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Supporting Information

Exploring the Potential of *N*-Benzylidenebenzohydrazide Derivatives as Antidiabetic and Antioxidant Agents: Design, Synthesis, Spectroscopic, Crystal Structure, DFT and Molecular Docking Study

Ibrahim Waziri,* Tunde L. Yusuf, Monsuru T. Kelani, Eric O. Akintemi, Kolawole A. Olofinsan, and Alfred J. Muller

Supplementary Information

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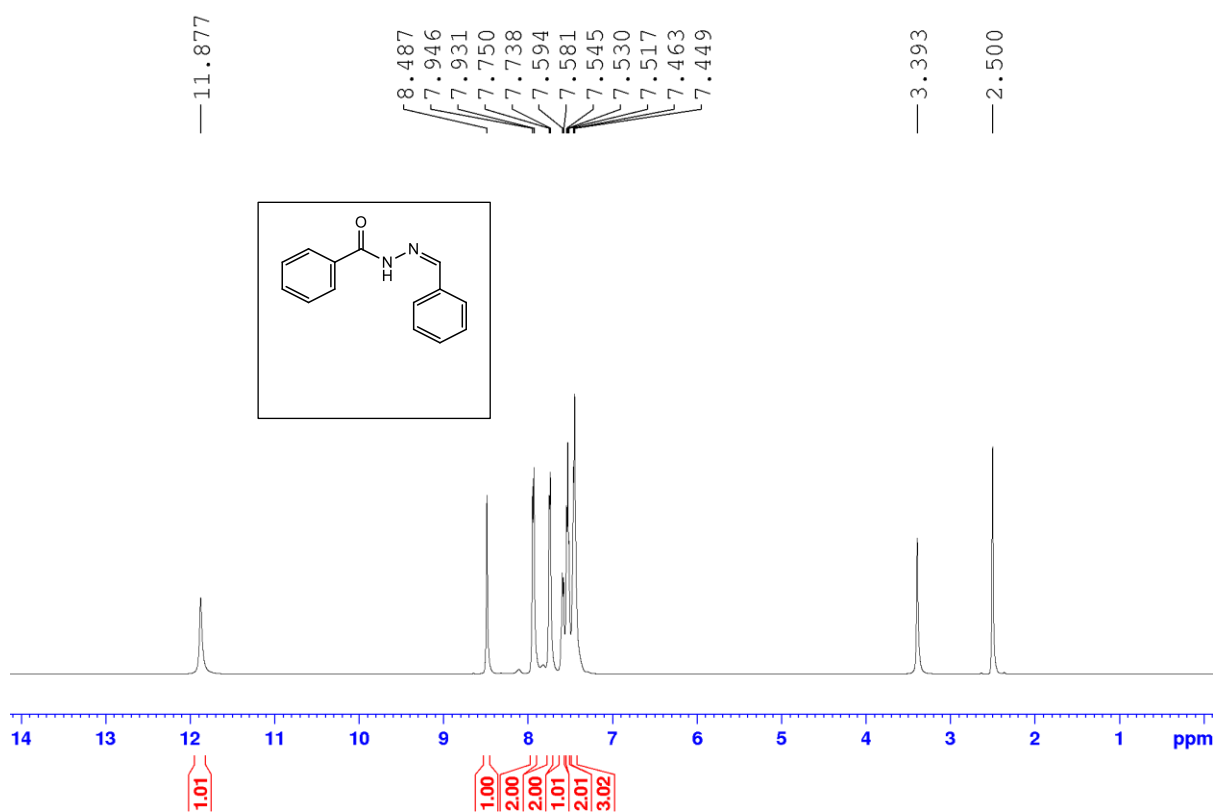


Figure S1: ¹H NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

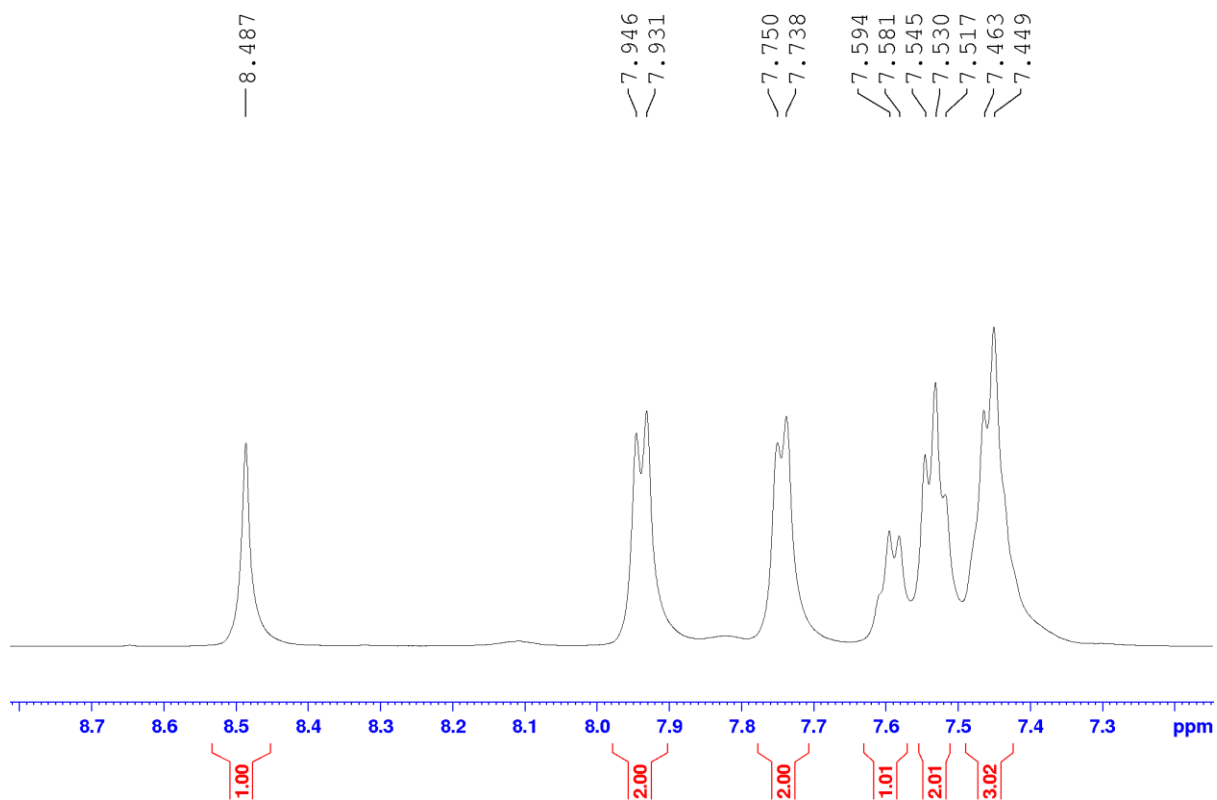


Figure S2: Expansion of the ^1H NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

