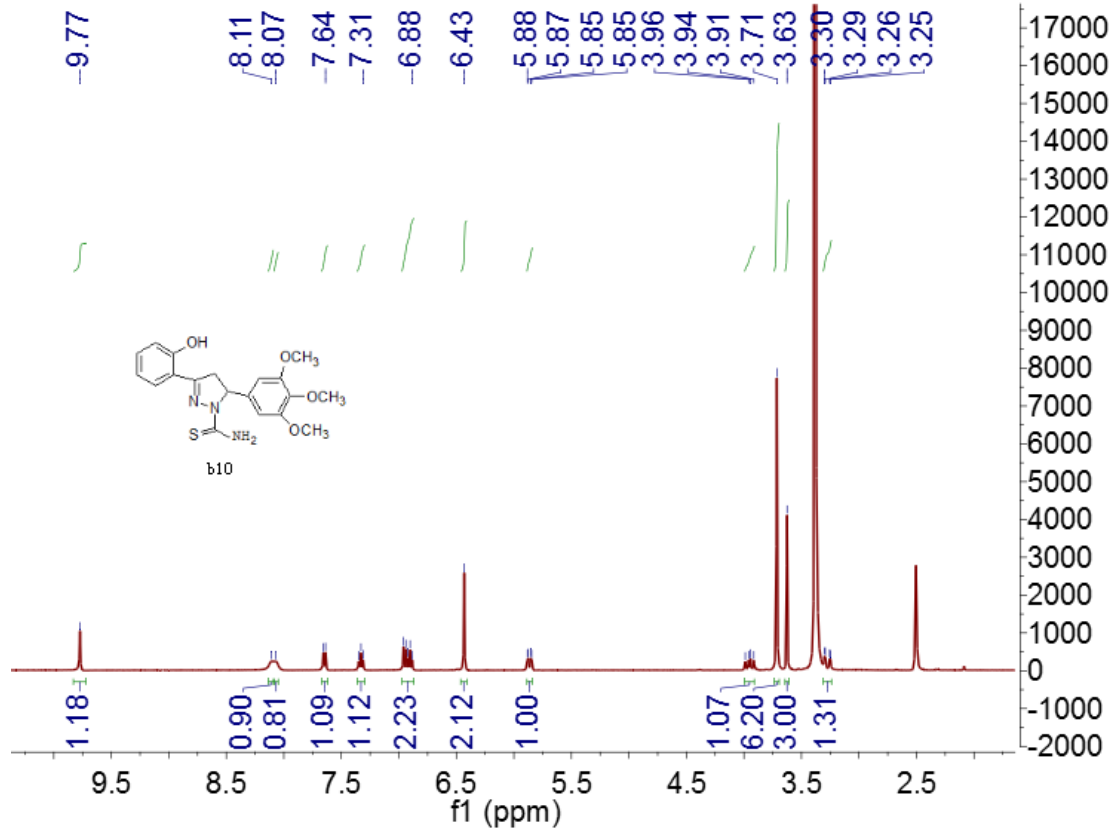


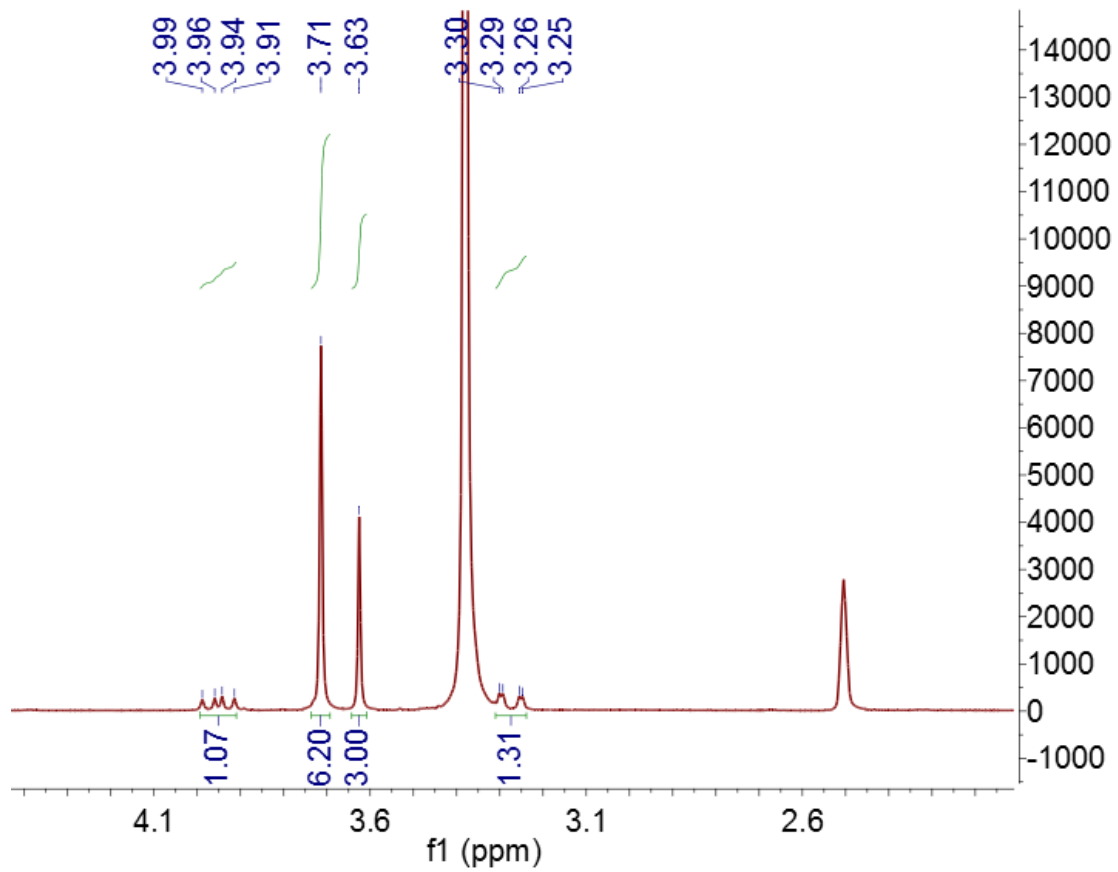
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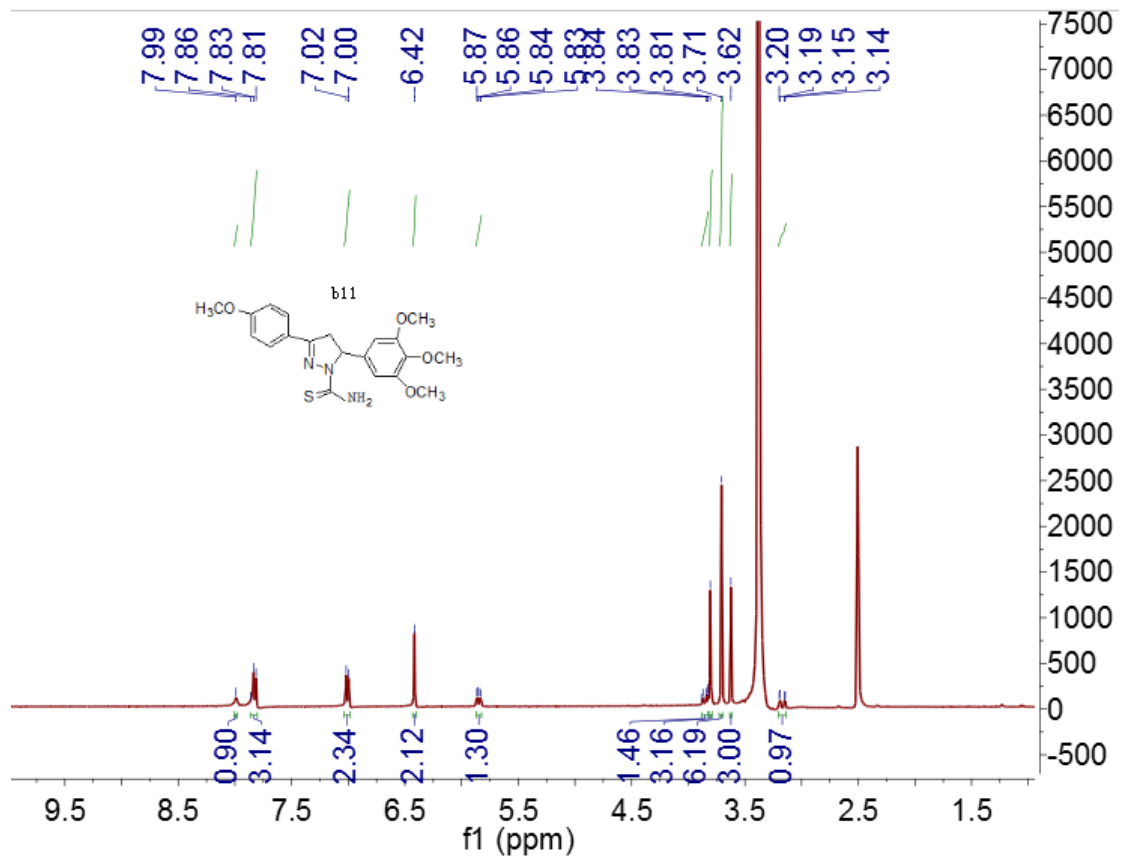


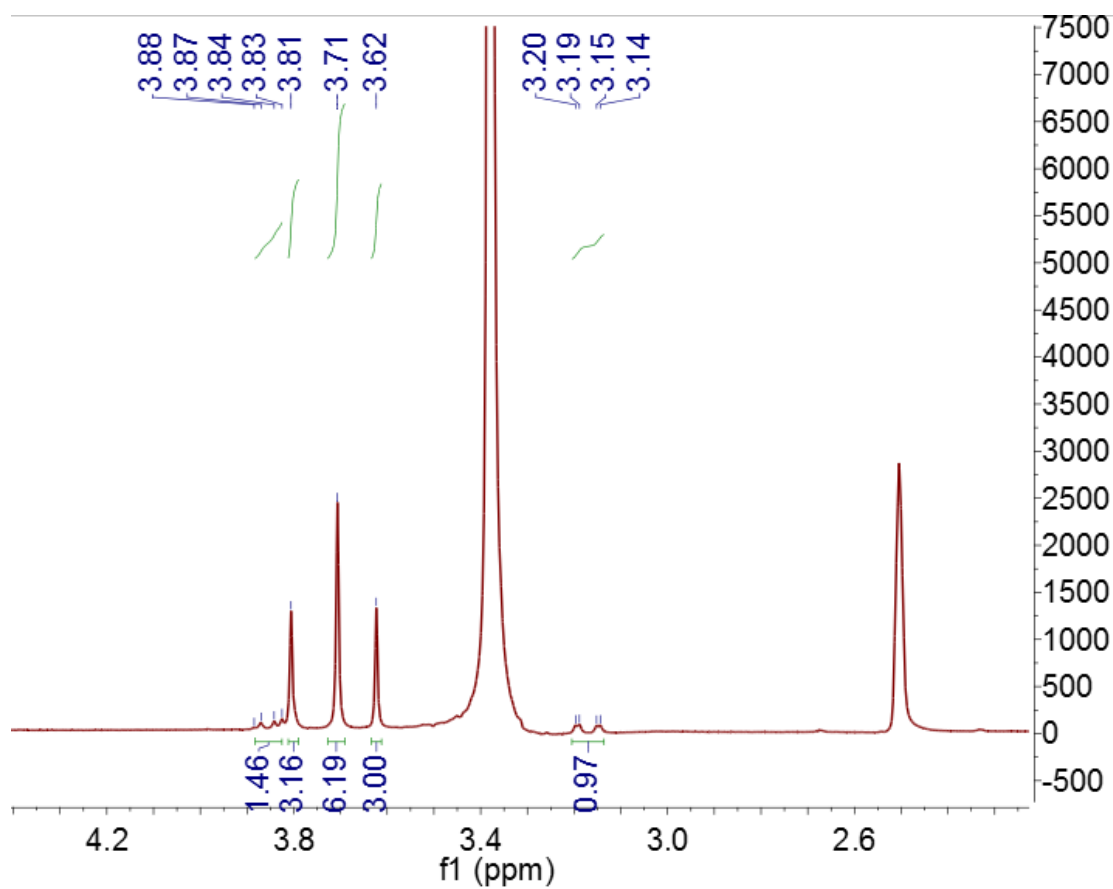
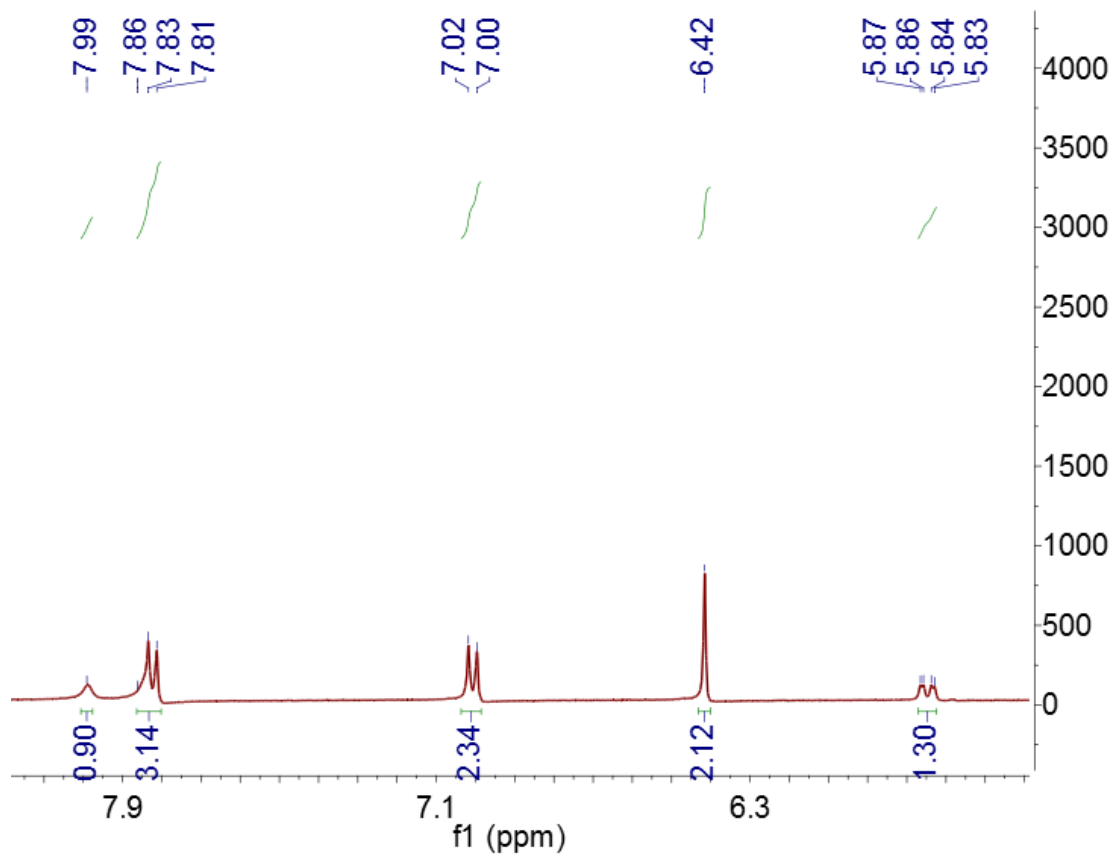
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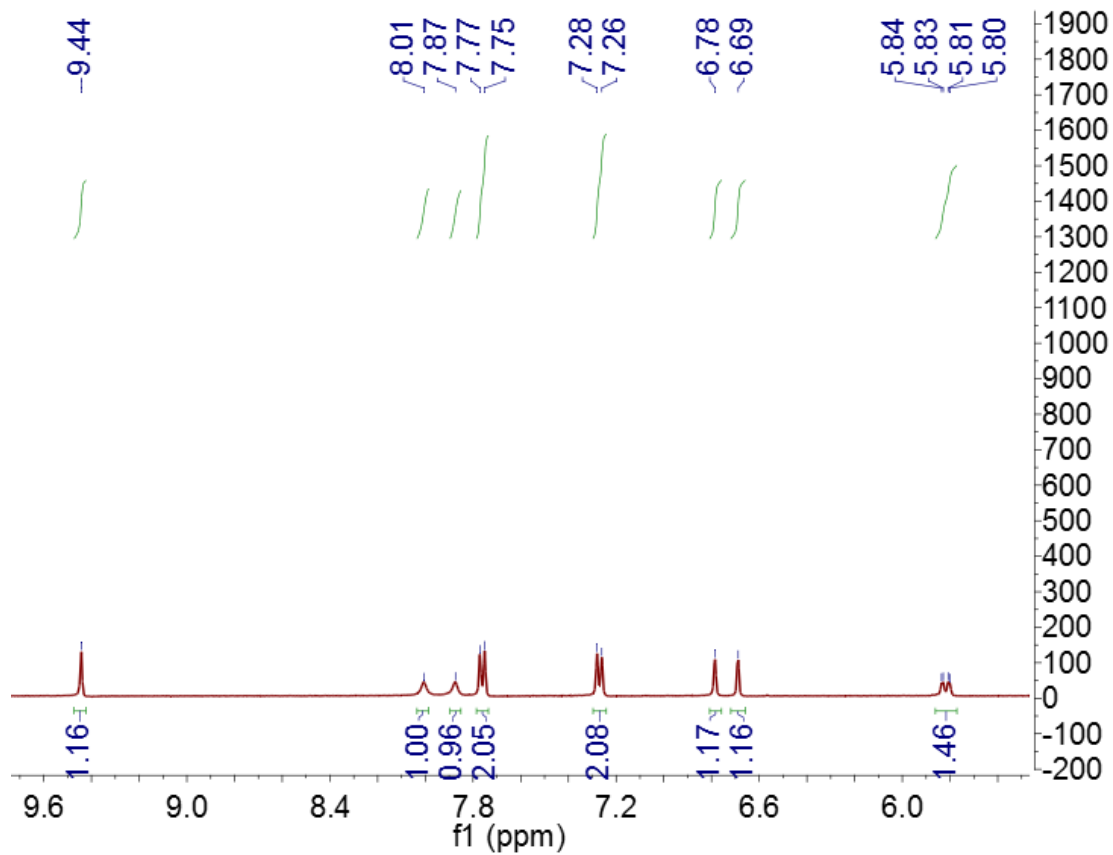
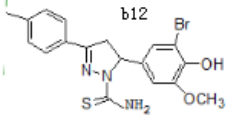
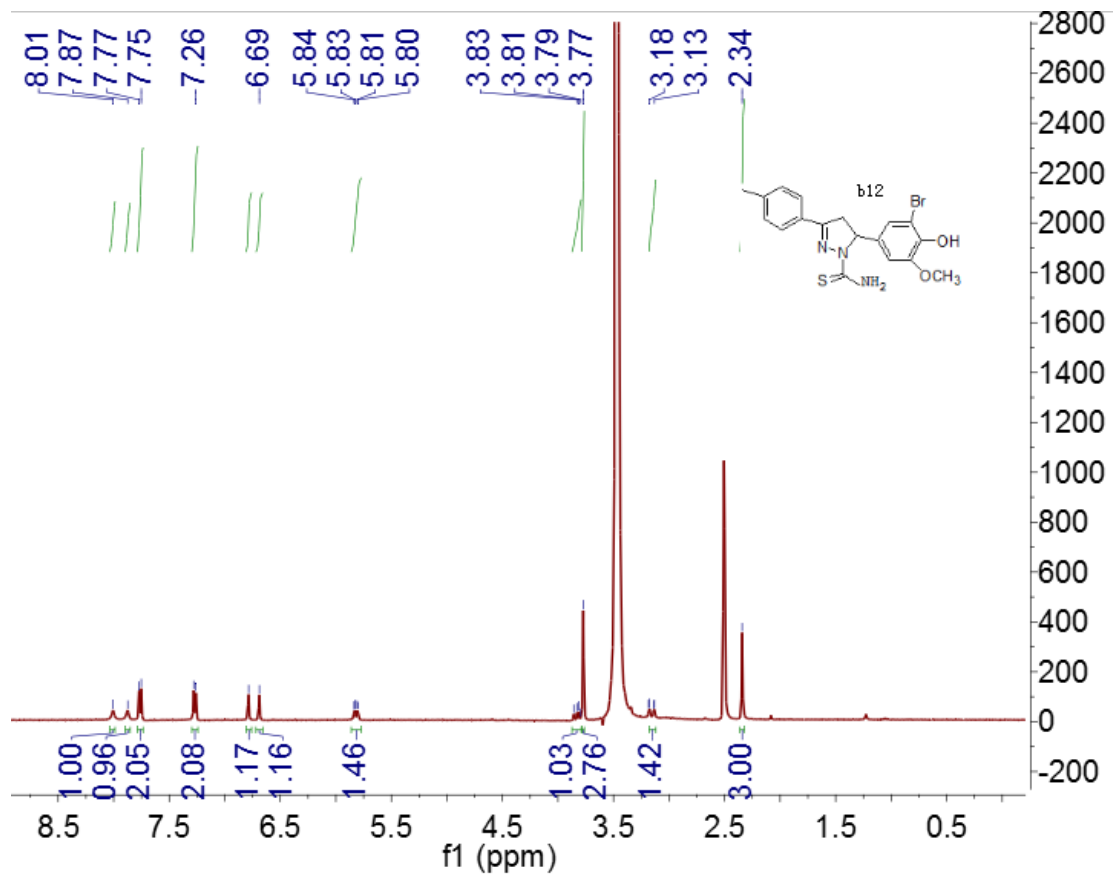


11b





12b



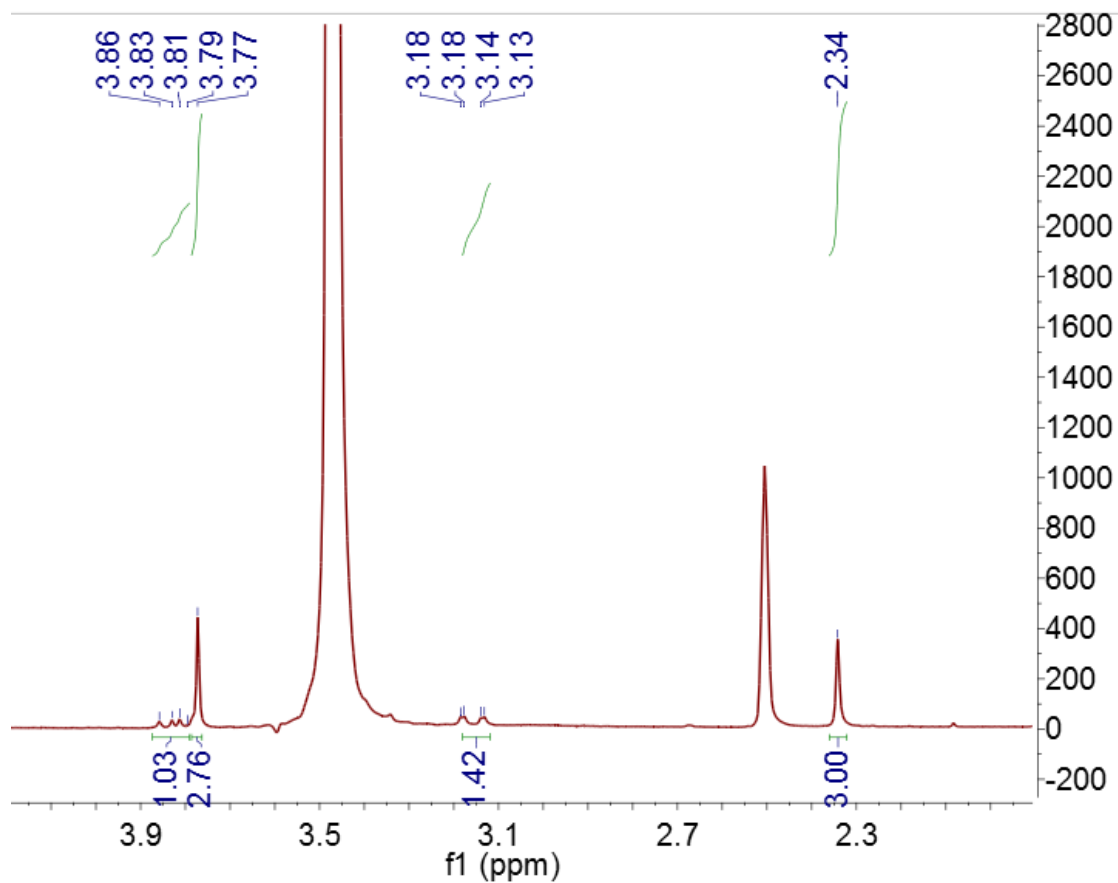
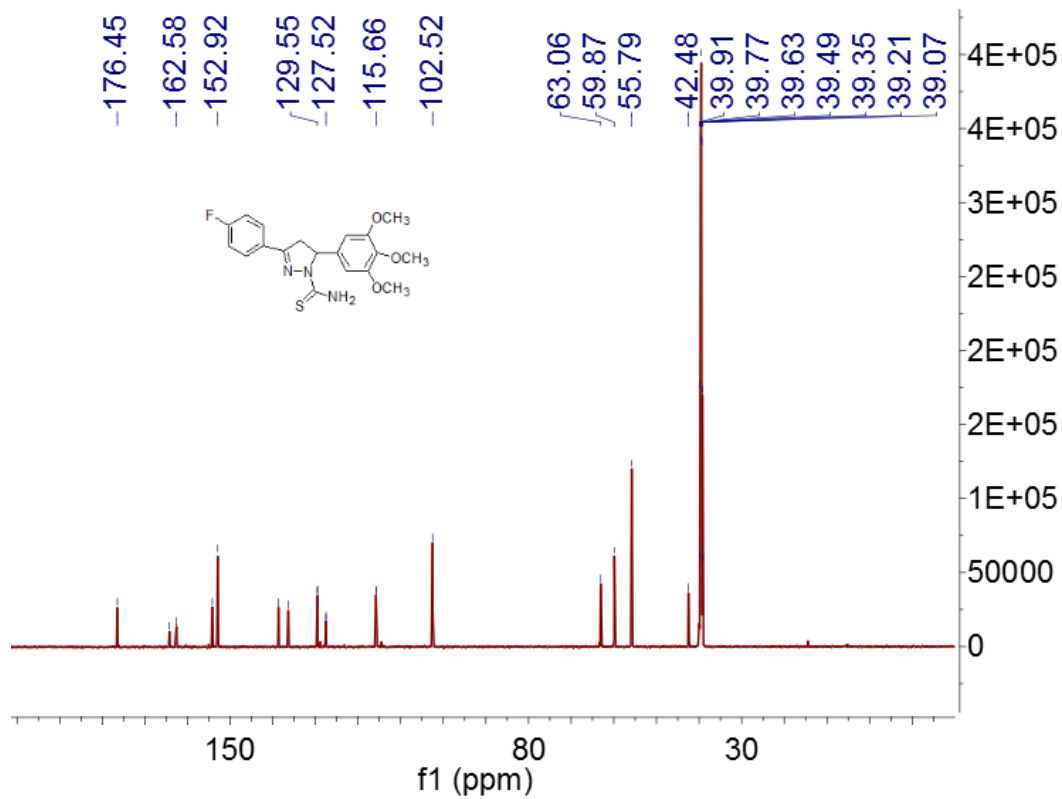
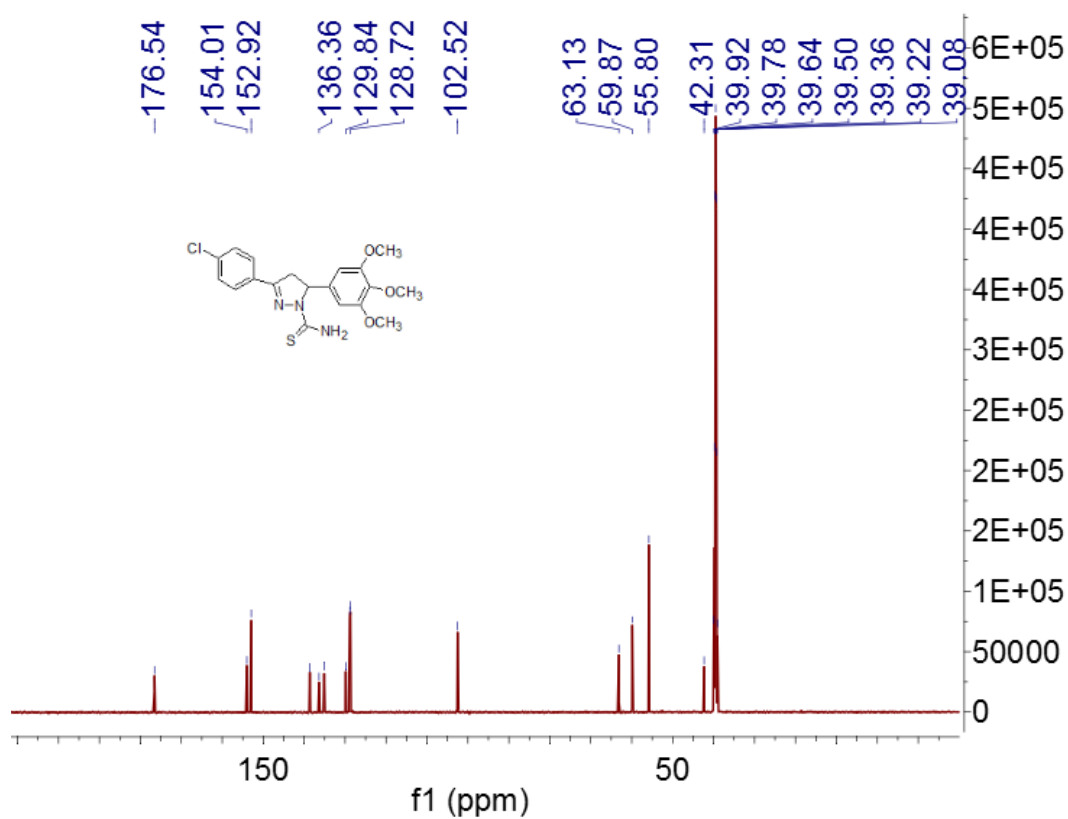


Figure S2. The representative ^{13}C NMR of compound **1b** and compound **2b**.
 ^{13}C NMR spectrum of compound **1b** and **2b** (150 MHz, DMSO)