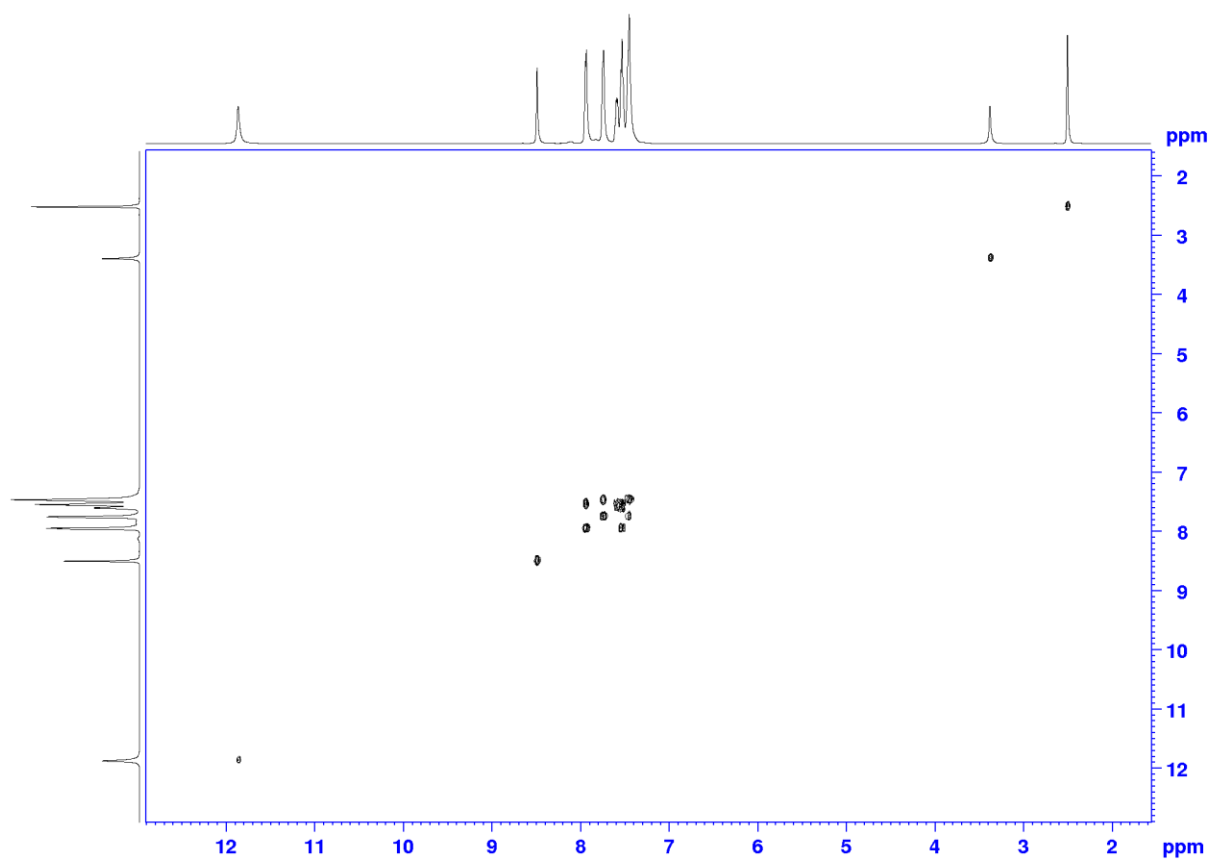


Figure S3: COSY NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

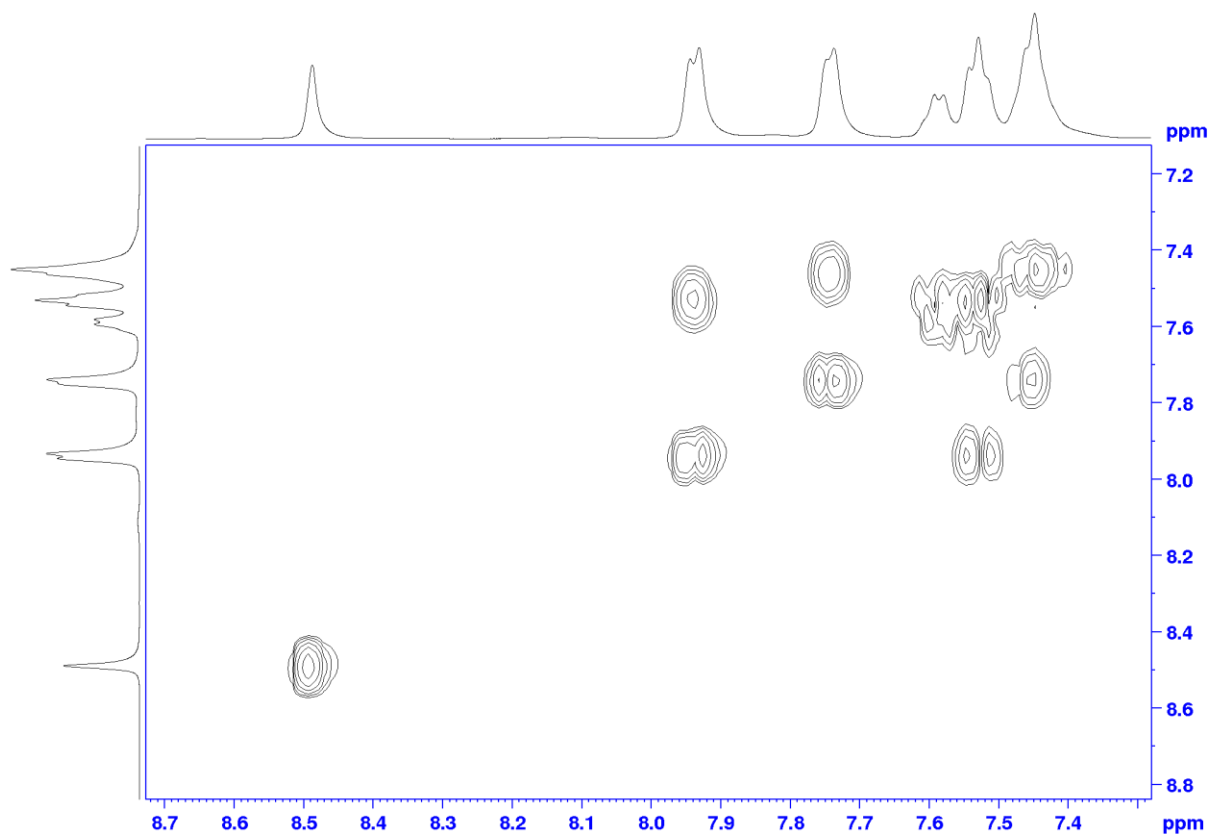


Figure S4: Expansion of the COSY NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

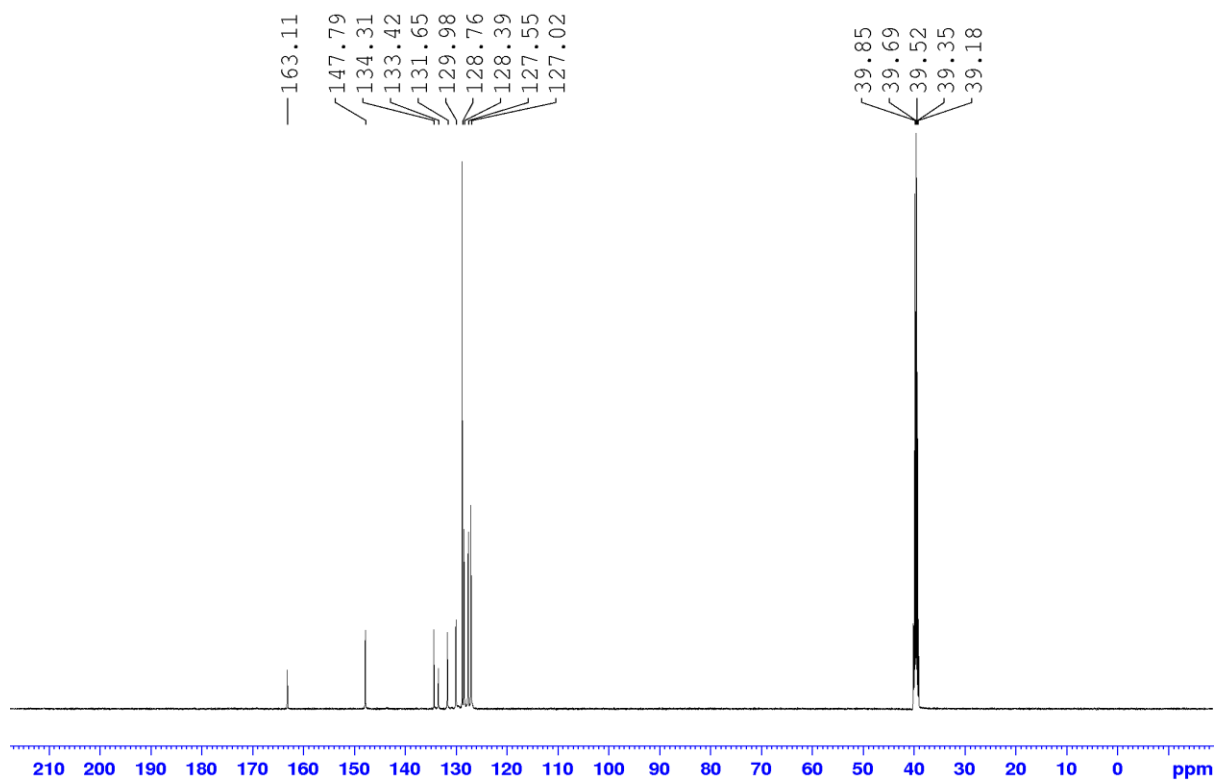


Figure S5: ^{13}C NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

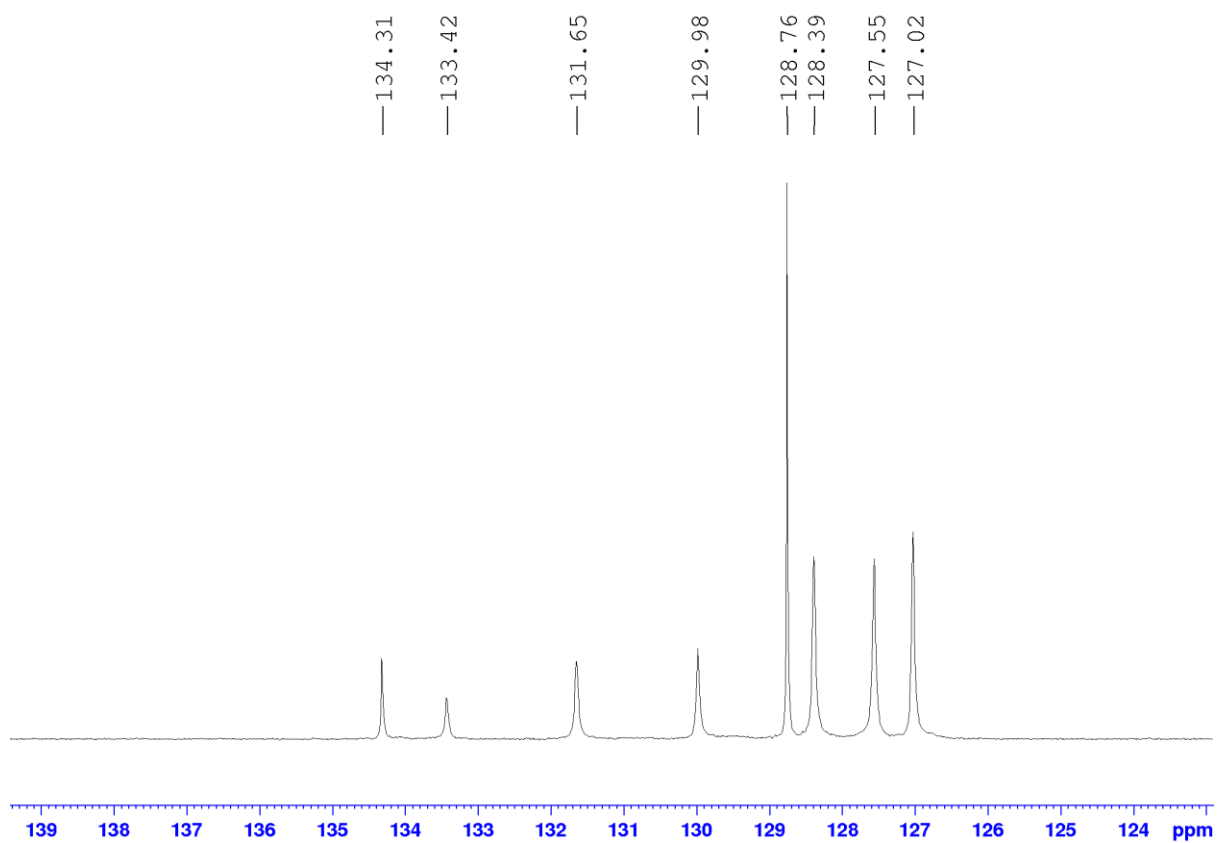


Figure S6: Expansion of the ^{13}C NMR spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