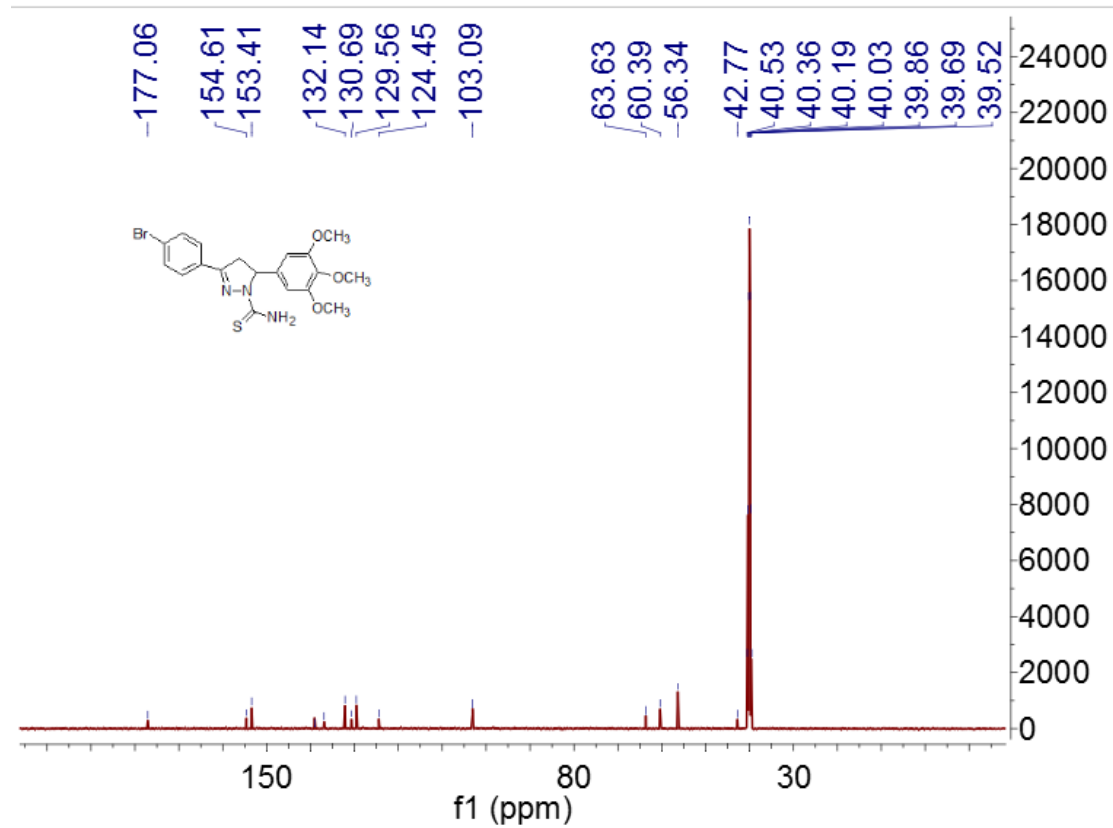
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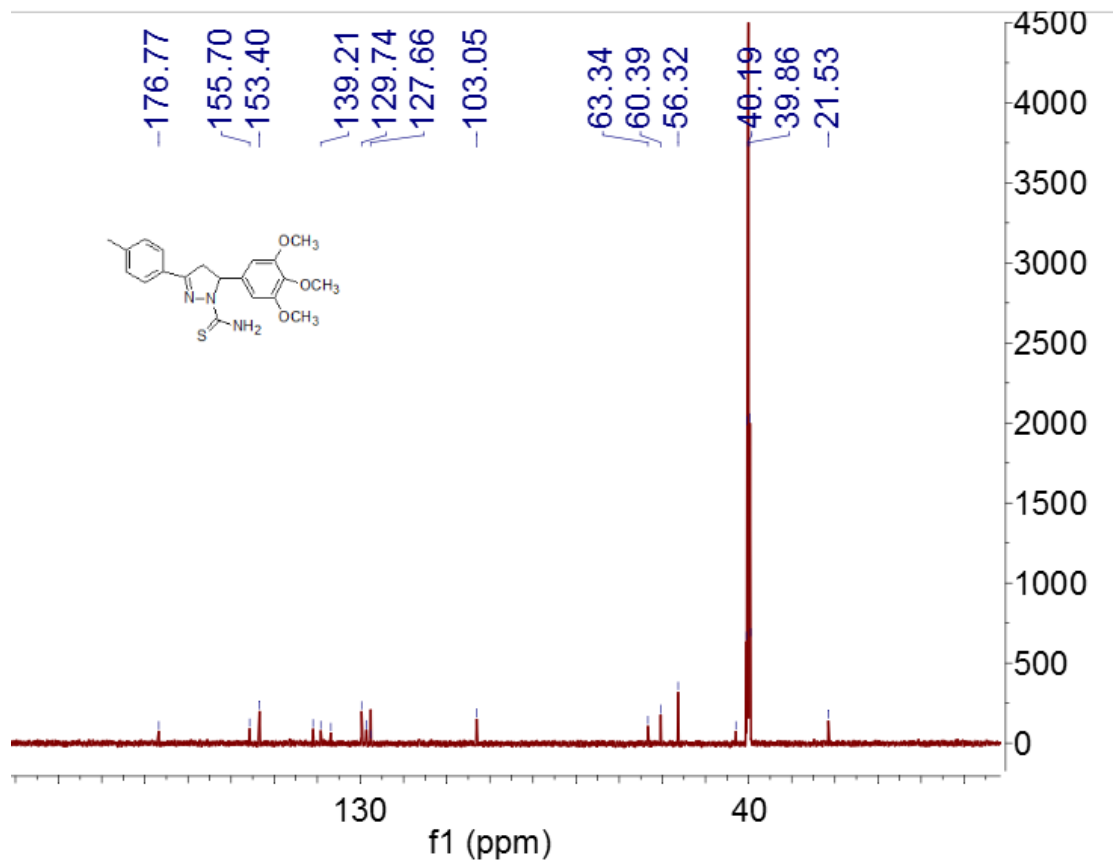
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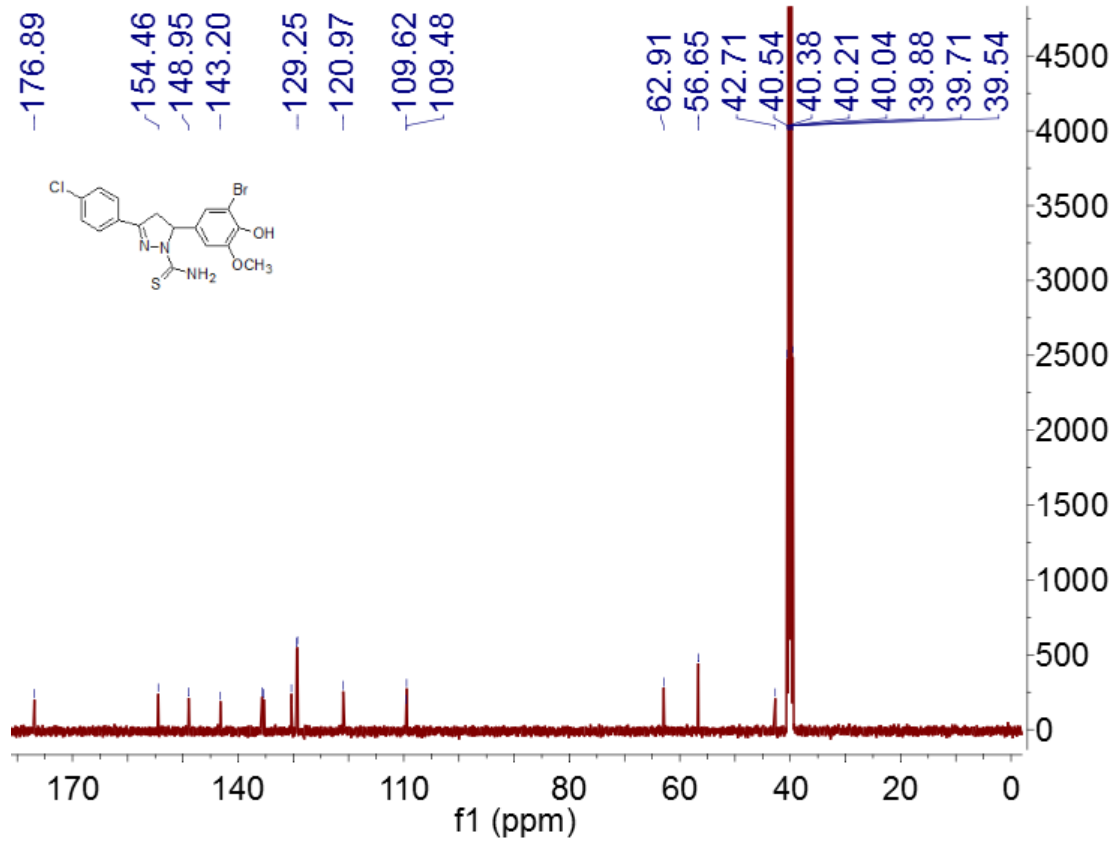
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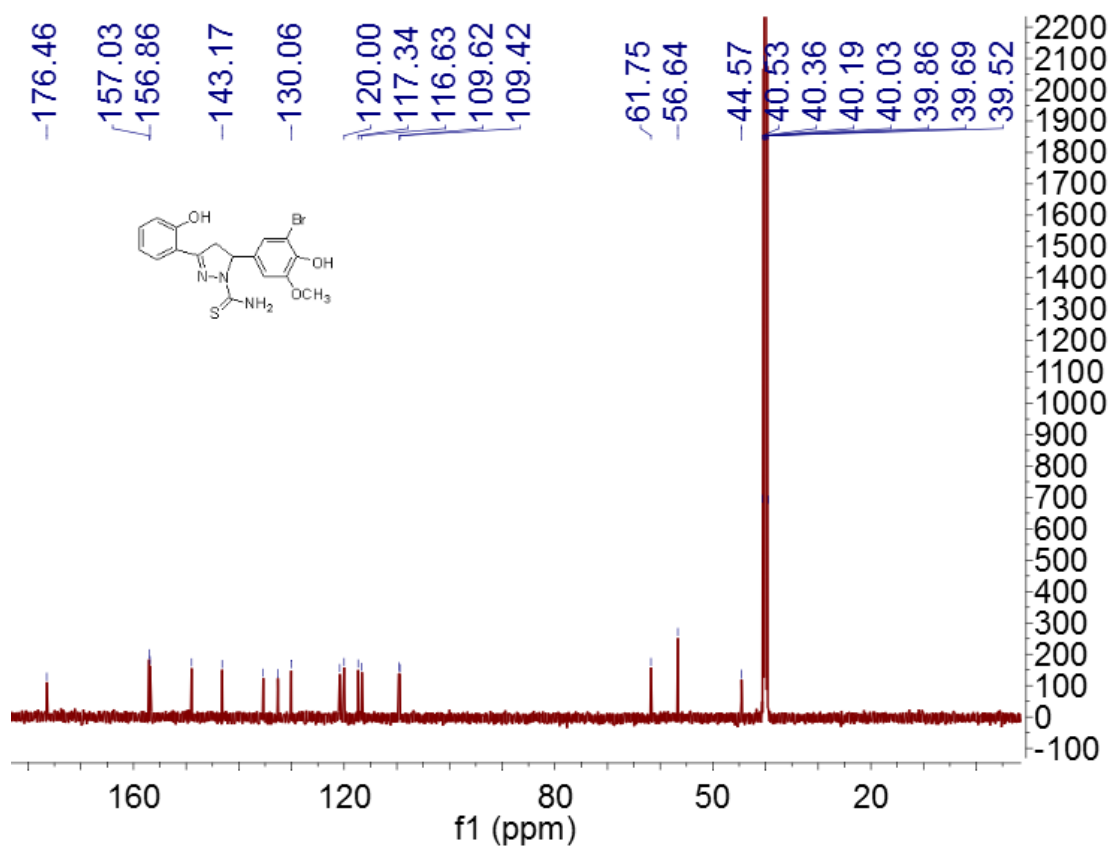
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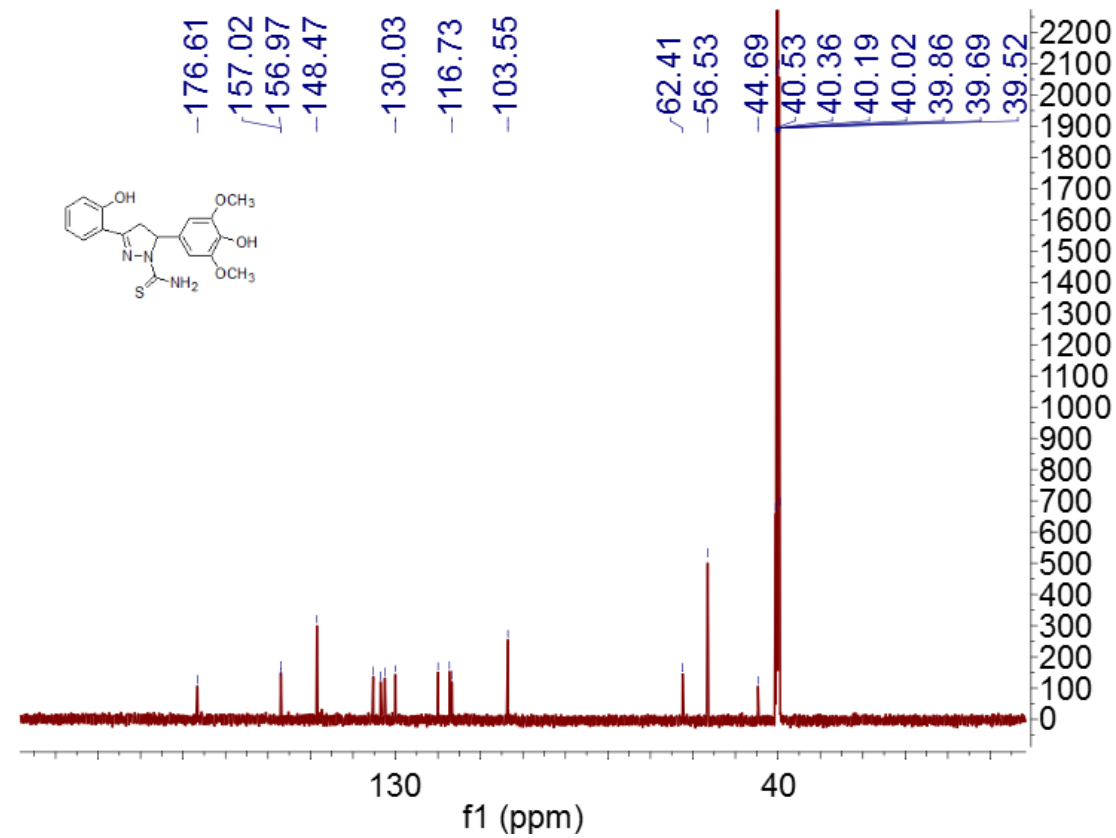
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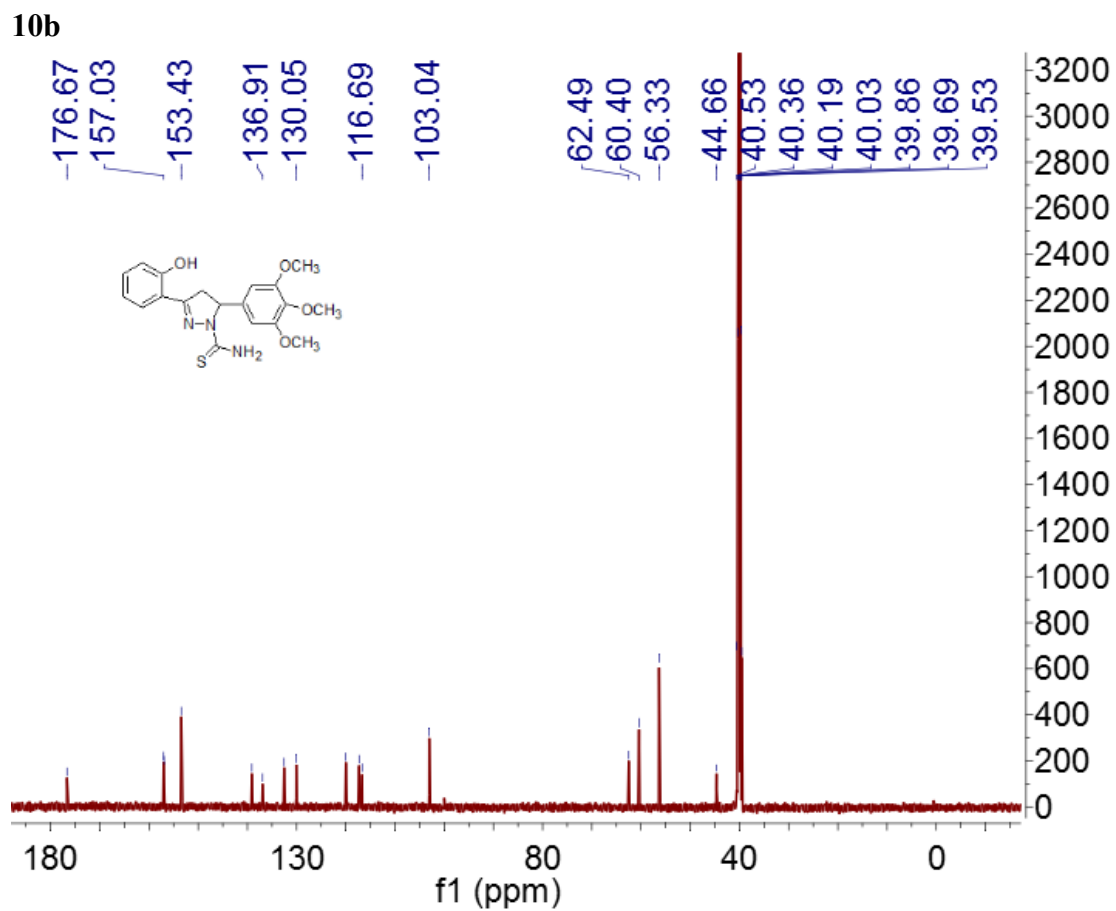
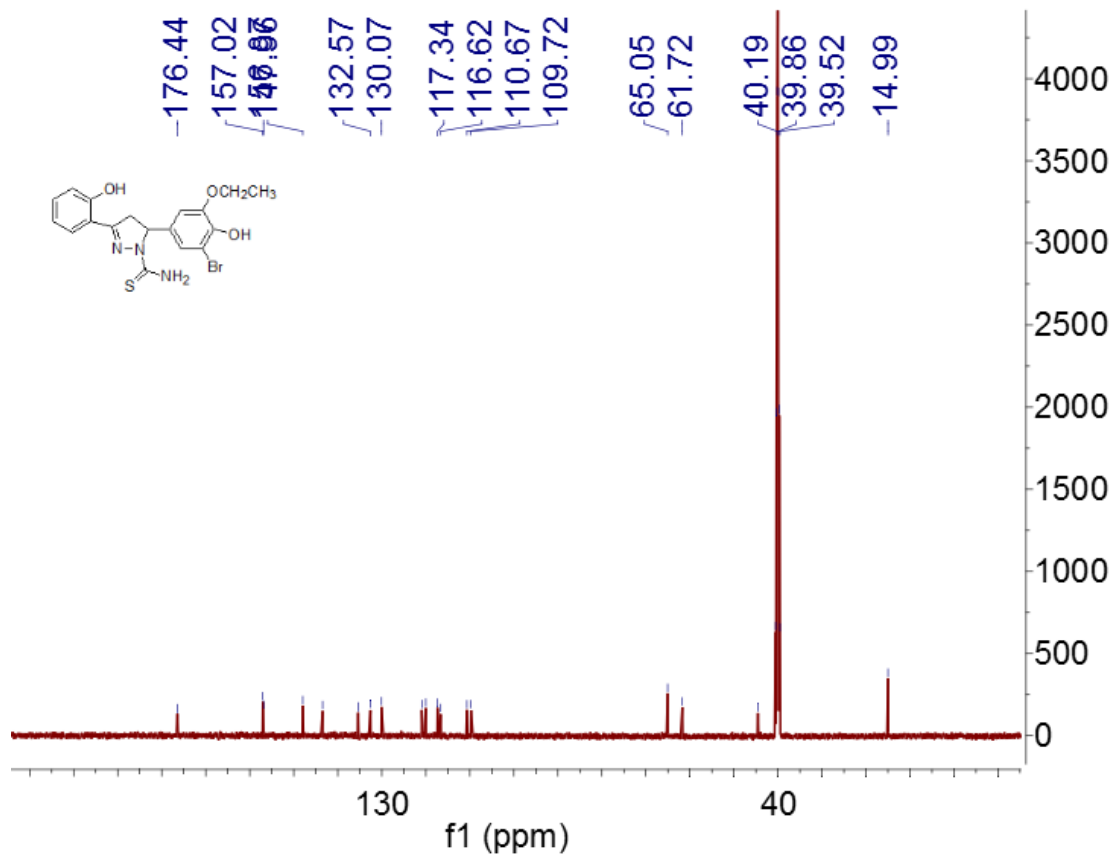
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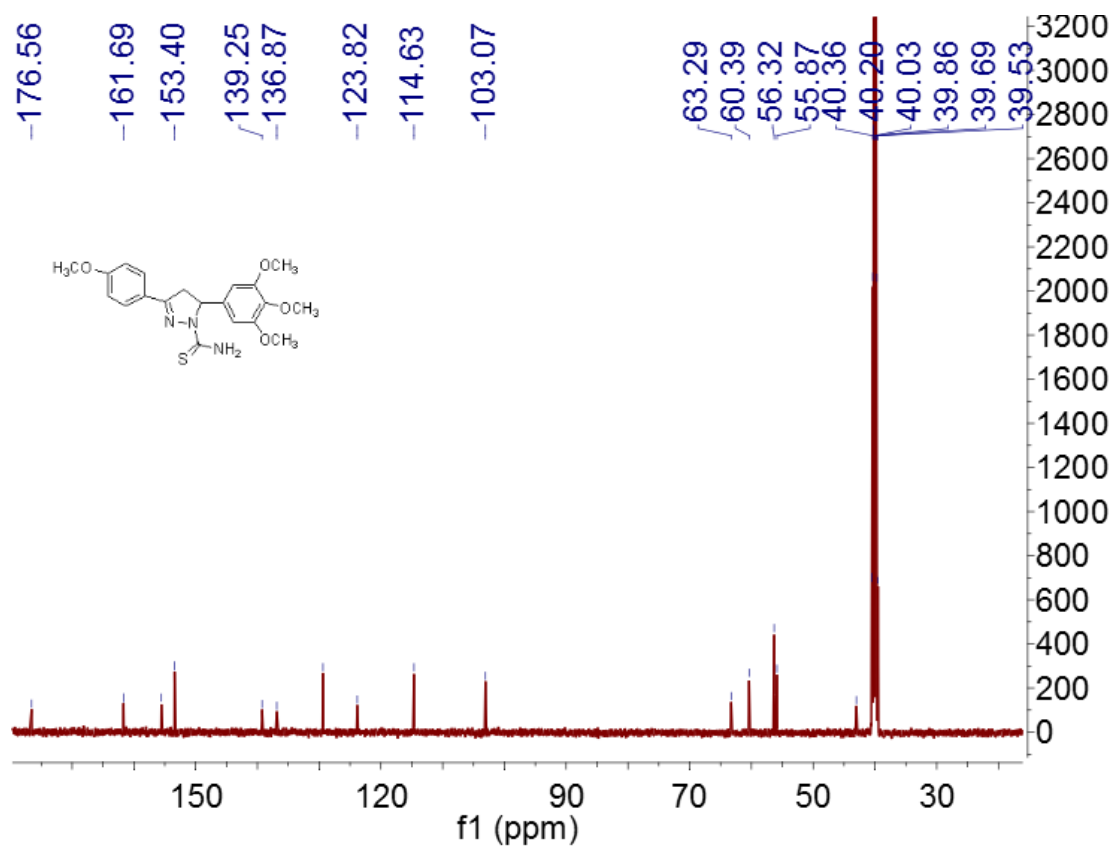
8b