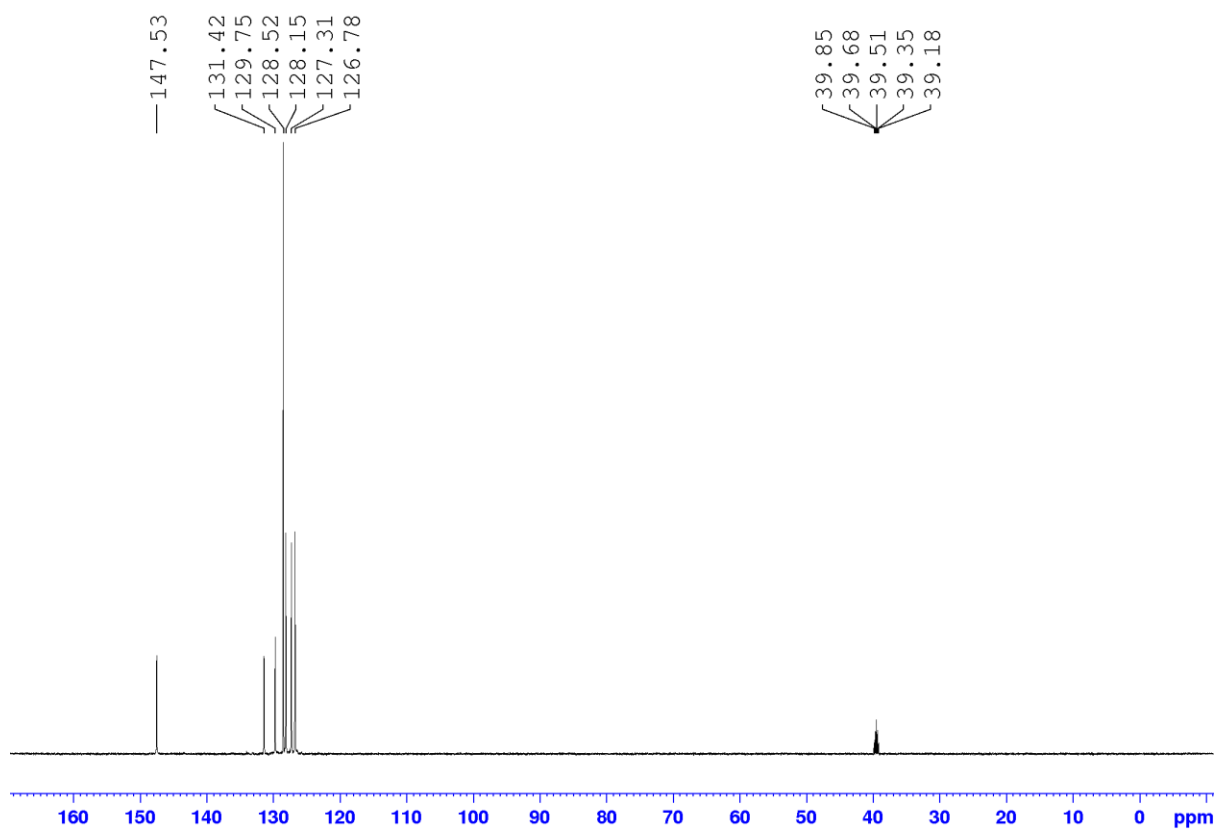


Figure S7: DEPT 135 spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

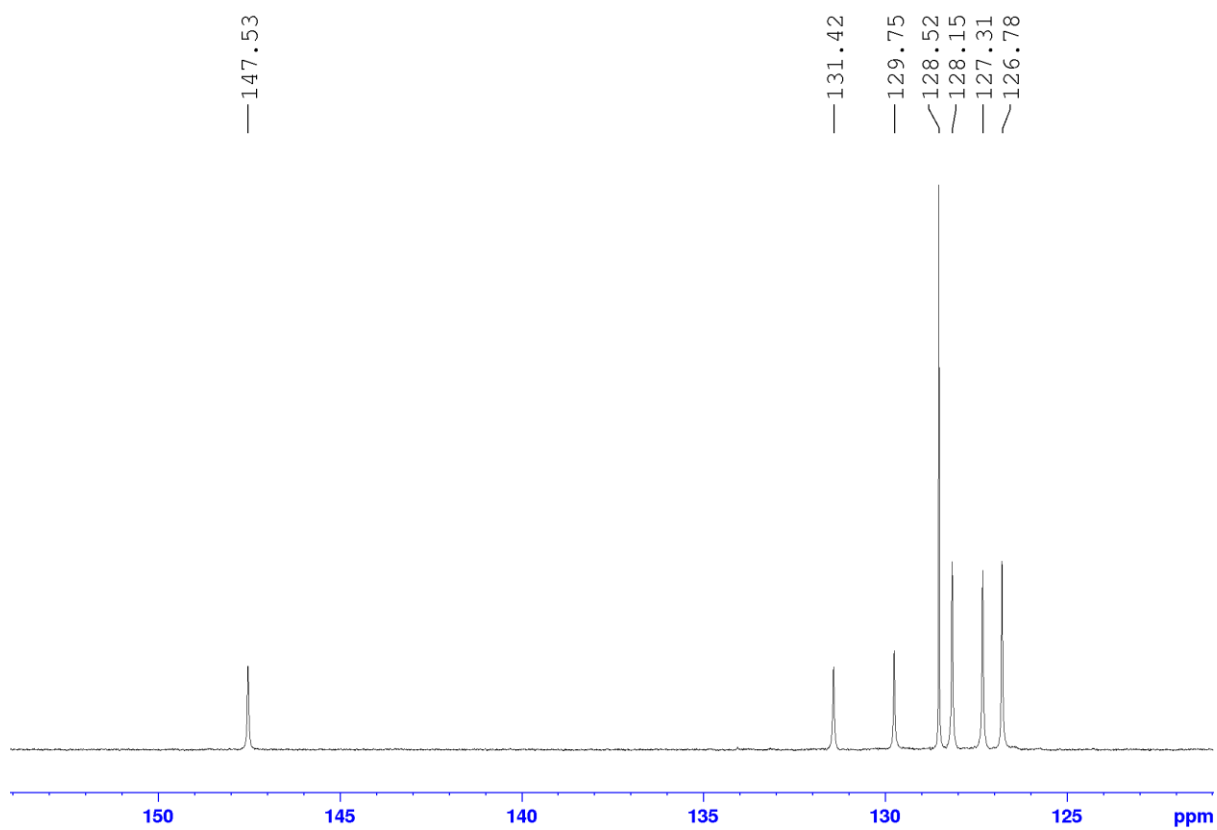


Figure S8: Expansion of the DEPT 135 spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