9b



11b



12b

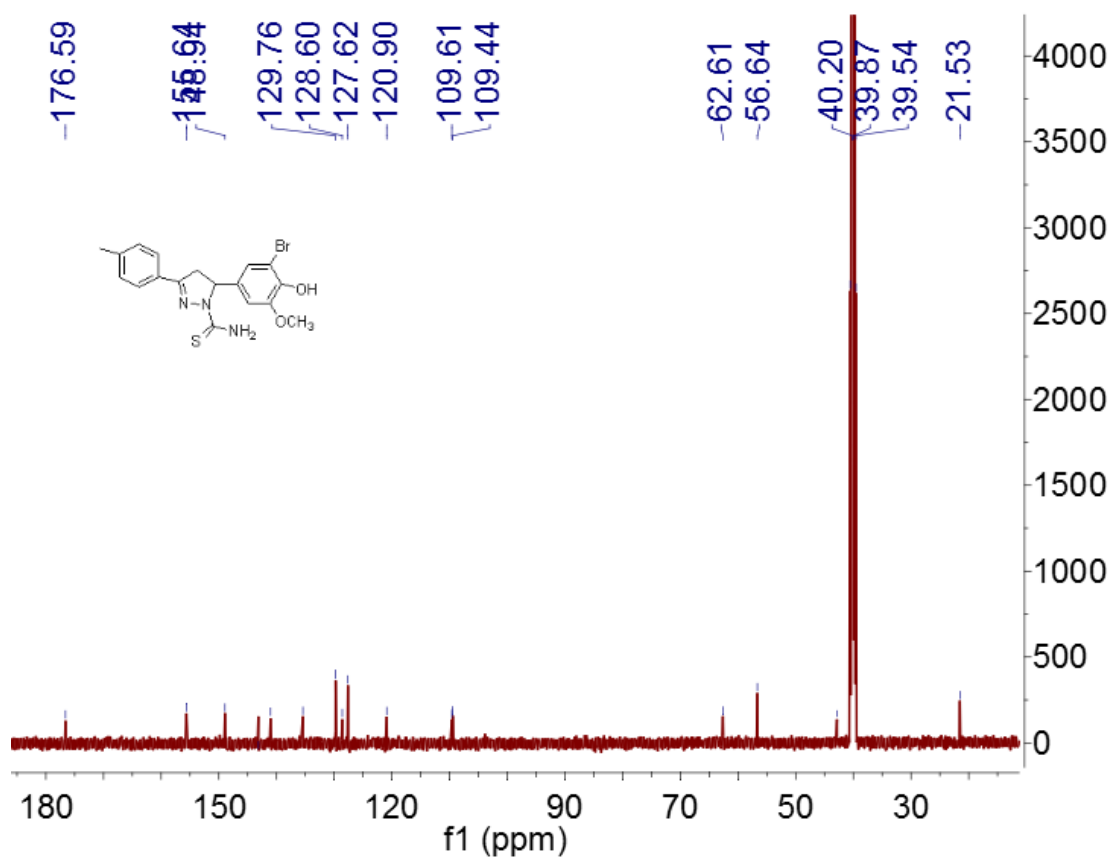
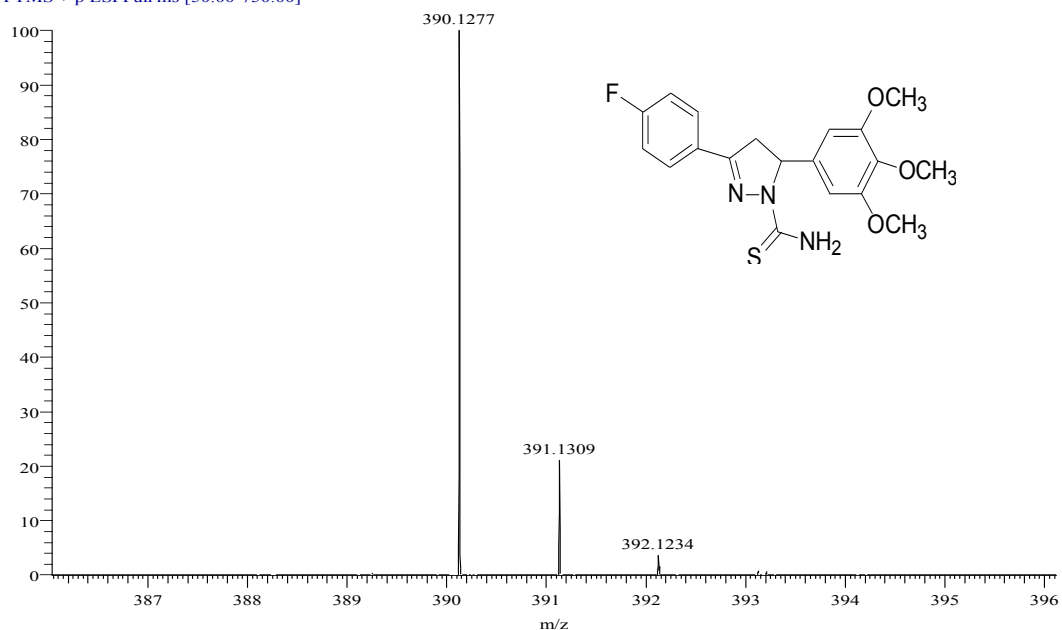


Figure S3. The representative HRMS (ESI) spectra of compound 1b-12b.

HRMS (ESI) spectrum of compound 1b

2017022801_170228104051 #9 RT: 0.09 AV: 1 NL: 3.43E7
T: FTMS + p ESI Full ms [50.00-750.00]

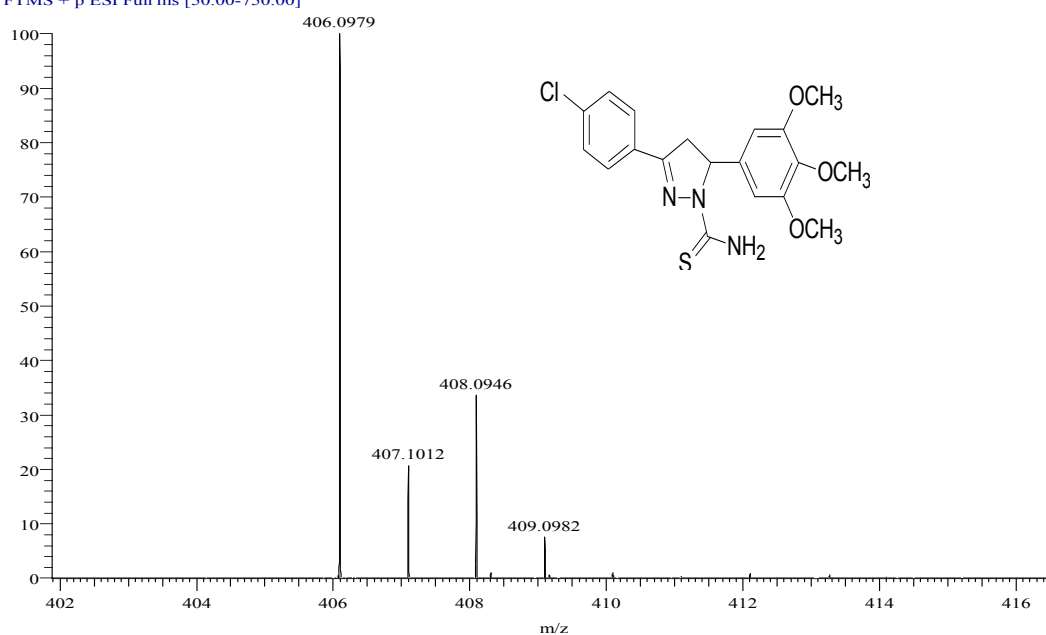


Elemental Composition calculator

Target M/Z	390.1277	Result type:	Positive	Species:	[M+H] ⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); F(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C ₁₉ H ₂₁ N ₃ O ₃ FS	390.1282		-1.28		

HRMS (ESI) spectrum of compound 2b

2017022802_170228104600 #11 RT: 0.10 AV: 1 NL: 8.29E7
T: FTMS + p ESI Full ms [50.00-750.00]