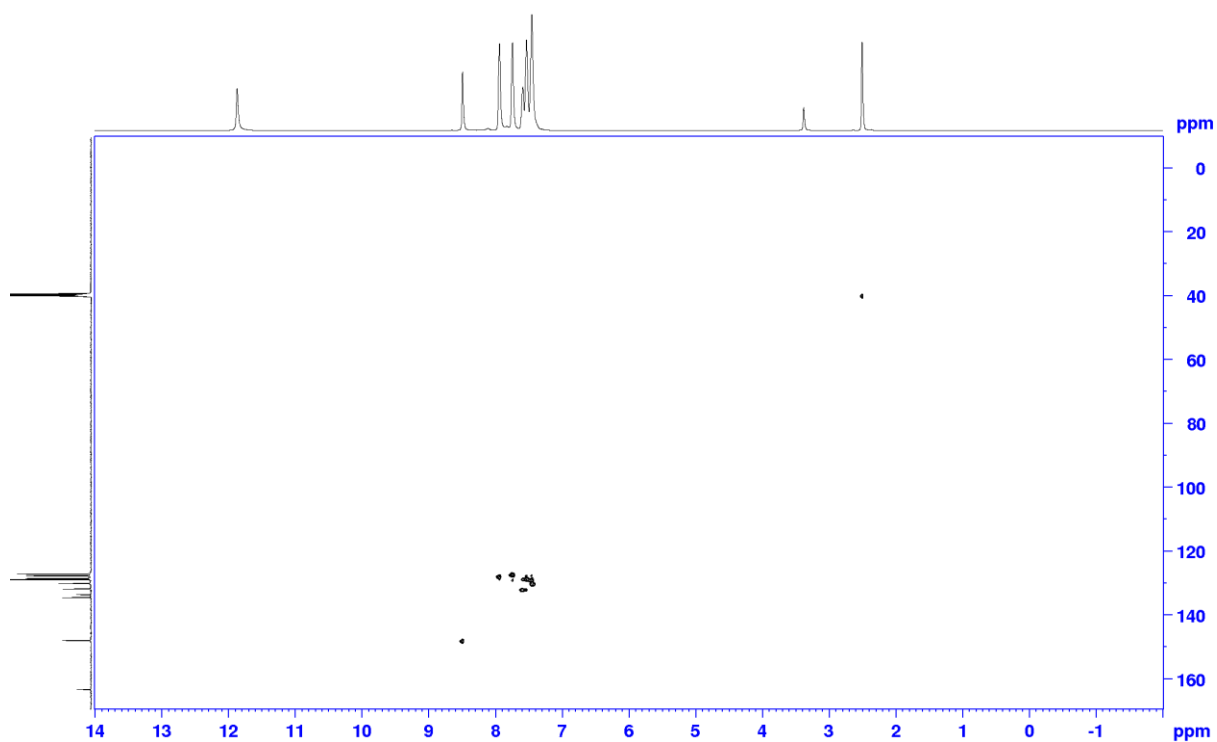


Figure S9: HSQC spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

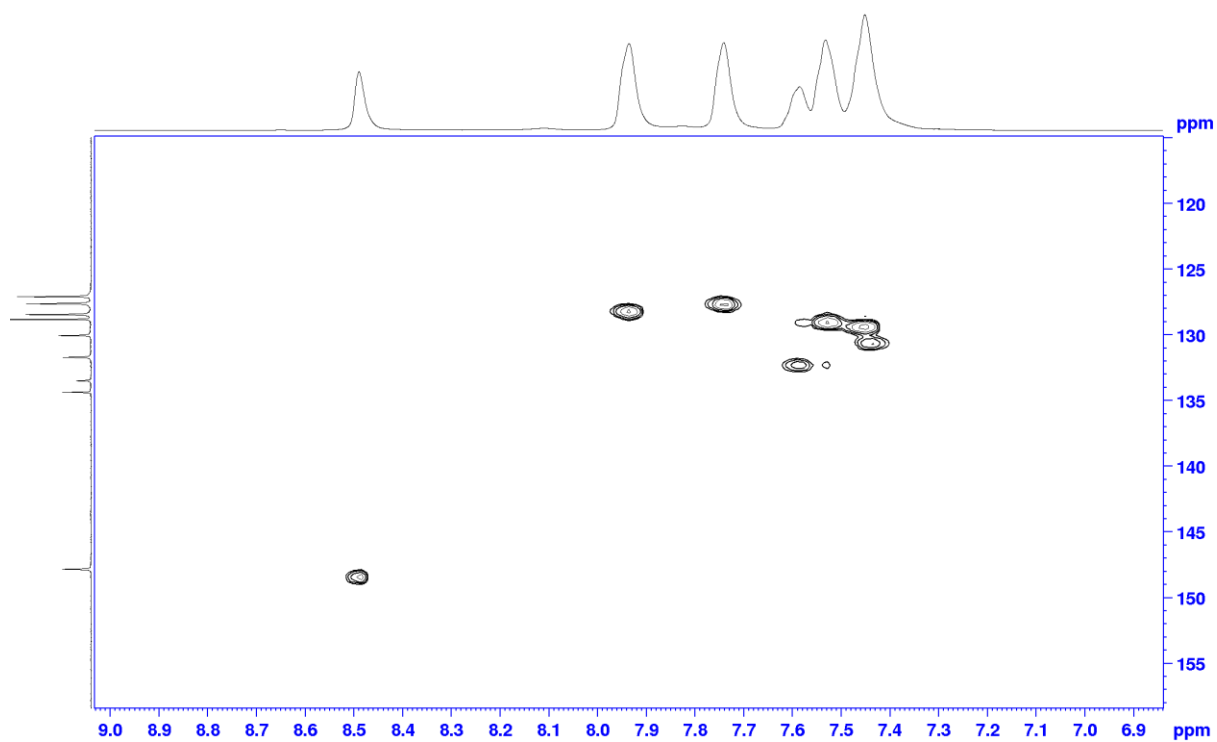


Figure S10: Expansion of the HSQC spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

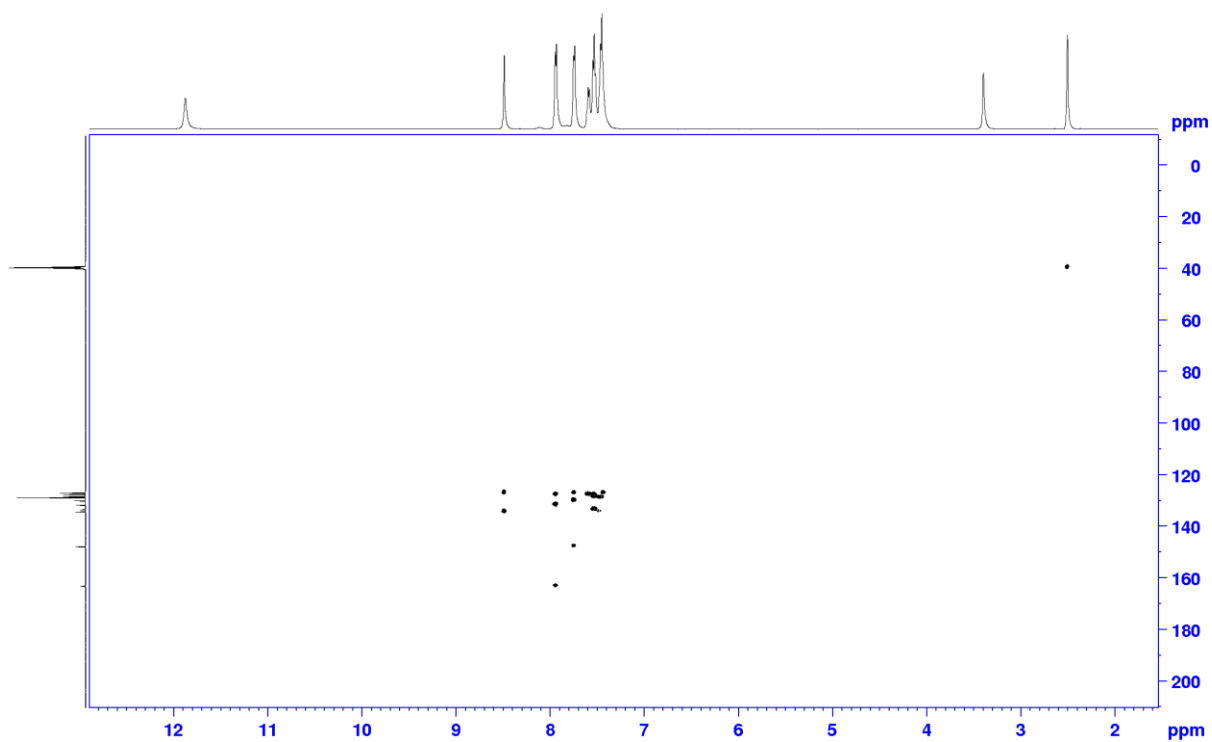


Figure S11: HMBC spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

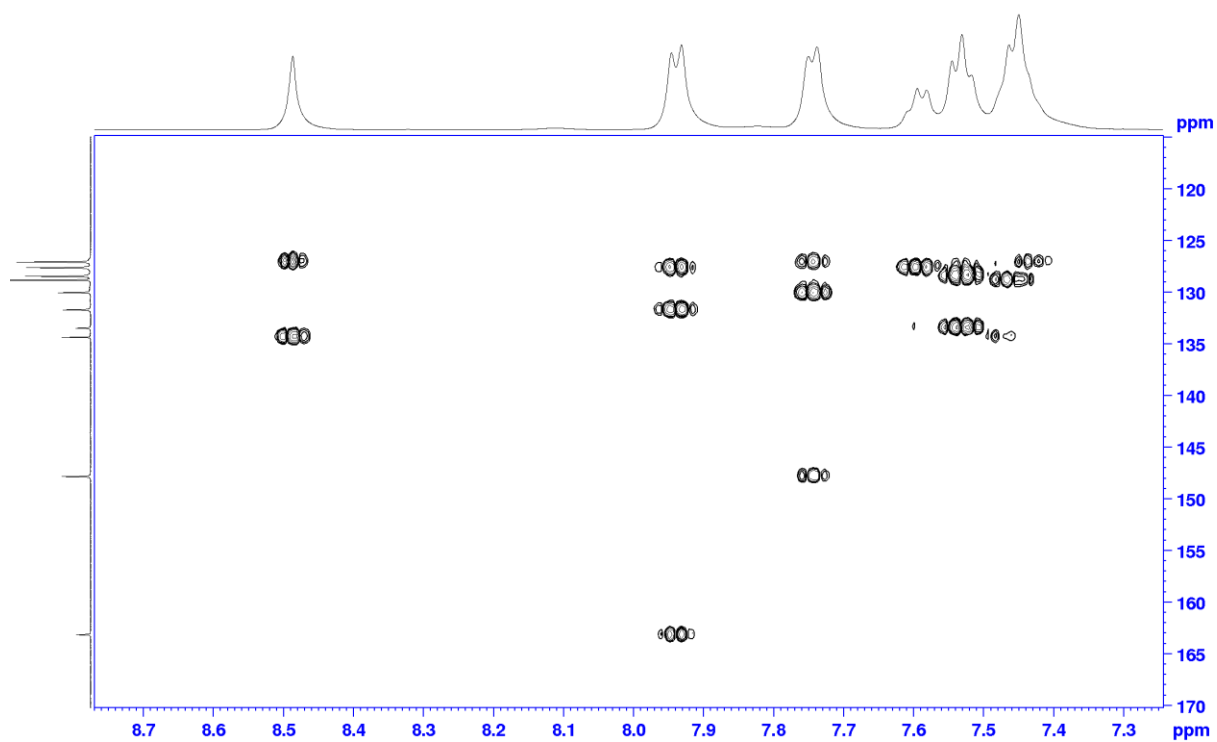


Figure S12: Expansion of the HMBC spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

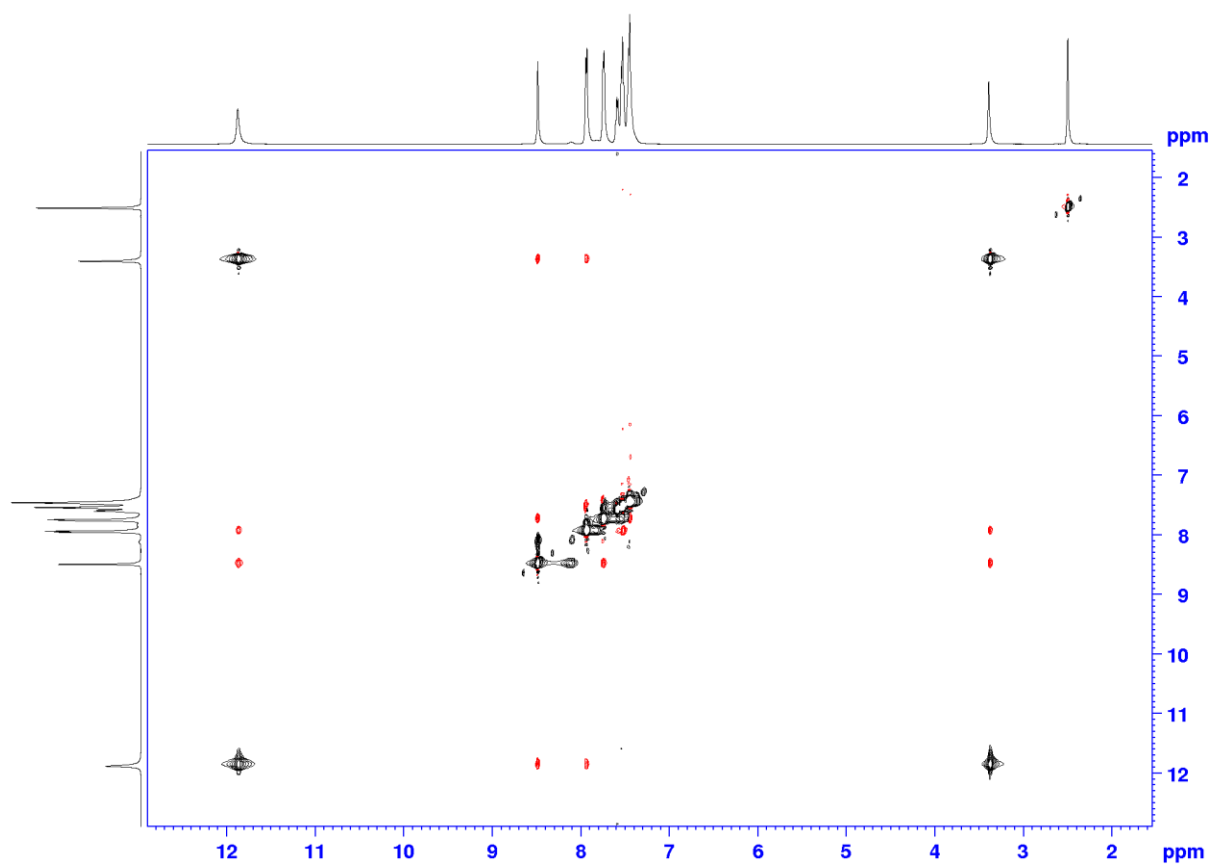


Figure S13: NOESY spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

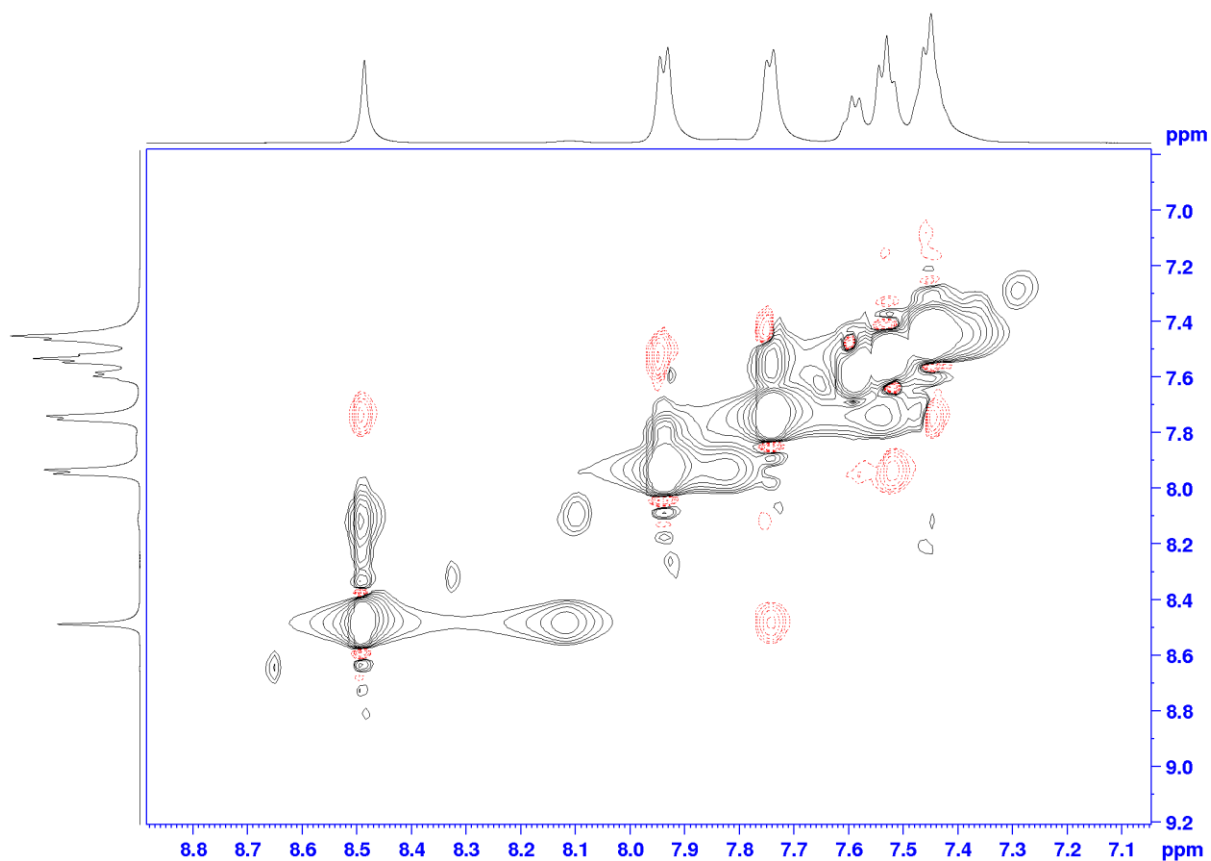


Figure S14: Expansion of the NOESY spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

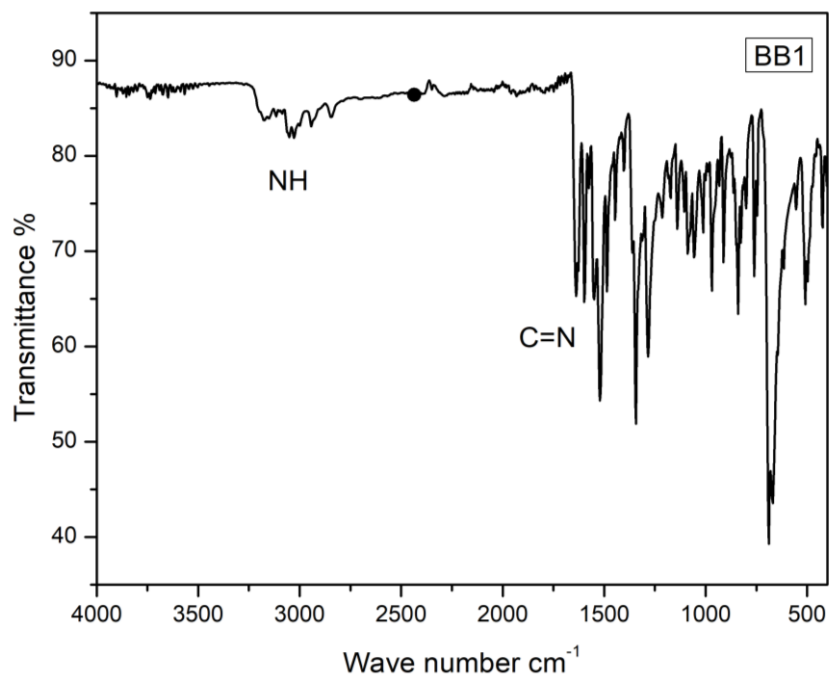


Figure S15: Infrared (IR) spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