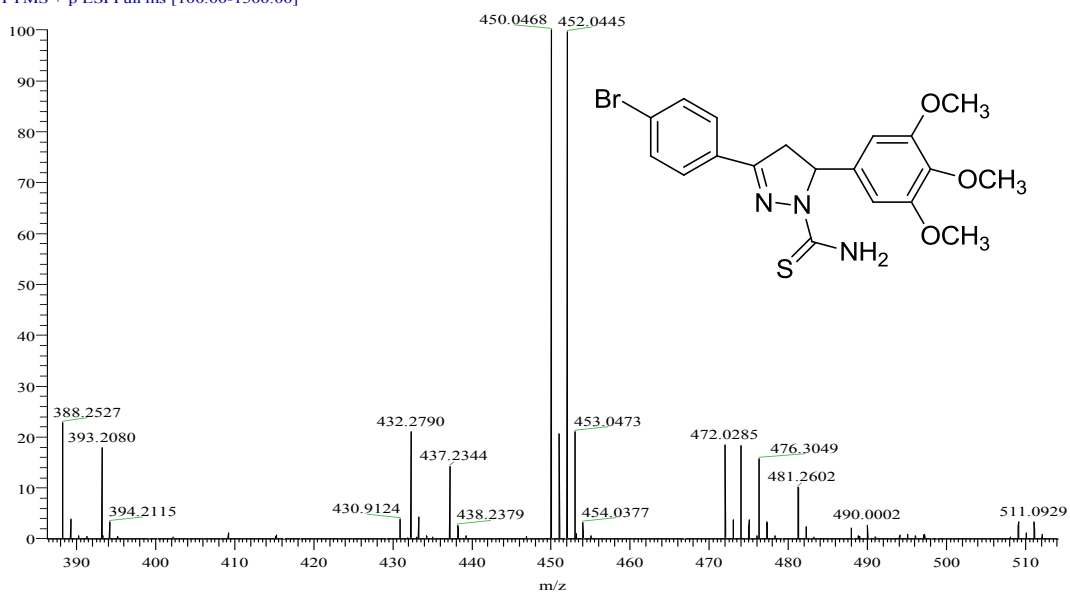


Elemental Composition calculator

Target M/Z	406.0979	Result type:	Positive	Species:	[M+H] ⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Cl(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C ₁₉ H ₂₁ N ₃ O ₃ SCl	406.0987		-1.97		

HRMS (ESI) spectrum of compound 3b

Mazhengyue-b3 #15 RT: 0.15 AV: 1 NL: 9.17E7
T: FTMS + p ESI Full ms [100.00-1500.00]

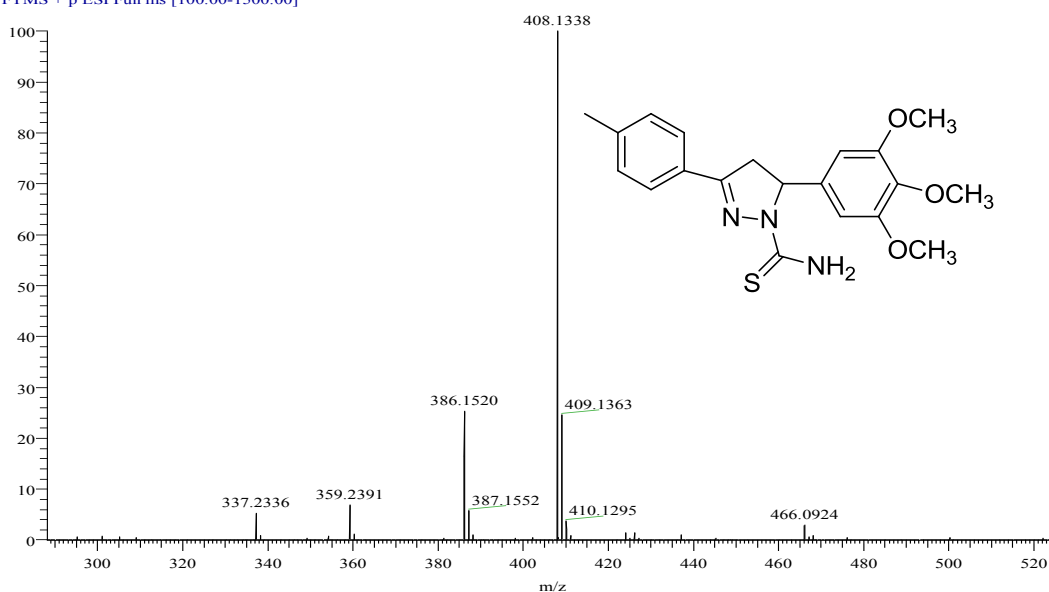


Elemental Composition calculator

Target M/Z	450.0468	Result type:	Positive	Species:	[M+H]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₁₉H₂₀BrN₃O₃S	450.0487		-4.22		

HRMS (ESI) spectrum of compound 4b

Mazhengyue-b4 #11 RT: 0.11 AV: 1 NL: 1.44E9
T: FTMS + p ESI Full ms [100.00-1500.00]

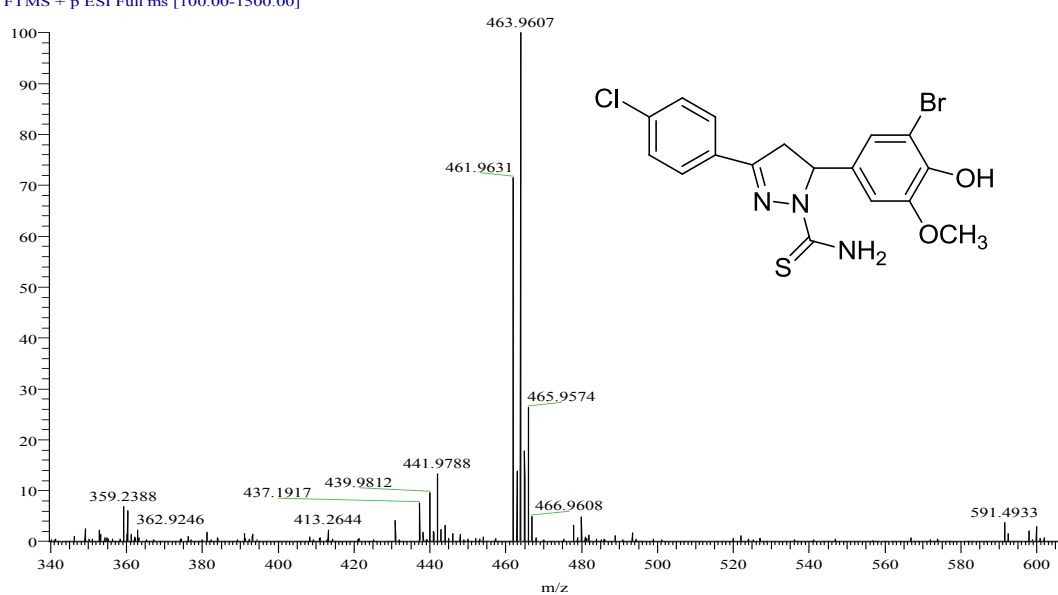


Elemental Composition calculator

Target M/Z	408.1338	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₂₀H₂₃N₃O₃S	408.1358		-4.9		

HRMS (ESI) spectrum of compound 5b

Mazhengyue-b5 #11 RT: 0.11 AV: 1 NL: 1.05E8
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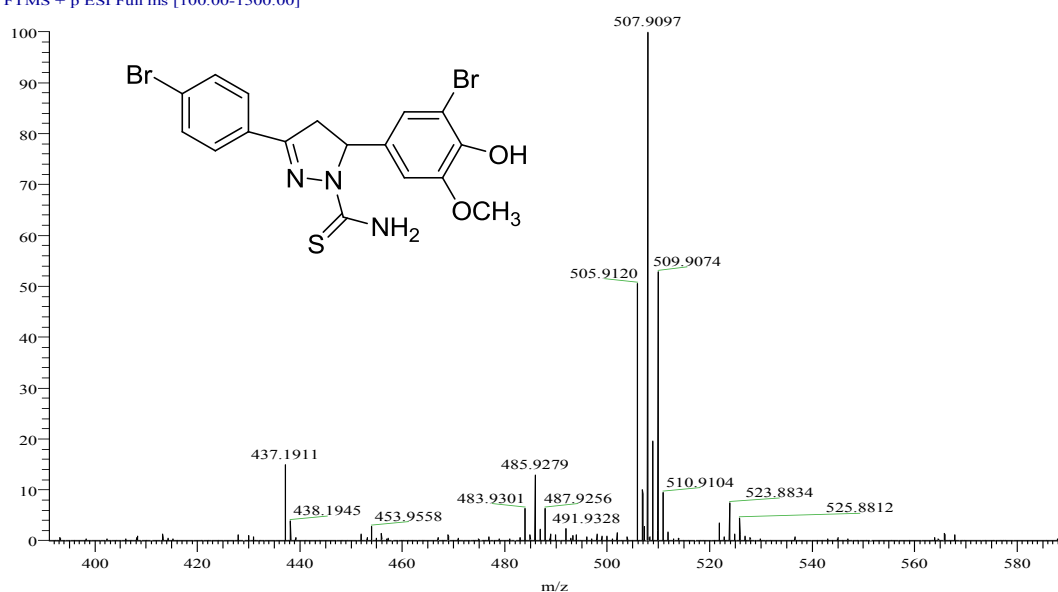


Elemental Composition calculator

Target M/Z	461.9631	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); Cl(0-1); S(0-1)				
Ion Formula	Calculated M/Z	PPM error			
C₁₇H₁₅BrClN₃O₂S	461.9634	-0.6			

HRMS (ESI) spectrum of compound 6b

Mazhengyue-b6 #13 RT: 0.13 AV: 1 NL: 2.33E8
 T: FTMS + p ESI Full ms [100.00-1500.00]

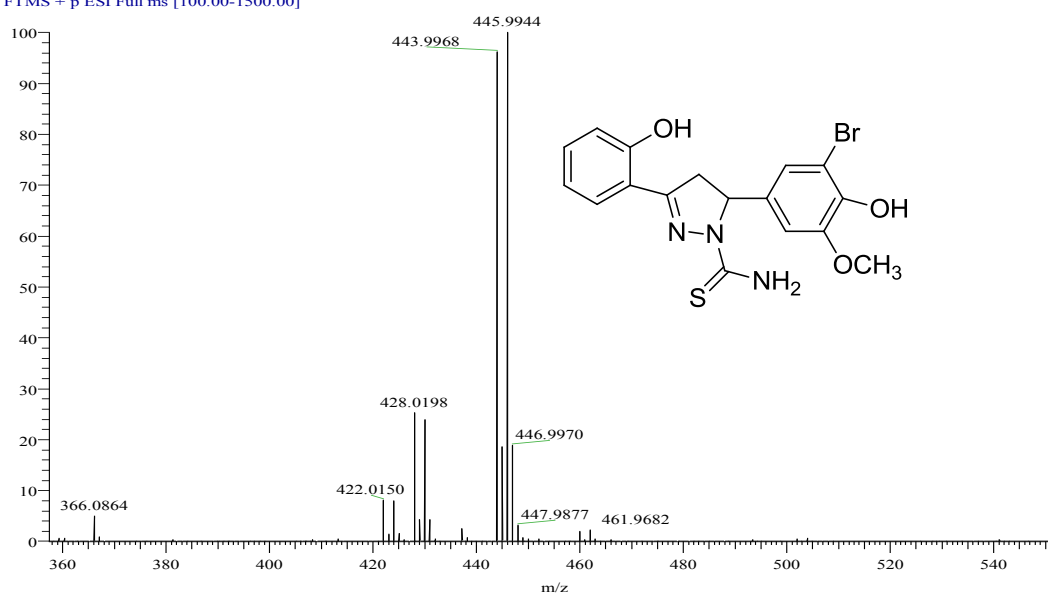


Elemental Composition calculator

Target M/Z	507.9097	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₁₇H₁₅Br₂N₃O₂S	507.9107		-1.96		

HRMS (ESI) spectrum of compound 7b

Mazhengyue-b7 #11 RT: 0.11 AV: 1 NL: 5.37E8
T: FTMS + p ESI Full ms [100.00-1500.00]

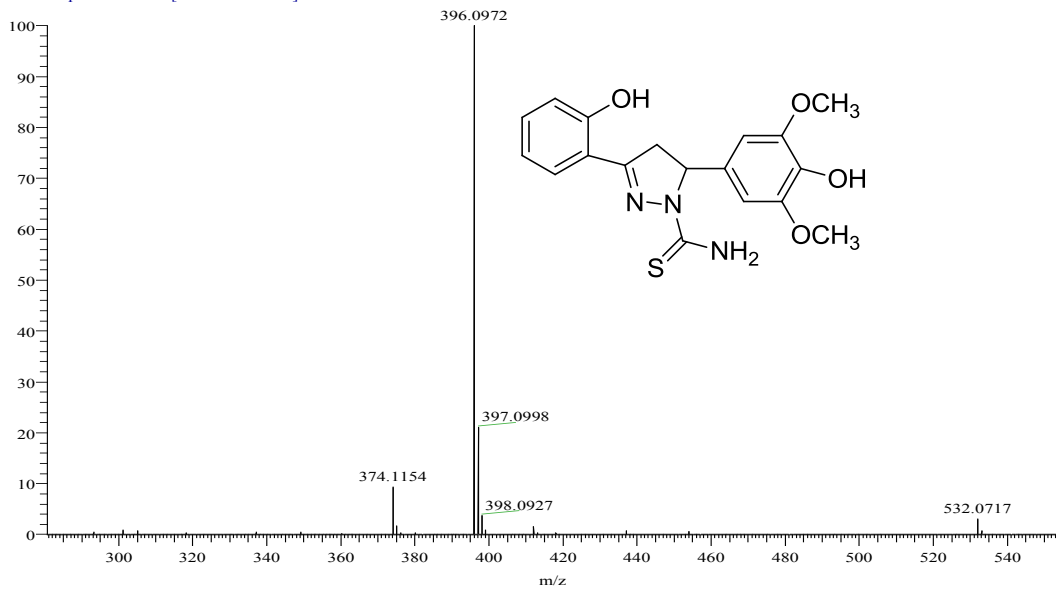


Elemental Composition calculator

Target M/Z	443.9968	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₁₇H₁₆BrN₃O₃S	443.9973		-1.1		

HRMS (ESI) spectrum of compound 8b

Mazhengyue-b8 #11 RT: 0.11 AV: 1 NL: 1.42E9
 T: FTMS + p ESI Full ms [100.00-1500.00]

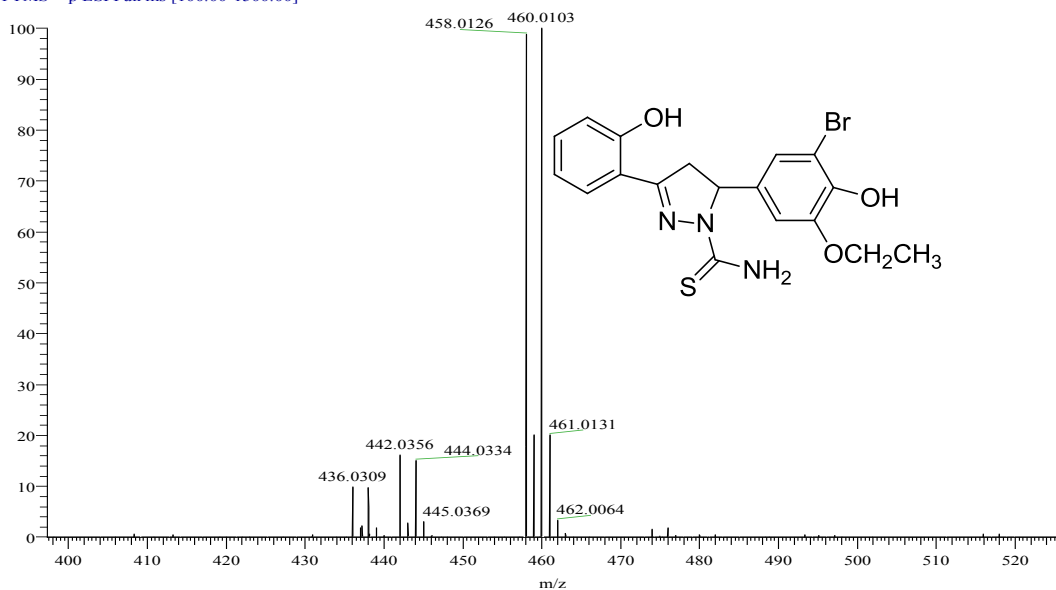


Elemental Composition calculator

Target M/Z	396.0972	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); S(0-1)				
Ion Formula	Calculated M/Z	PPM error			
C₁₈H₁₉N₃O₄S	396.0984	-3.0			