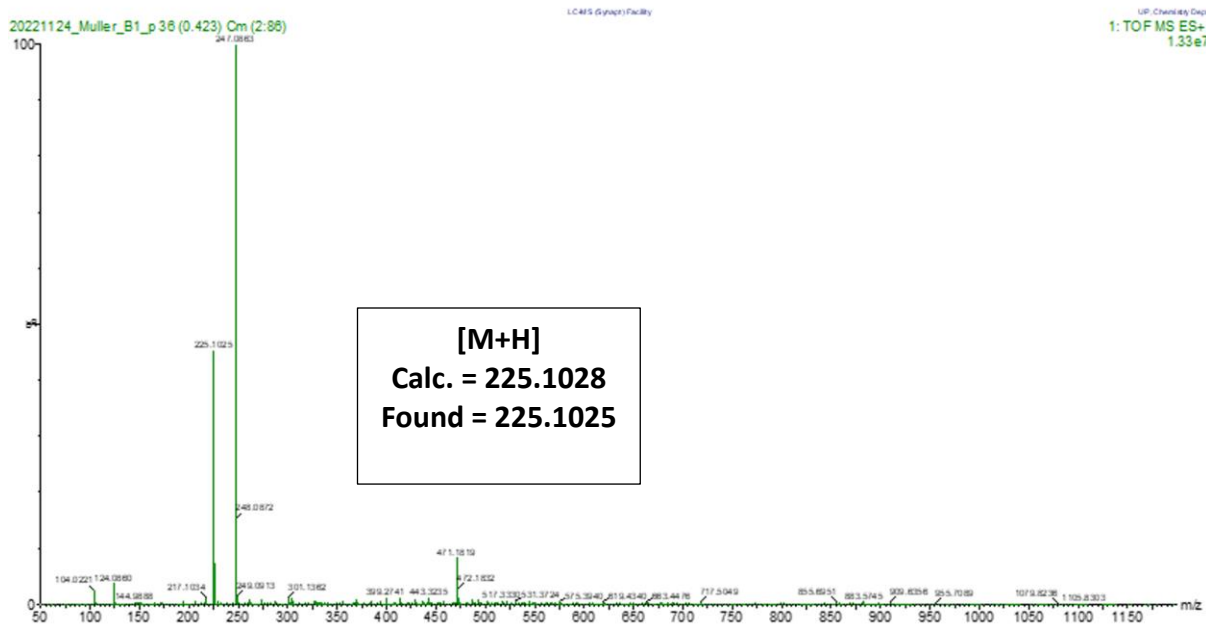


Figure S16: Mass spectrum of (*Z*)-*N*-benzylidenebenzohydrazide **BB1**

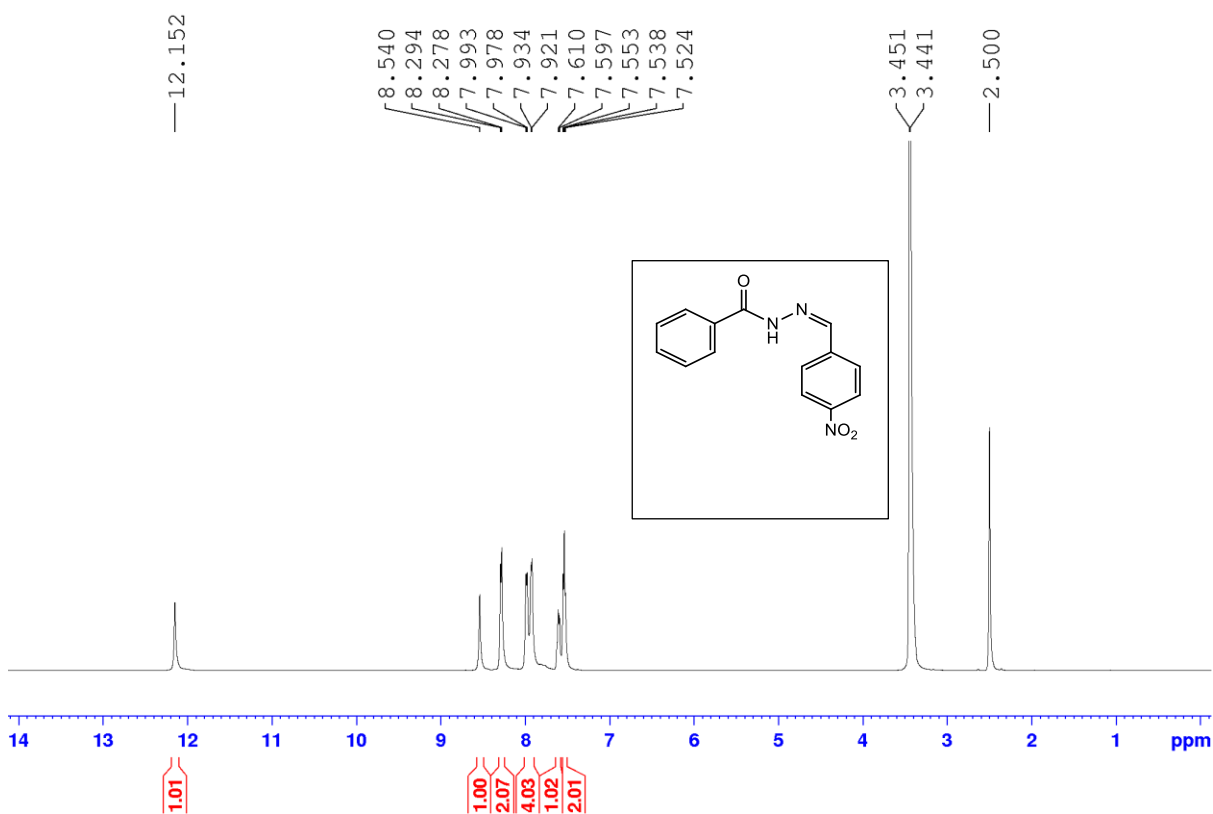


Figure S17: ^1H NMR spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

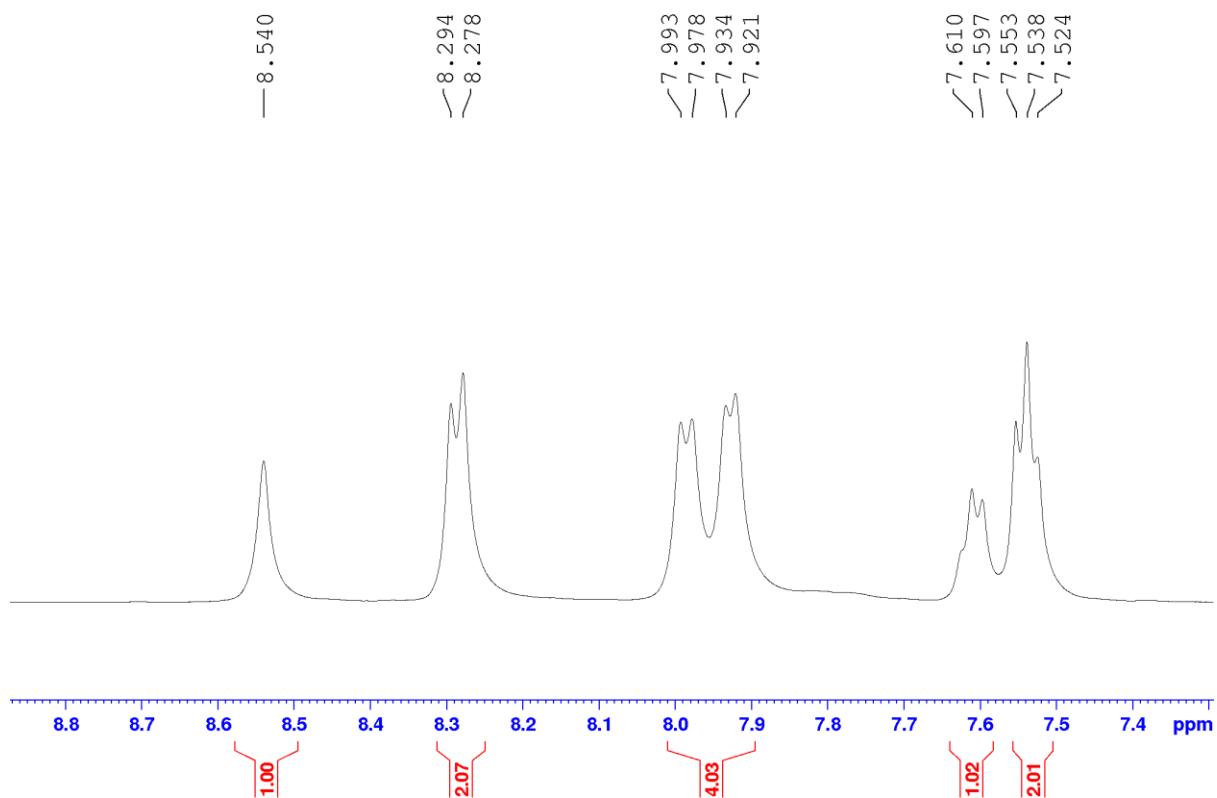


Figure S18: Expansion of the ^1H NMR spectrum of *(Z)*-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

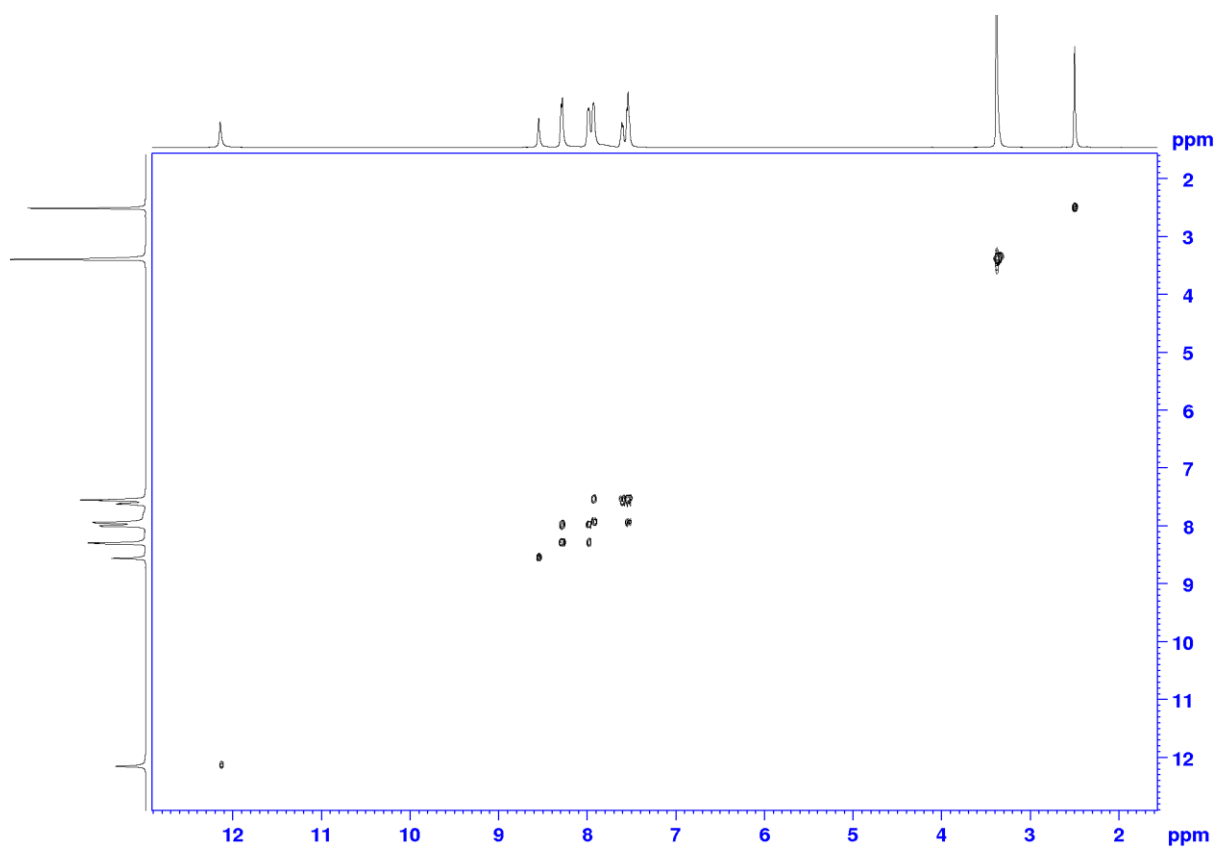


Figure S19: COSY NMR spectrum of *(Z)*-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

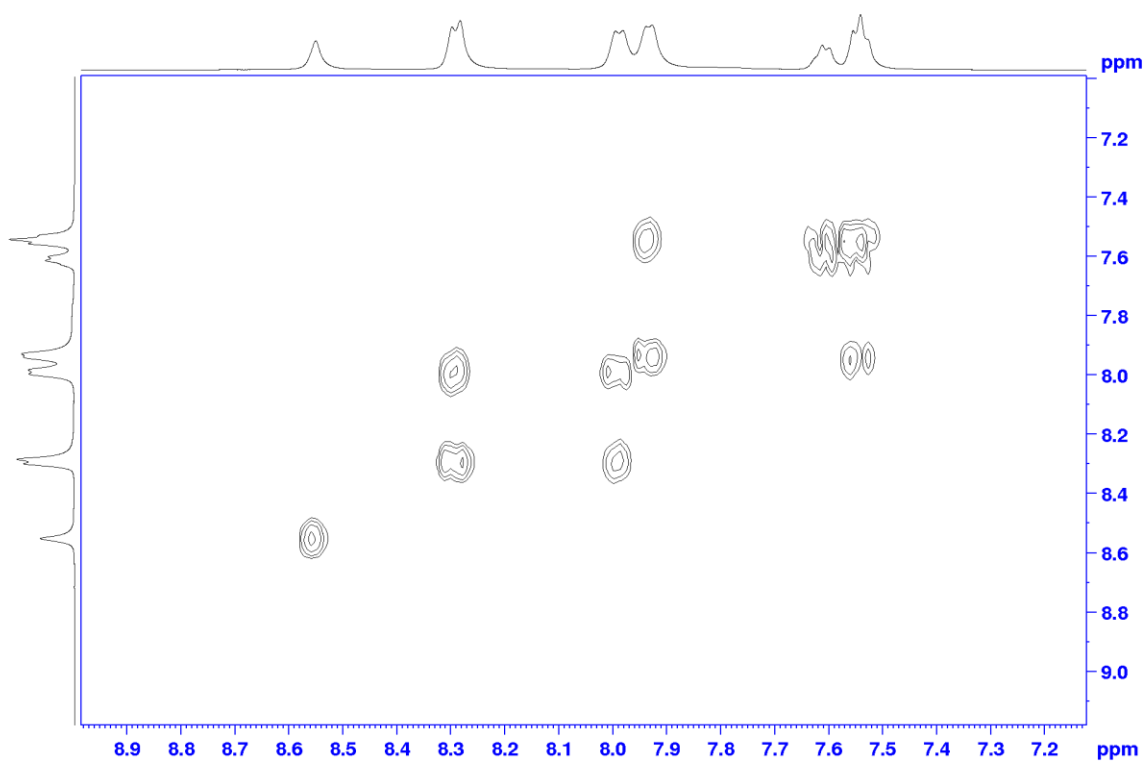


Figure S20: Expansion of the COSY NMR spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

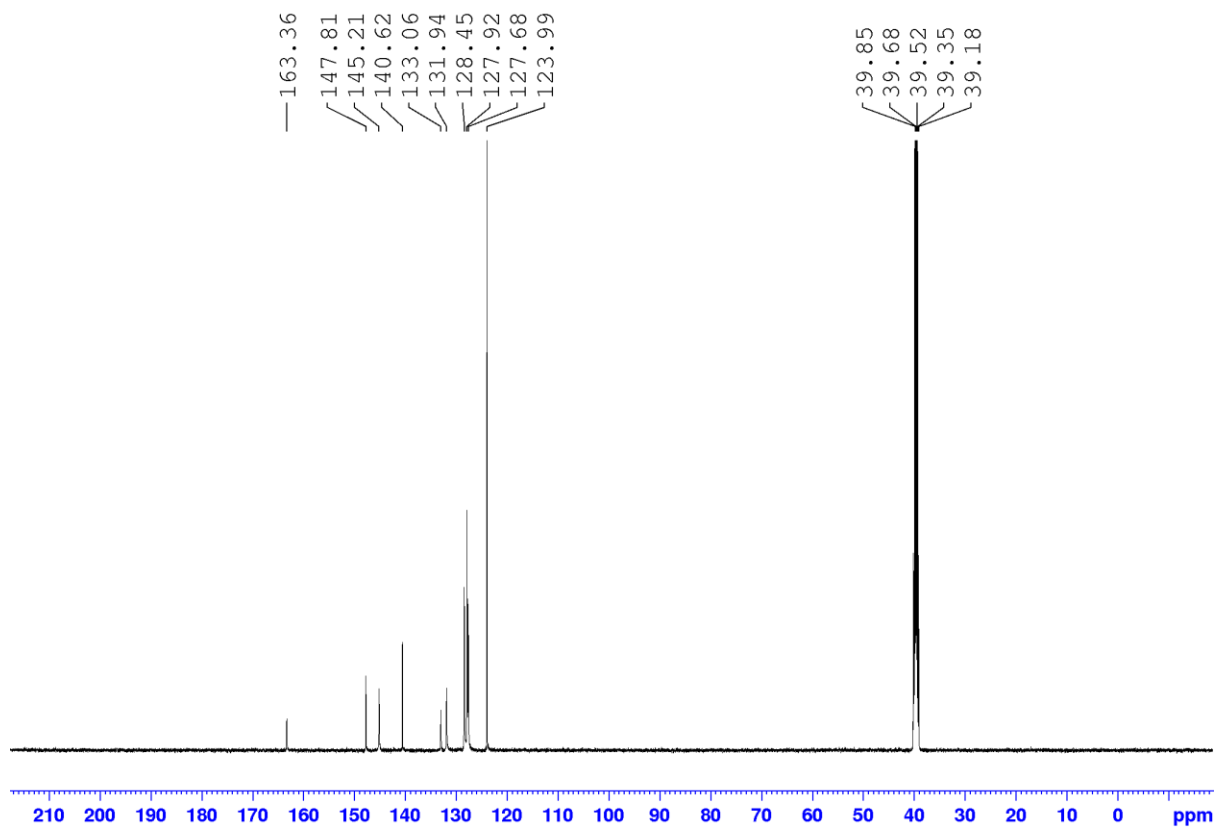


Figure S21: ^{13}C NMR spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

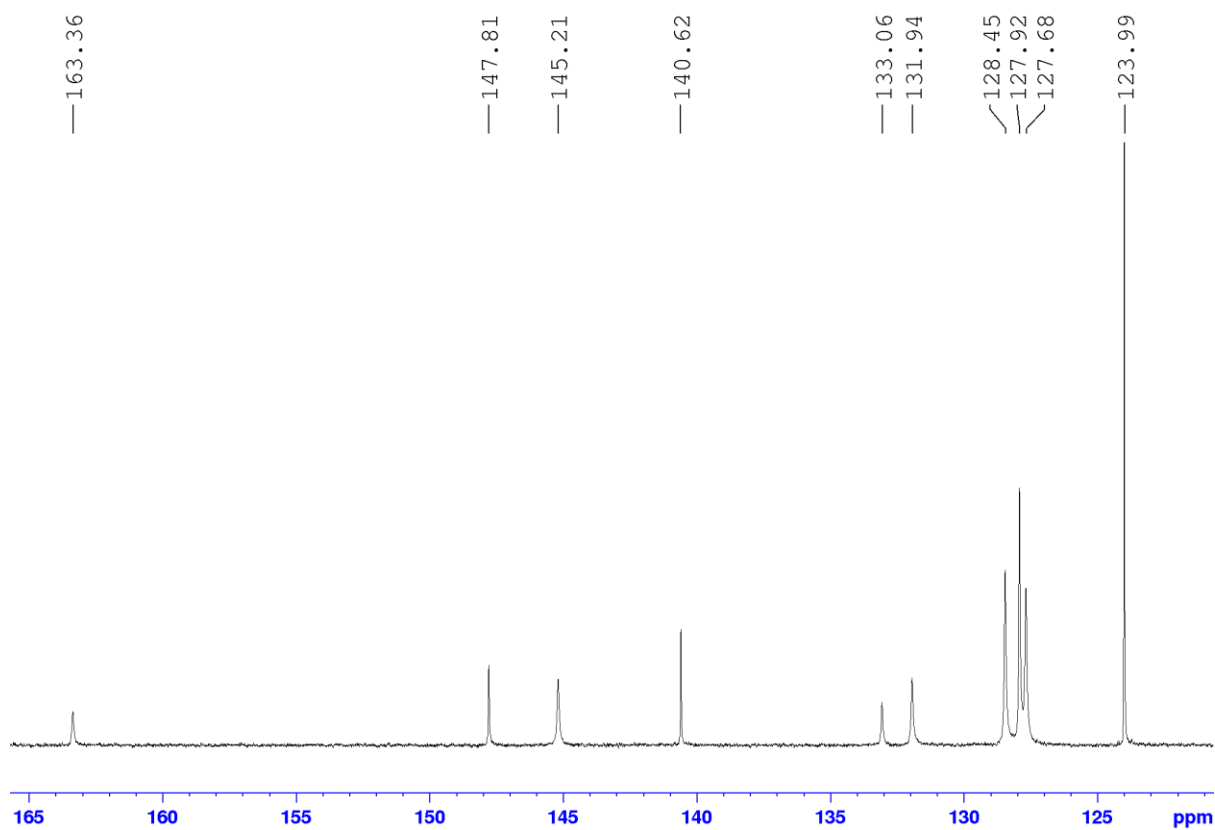


Figure S22: Expansion of the ^{13}C NMR spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