HRMS (ESI) spectrum of compound 9b

Mazhengyue-b9 #11 RT: 0.11 AV: 1 NL: 4.97E8
 T: FTMS + p ESI Full ms [100.00-1500.00]

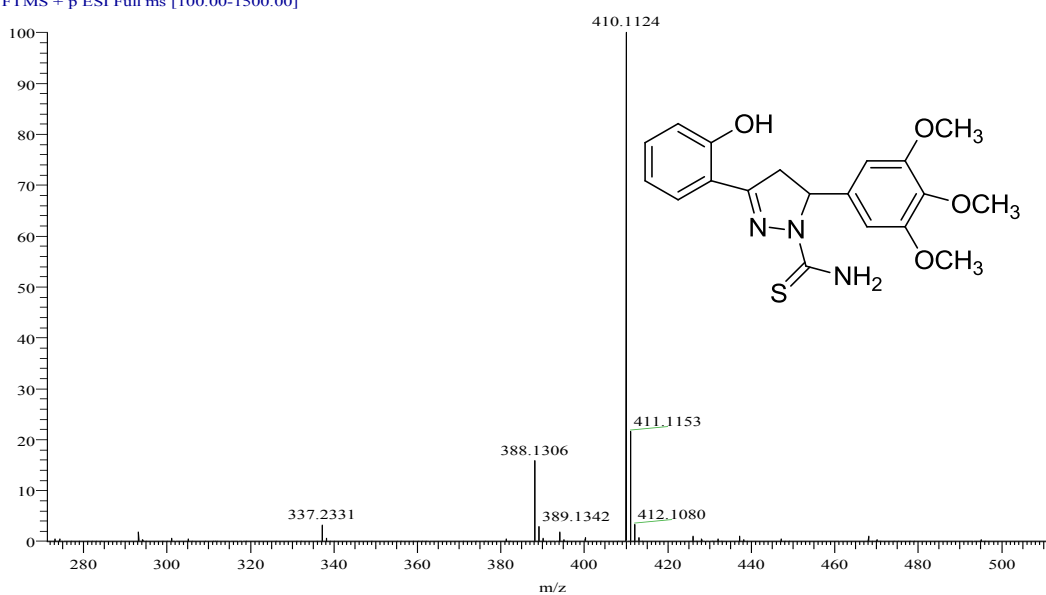


Elemental Composition calculator

Target M/Z	460.0108	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₁₈H₁₈BrN₃O₃S	460.0129		-4.5		

HRMS (ESI) spectrum of compound 10b

Mazhengyue-b10 #11 RT: 0.11 AV: 1 NL: 1.36E9
T: FTMS + p ESI Full ms [100.00-1500.00]

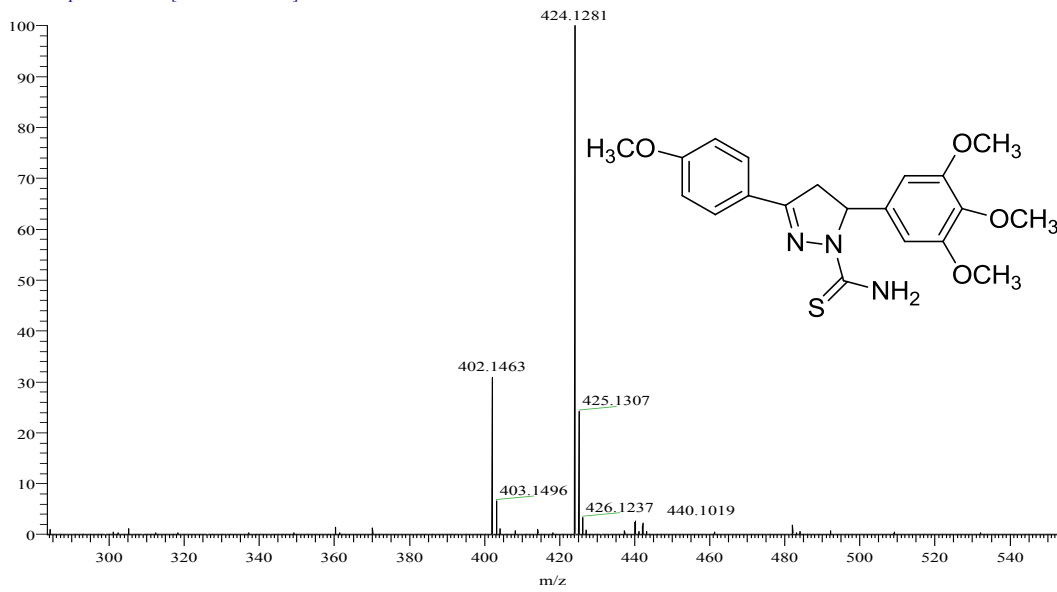


Elemental Composition calculator

Target M/Z	410.1124	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C₁₉H₂₁N₃O₄S	410.1140		-3.9		

HRMS (ESI) spectrum of compound 11b

Mazhengyue-b11 #13 RT: 0.13 AV: 1 NL: 1.64E9
 T: FTMS + p ESI Full ms [100.00-1500.00]

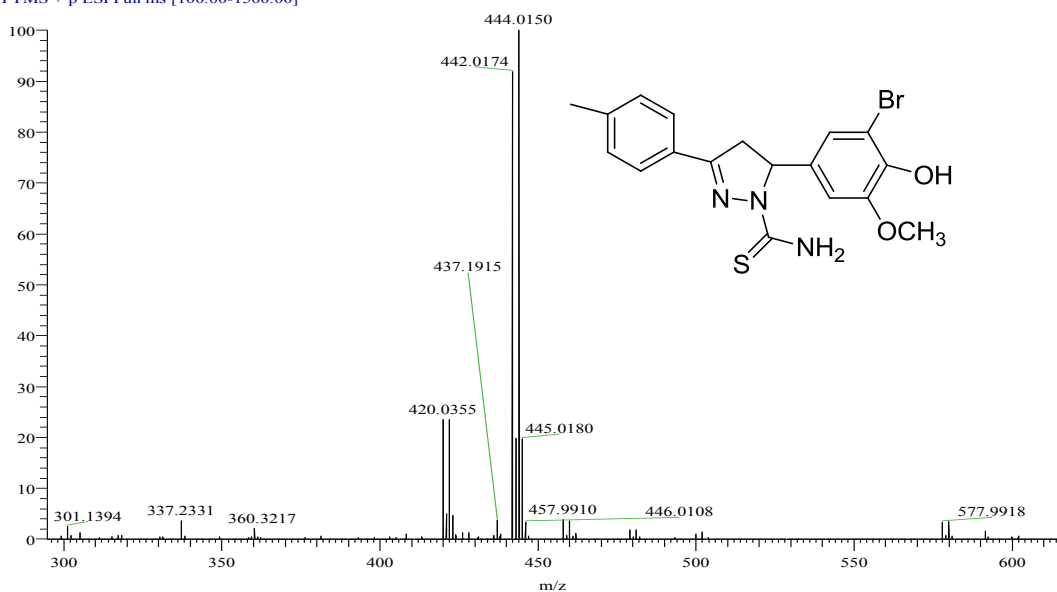


Elemental Composition calculator

Target M/Z	424.1281	Result type:	Positive	Species:	[M+Na]⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); S(0-1)				
Ion Formula	C₂₀H₂₃N₃O₄S	Calculated M/Z	424.1301	PPM error	-4.7

HRMS (ESI) spectrum of compound 12b

Mazhengyue-b12 #11 RT: 0.11 AV: 1 NL: 4.58E8
 T: FTMS + p ESI Full ms [100.00-1500.00]

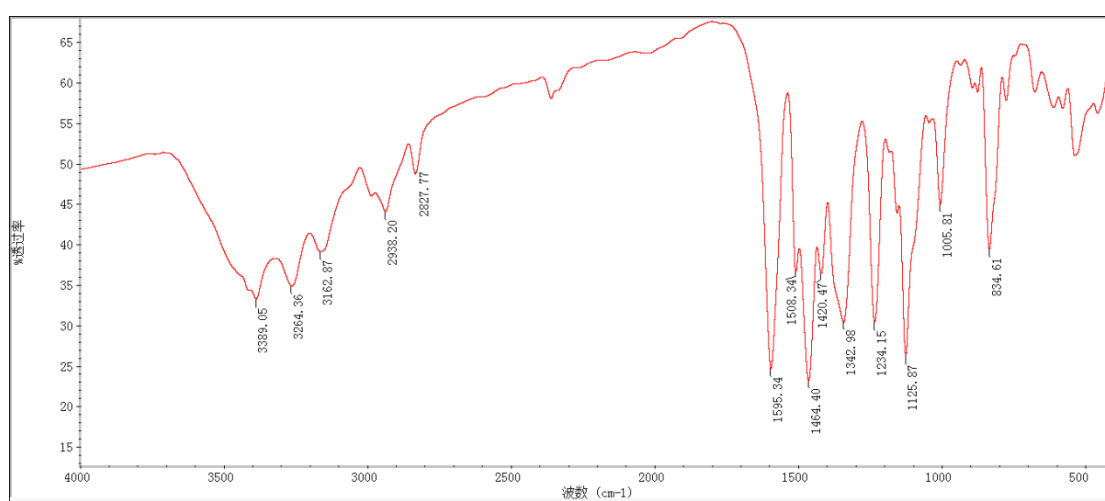


Elemental Composition calculator

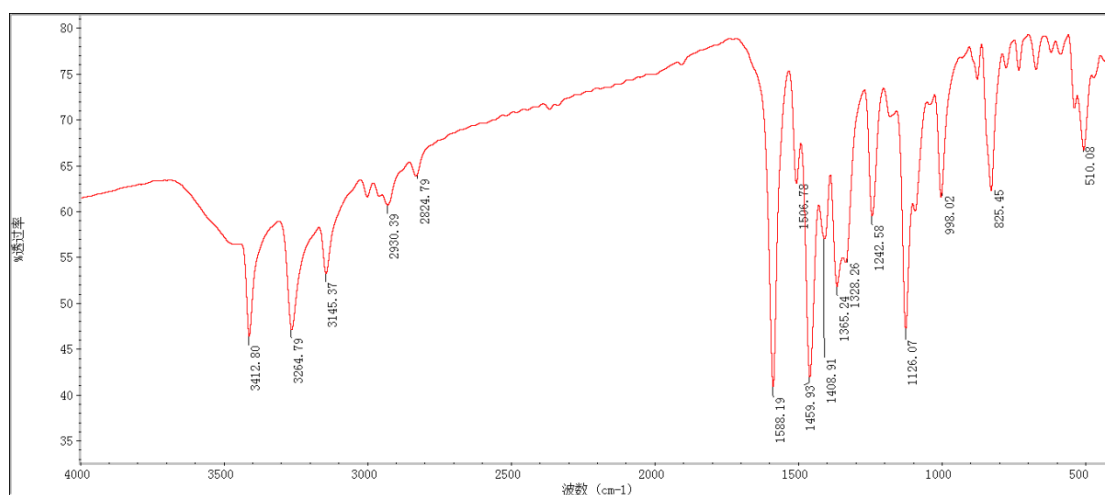
Target M/Z	444.0150	Result type:	Positive	Species:	[M+Na] ⁺
Elements:	C(0-40); H(0-80); O(0-10); N(0-10); Br(0-1); S(0-1)				
Ion Formula	Calculated M/Z		PPM error		
C ₁₈ H ₁₈ BrN ₃ O ₂ S	444.0170		-4.5		

Figure S4. The representative IR of compound 1b-12b.

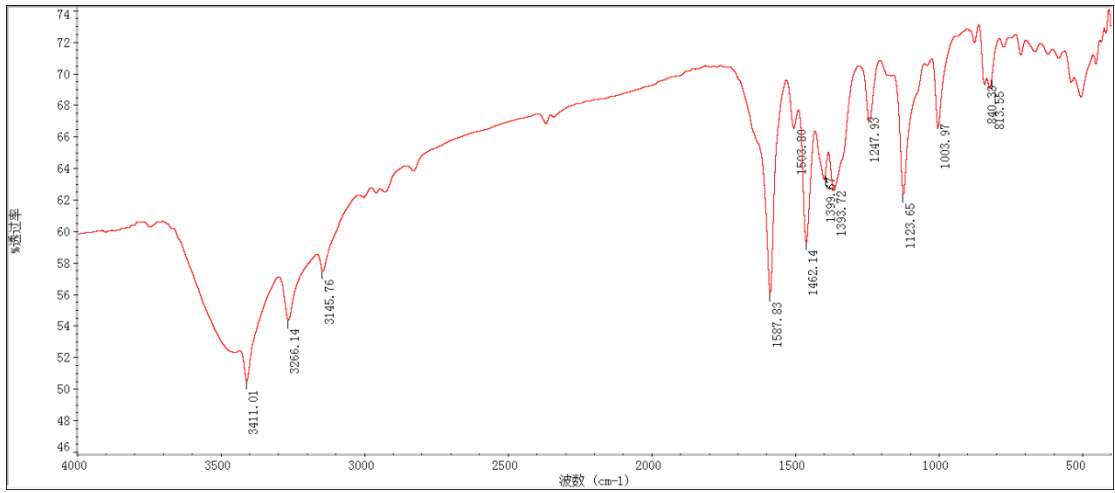
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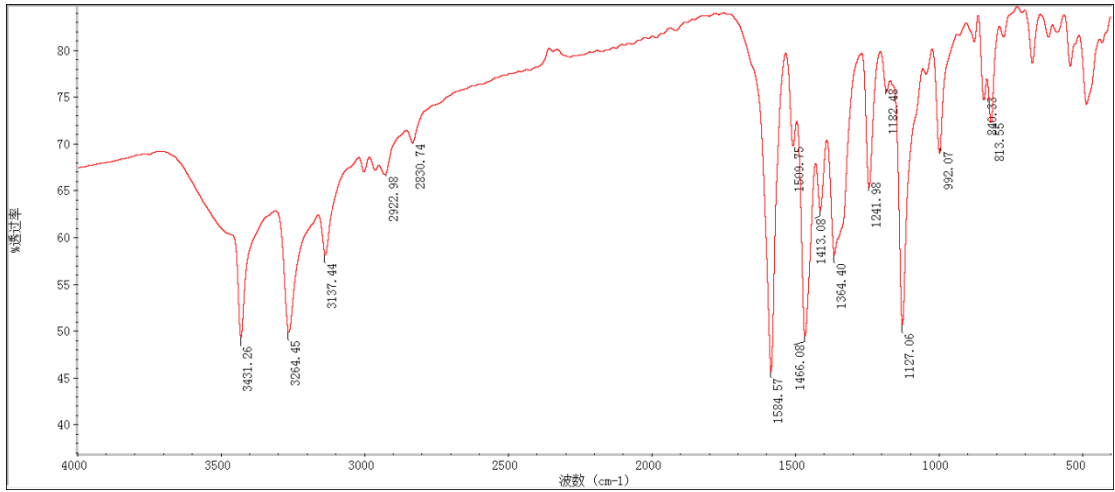
2b



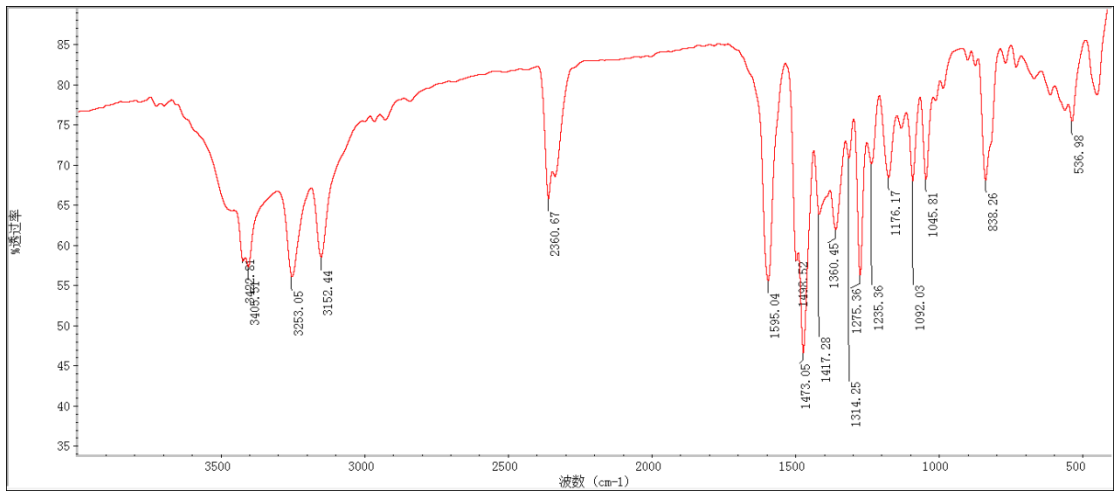
3b



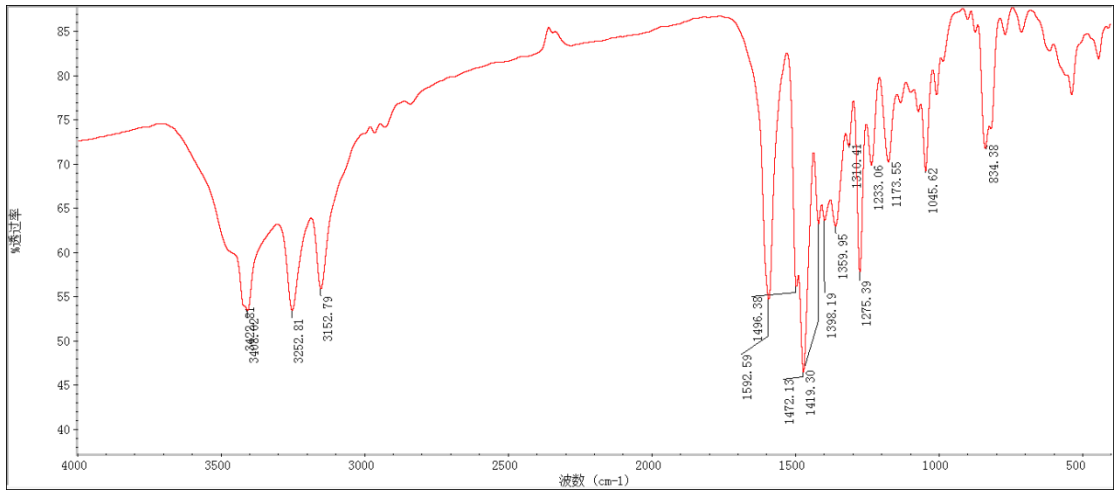
4b



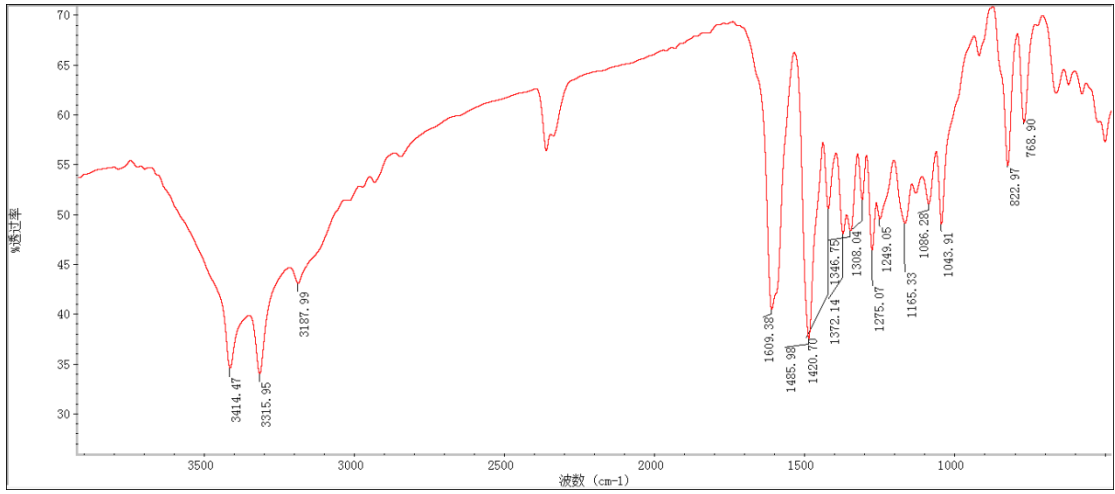
5b



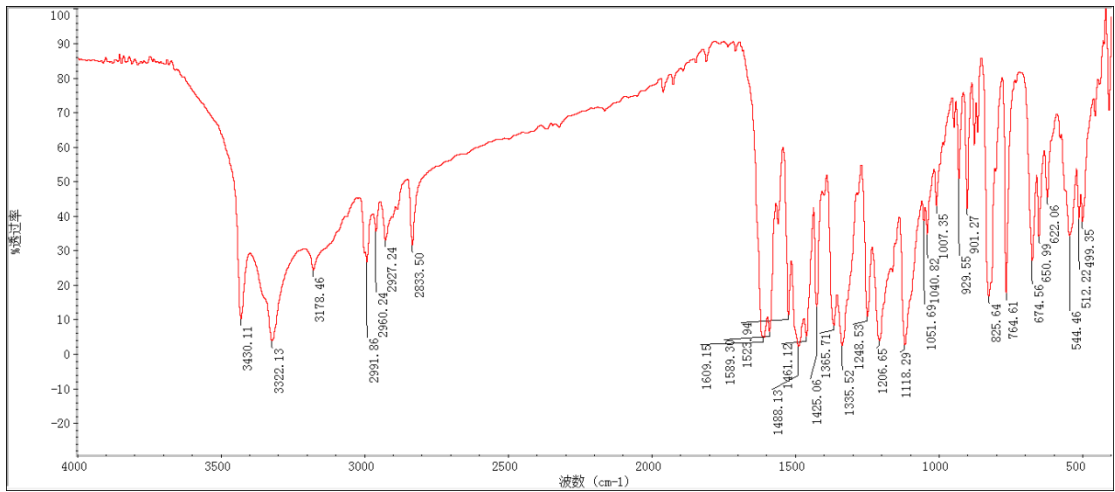
6b



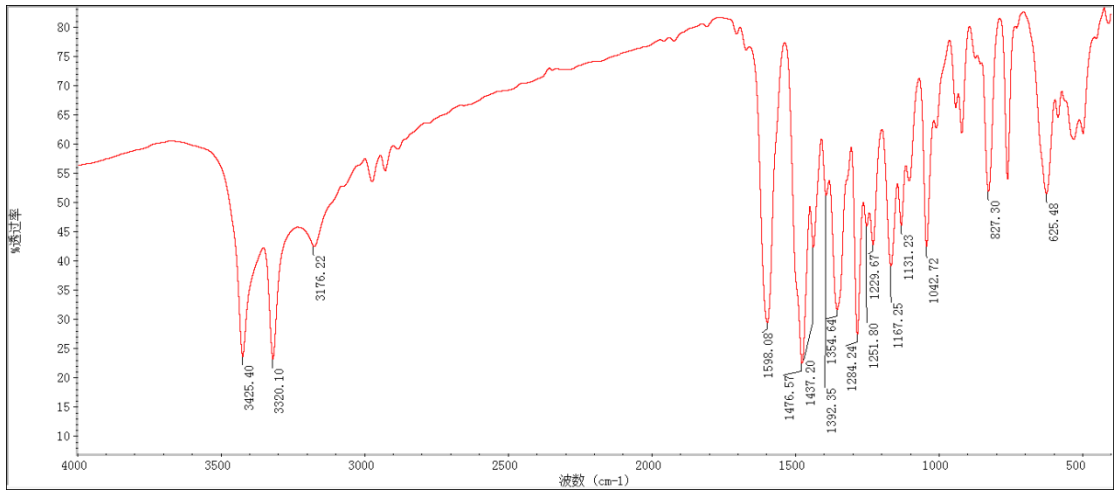
7b



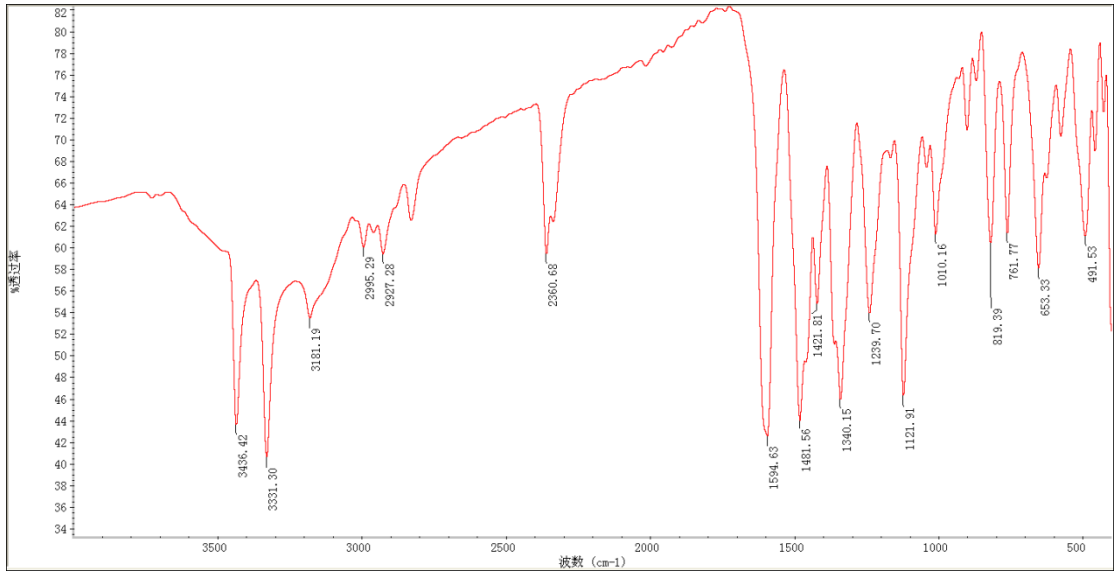
8b



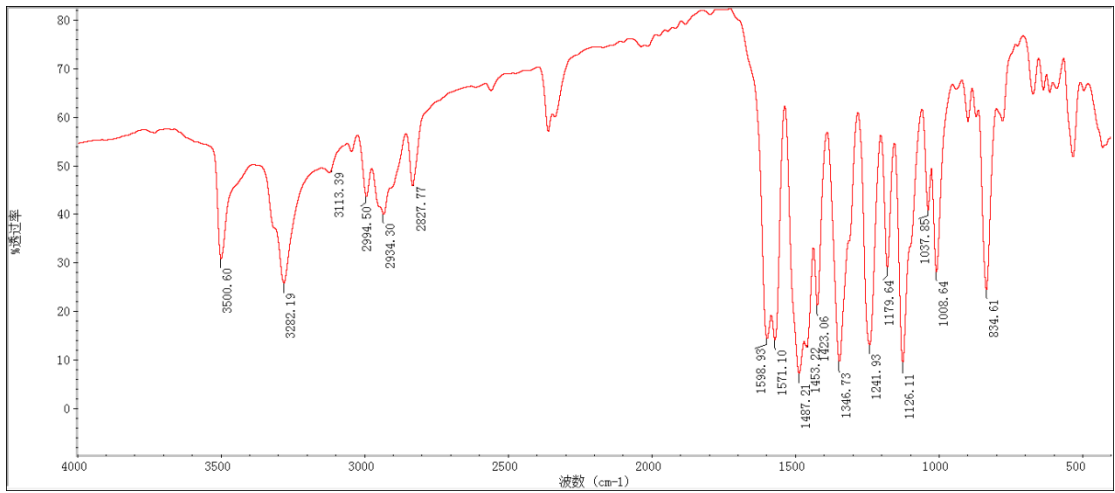
9b



10b



11b



12b

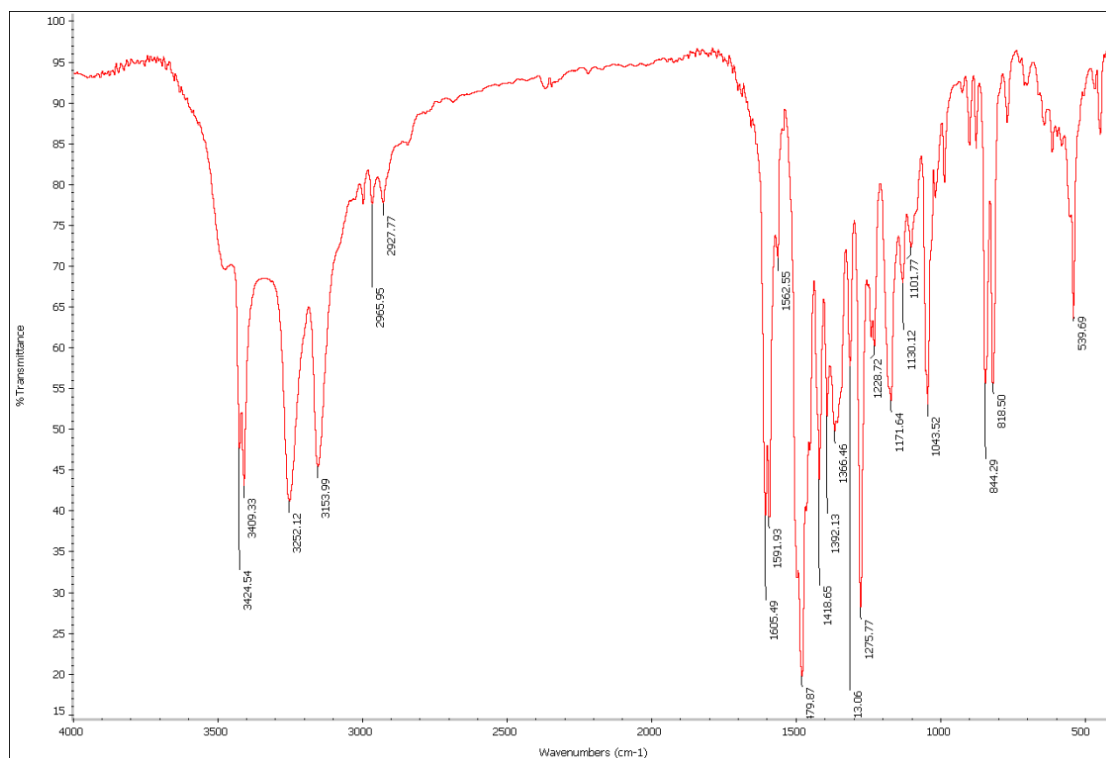
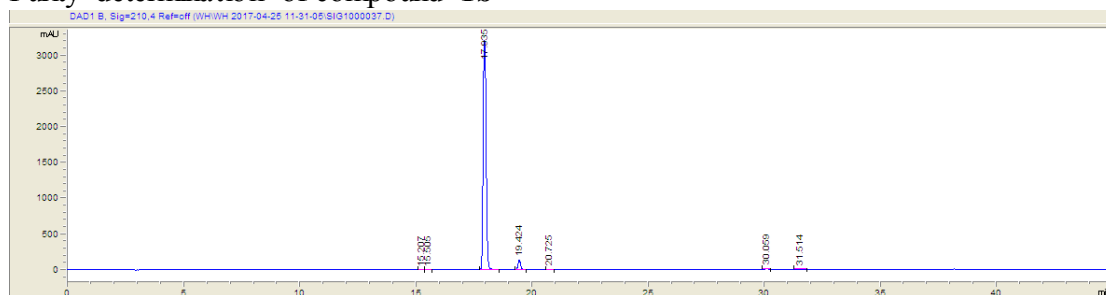


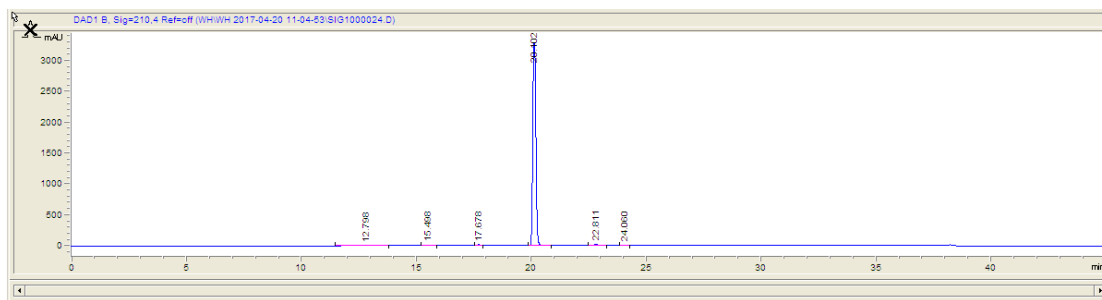
Figure S5. The representative HPLC chromatogram of compound **1b-12b**.

Purity determination of compound **1b**



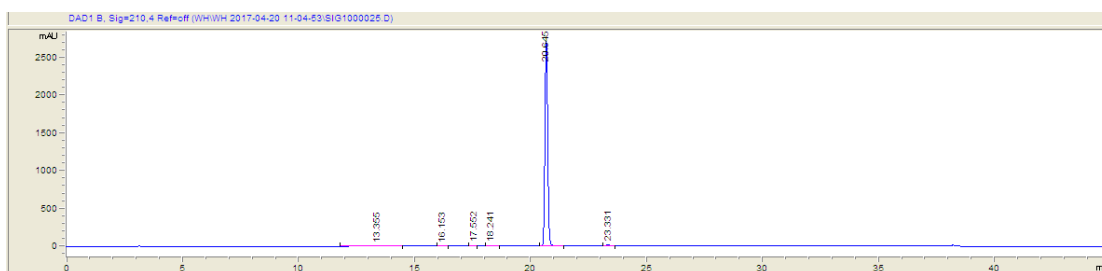
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	15.207	19.4	2.7	0.1123	0.881	0.065
2	15.505	20.1	2.8	0.1119	0.884	0.067
3	17.935	28596.9	3203.1	0.1422	0.852	95.773
4	19.424	1057.7	136.3	0.1205	0.865	3.542
5	20.725	25.3	3.2	0.1201	0.85	0.085
6	30.059	113.4	13.5	0.13	0.928	0.380
7	31.514	26.3	1.9	0.2063	0.56	0.088

Purity determination of compound **2b**



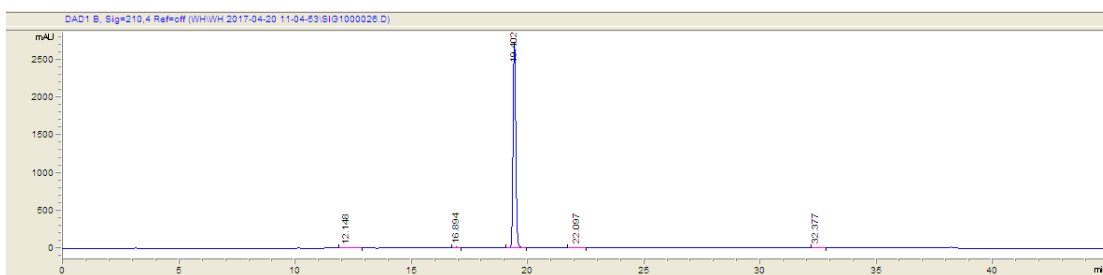
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	12.798	574.2	7.3	1.0407	1.437	1.792
2	15.498	120.6	11.4	0.1514	0.816	0.376
3	17.678	147.3	16.3	0.1336	0.787	0.460
4	20.102	30824.5	3289.7	0.1493	0.875	96.218
5	22.811	261.7	24.4	0.1571	0.793	0.817
6	24.06	107.7	9.5	0.1636	0.957	0.336

Purity determination of compound **3b**



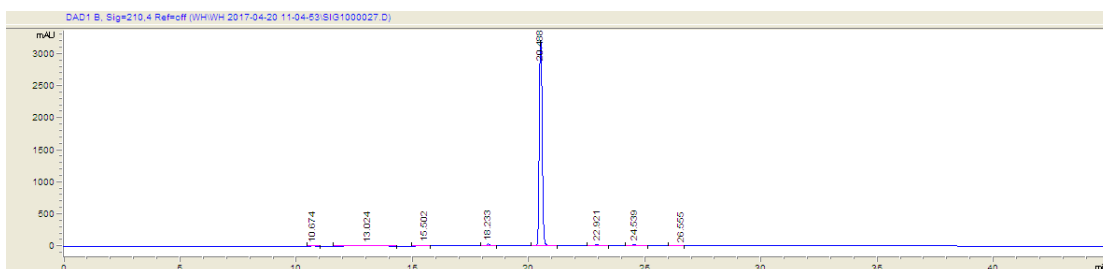
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	13.355	377.9	4.8	1.0586	1.452	1.630
2	16.153	45.5	4.4	0.1515	0.745	0.196
3	17.552	54.3	6.2	0.1349	0.938	0.234
4	18.241	102	10.2	0.1441	0.64	0.44
5	20.645	22429.1	2707	0.1287	0.88	96.768
6	23.331	169.5	18.1	0.1412	0.889	0.731

Purity determination of compound **4b**



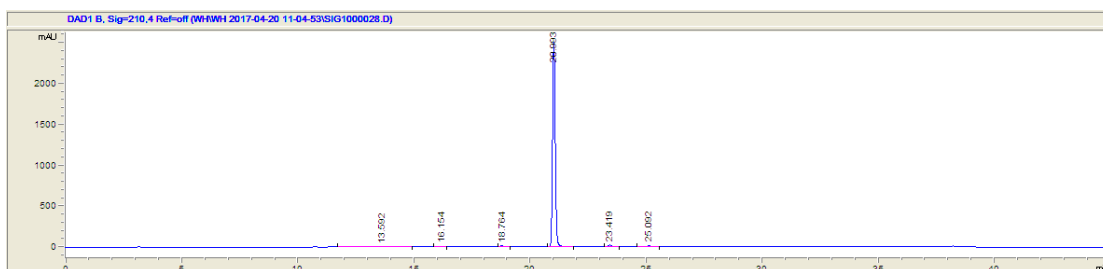
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	12.148	141.6	3.5	0.5001	0.557	0.623
2	16.894	109.5	12.9	0.1267	0.82	0.482
3	19.402	22280.8	2721.3	0.1315	0.866	98.038
4	22.097	111.6	9.6	0.164	0.813	0.419
5	32.377	83.2	6.6	0.1824	0.61	0.366

Purity determination of compound **5b**



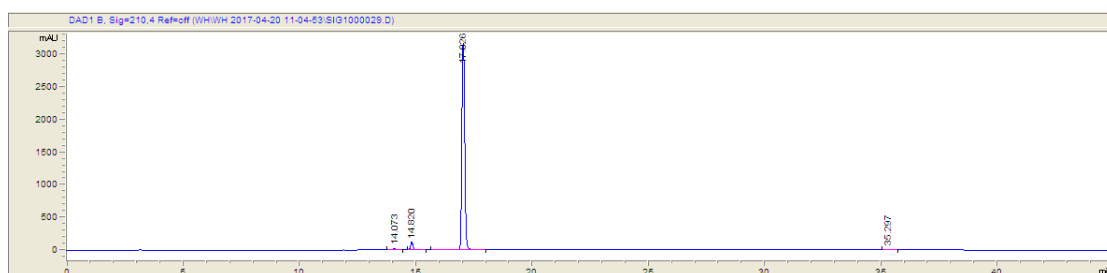
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	10.674	47.9	5.3	0.1367	0.803	0.161
2	13.024	390	5.2	0.9833	1.326	1.313
3	15.502	136.5	15	0.1383	1.125	0.459
4	18.233	260.3	31.6	0.1281	0.785	0.876
5	20.488	28318.7	3207.4	0.143	0.857	95.319
6	22.921	280.2	27.4	0.1512	0.893	0.943
7	24.539	252	23.1	0.1592	0.632	0.848
8	26.555	23.7	8.1E-1	0.3747	3.118	0.080

Purity determination of compound **6b**



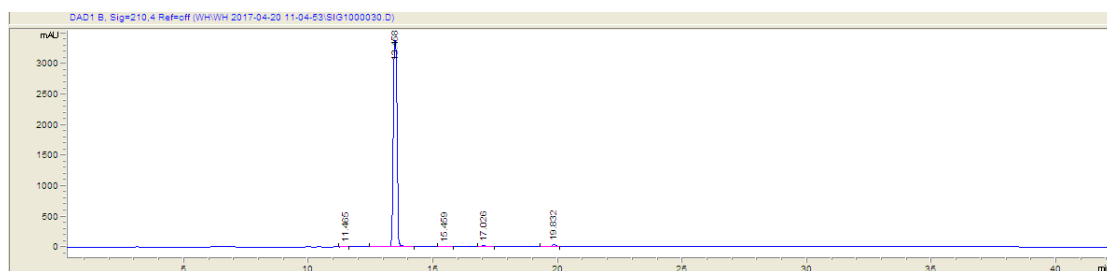
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	13.592	295.8	3.9	0.9823	1.314	1.418
2	16.154	47.8	5.5	0.1337	1.022	0.229
3	18.764	120.7	14.1	0.128	0.708	0.579
4	20.993	20007.5	2498.1	0.1254	0.857	95.940
5	23.419	208.1	21.9	0.1431	0.789	0.998
6	25.092	174.4	14.1	0.1735	0.705	0.836

Purity determination of compound **7b**



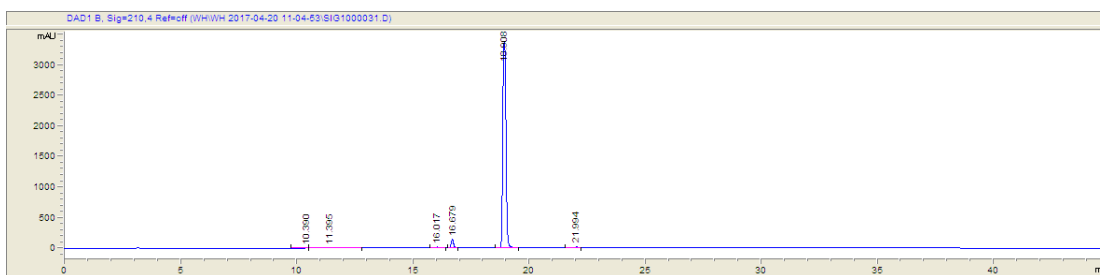
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	14.073	184.7	23.8	0.1187	0.829	0.648
2	14.82	881.8	117.2	0.1158	0.822	3.095
3	17.026	27329.1	3157.9	0.1369	0.823	95.891
4	35.297	104.2	7.9	0.2067	0.937	0.366

Purity determination of compound **8b**



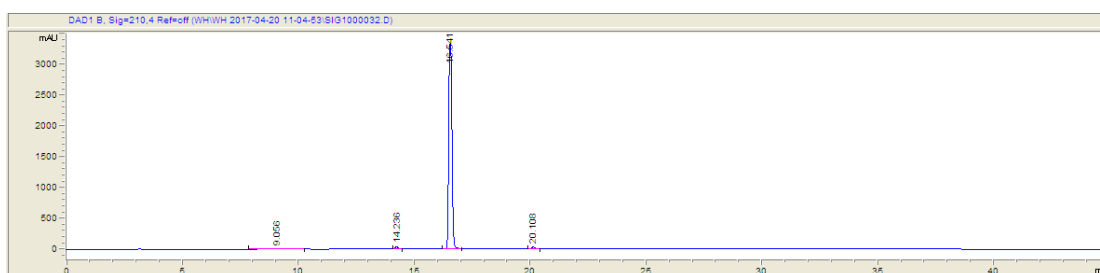
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	11.465	114.1	14.2	0.1219	0.989	0.343
2	13.458	32450.4	3379.2	0.152	0.861	97.543
3	15.459	113.2	9	0.178	0.771	0.340
4	17.026	214.5	24.6	0.1296	0.781	0.645
5	19.832	375.7	43.6	0.1326	0.753	1.129

Purity determination of compound **9b**



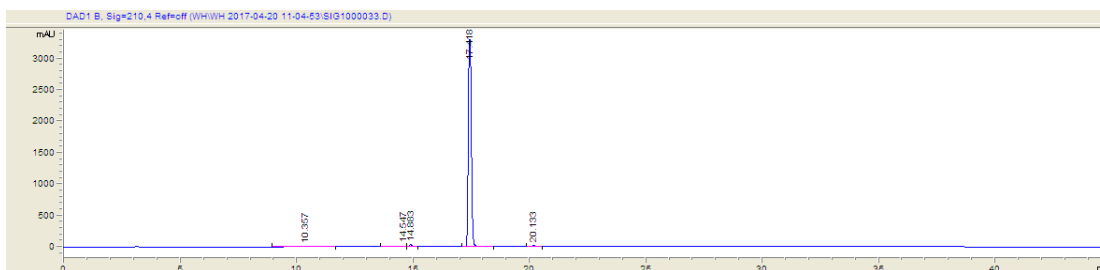
	RT	Area	Height	Peak width	Symmetry factor	%Area
1	10.39	26.8	2.9	0.1369	1.203	0.079
2	11.395	270.7	4.1	0.8545	1.013	0.795
3	16.017	134.3	15.5	0.1329	0.806	0.394
4	16.679	1037.6	137.1	0.1163	0.832	3.046
5	18.908	32395.2	3384.5	0.1517	0.836	95.103
6	21.994	198.8	21.5	0.14	1.017	0.584

Purity determination of compound 10b



	RT	Area	Height	Peak width	Symmetry factor	%Area
1	9.056	407.1	6.6	0.8444	1.235	1.219
2	14.236	342.8	45.7	0.1155	0.841	1.027
3	16.541	32389.3	3344.9	0.157	0.817	96.980
4	20.108	258.6	29.9	0.1288	0.795	0.774

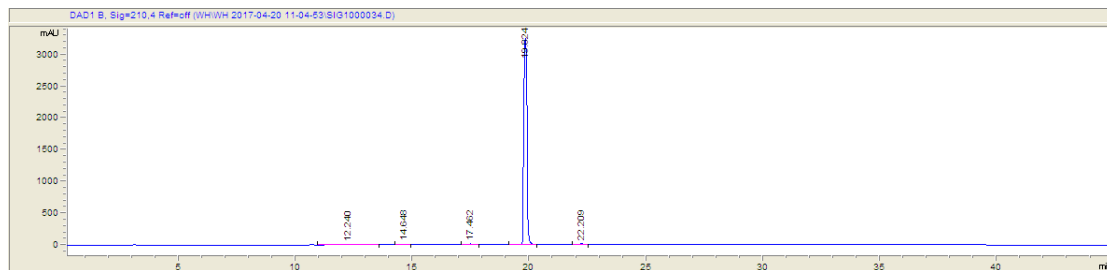
Purity determination of compound 11b



	RT	Area	Height	Peak width	Symmetry factor	%Area
	10.357					
	14.57					
	14.865					
	18					
	20.133					

1	10.357	408.7	6.3	0.8807	1.373	1.326
2	14.547	105.4	6.6	0.2139	1.438	0.342
3	14.883	266.6	32.8	0.1227	0.743	0.865
4	17.418	29855.2	3301	0.1455	0.849	96.835
5	20.133	194.9	19.6	0.1443	1.004	0.632

Purity determination of compound **12b**



	RT	Area	Height	Peak width	Symmetry factor	%Area
1	12.24	385.1	4.8	1.0289	1.041	1.279
2	14.648	113.8	8.5	0.1886	1.032	0.378
3	17.462	225.8	19.1	0.1698	0.831	0.750
4	19.824	29074.3	3248.3	0.1444	0.855	96.604
5	22.209	297.4	20.1	0.2043	0.789	0.988