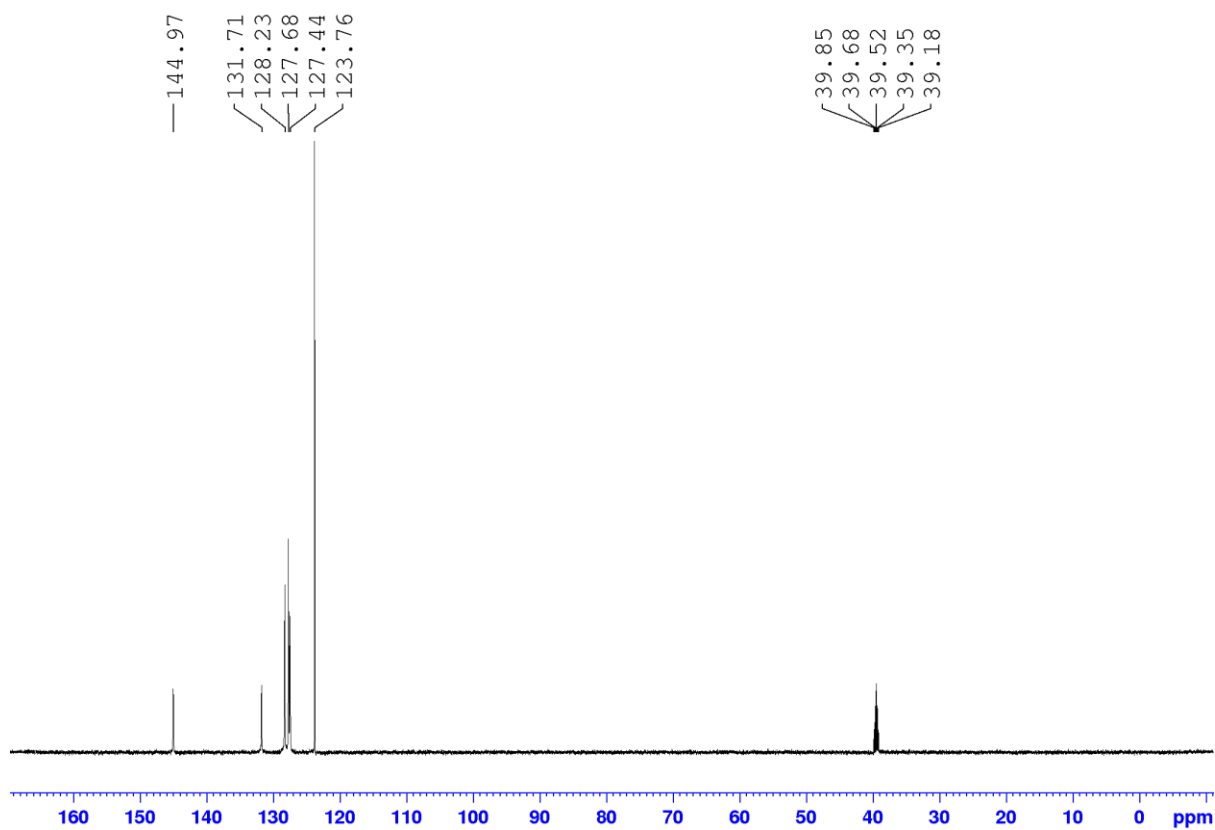


Figure S23: DEPT 135 spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

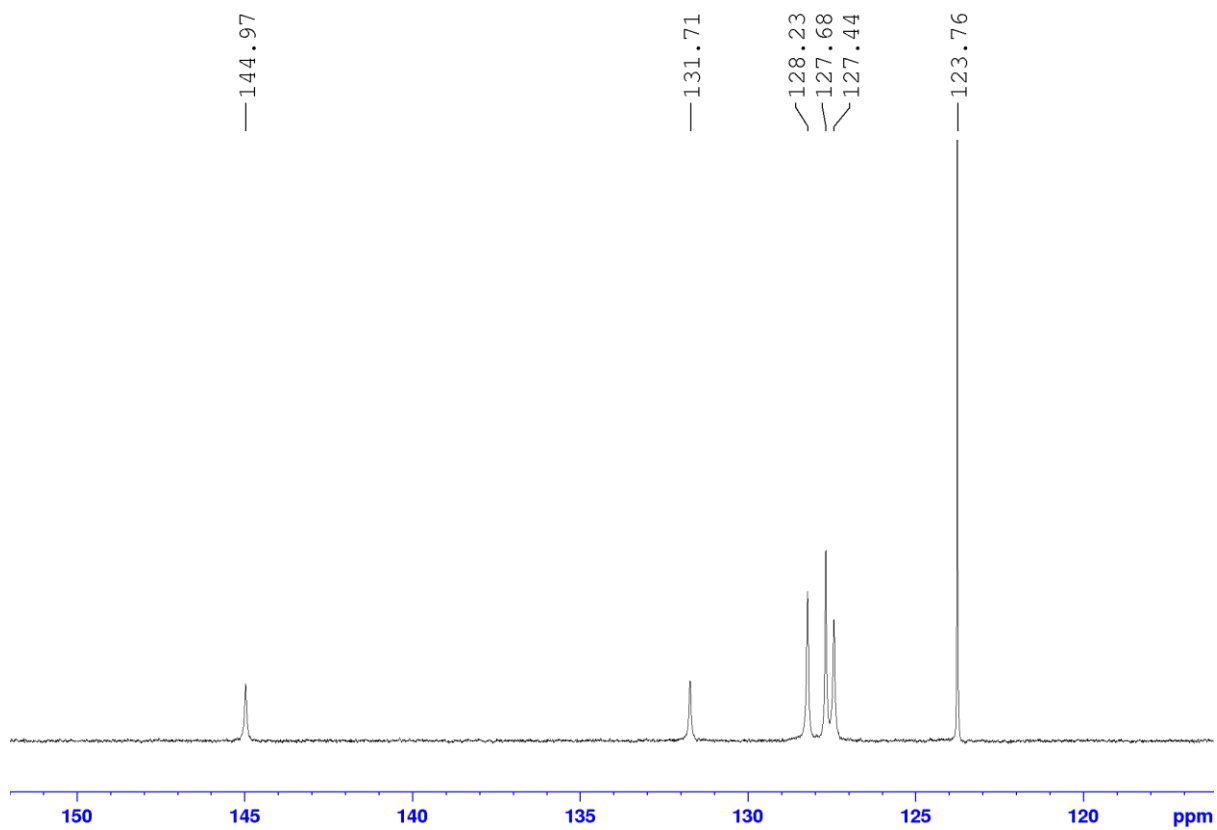


Figure S24: Expansion of the DEPT 135 spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

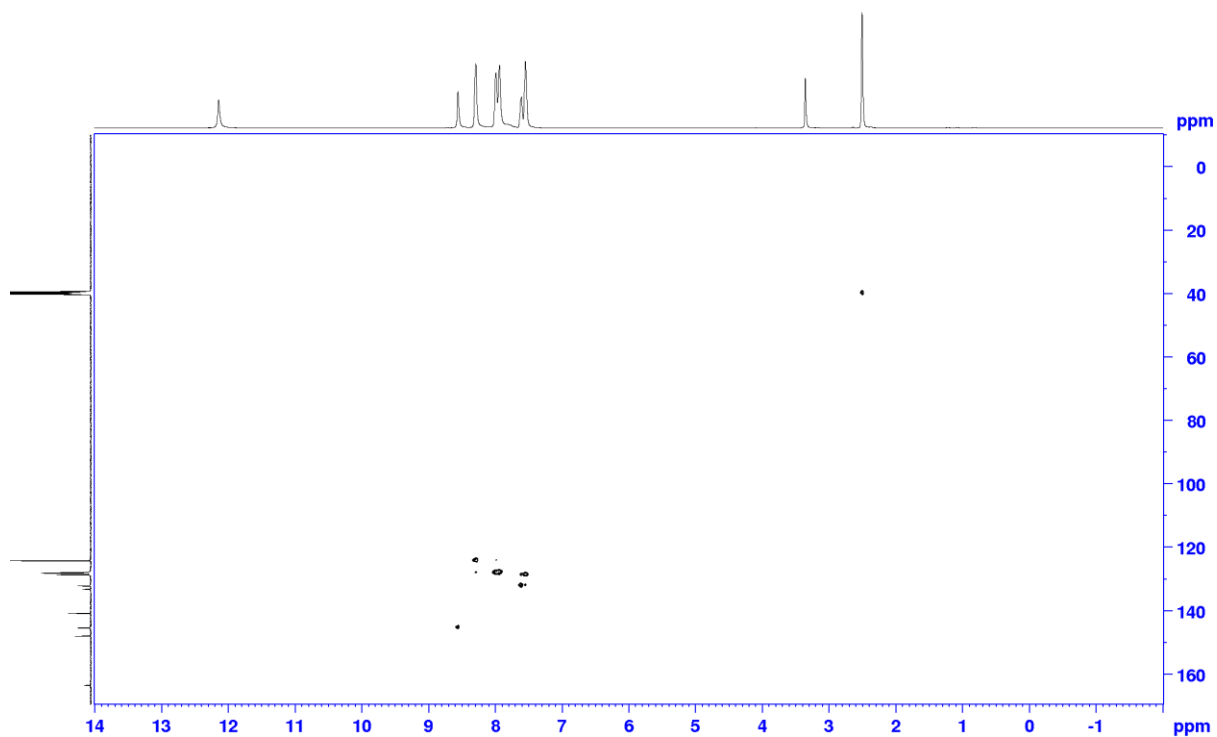


Figure S25: HSQC spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

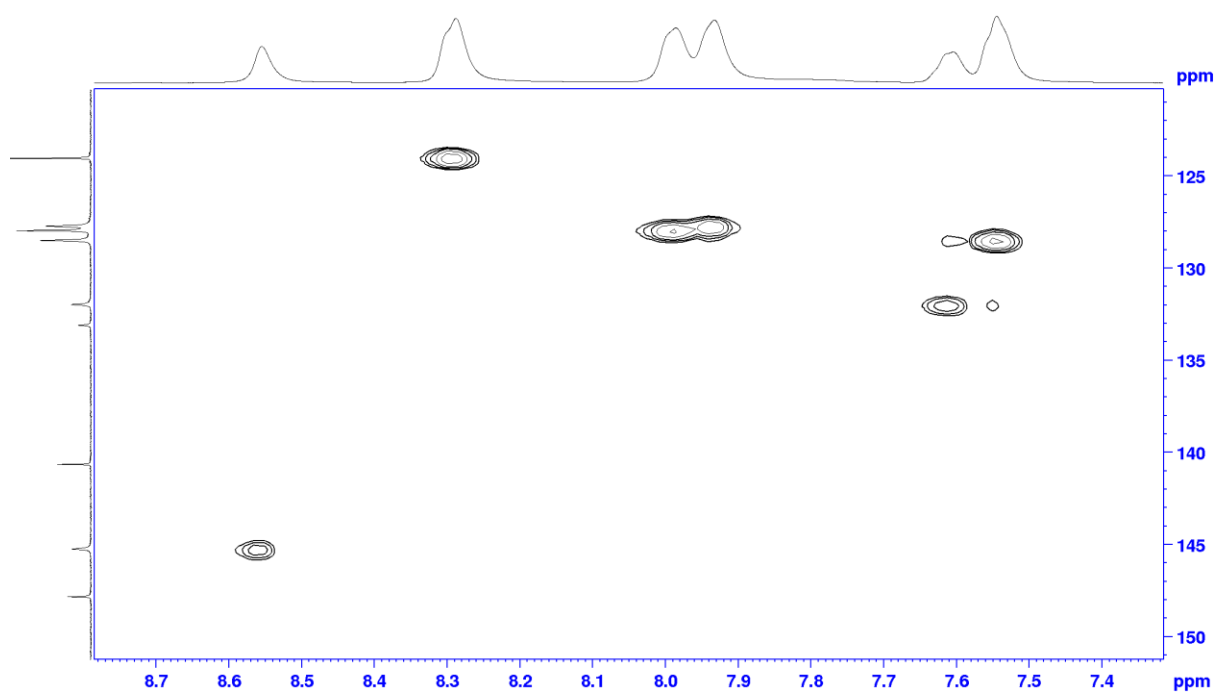


Figure S26: Expansion of the HSQC spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

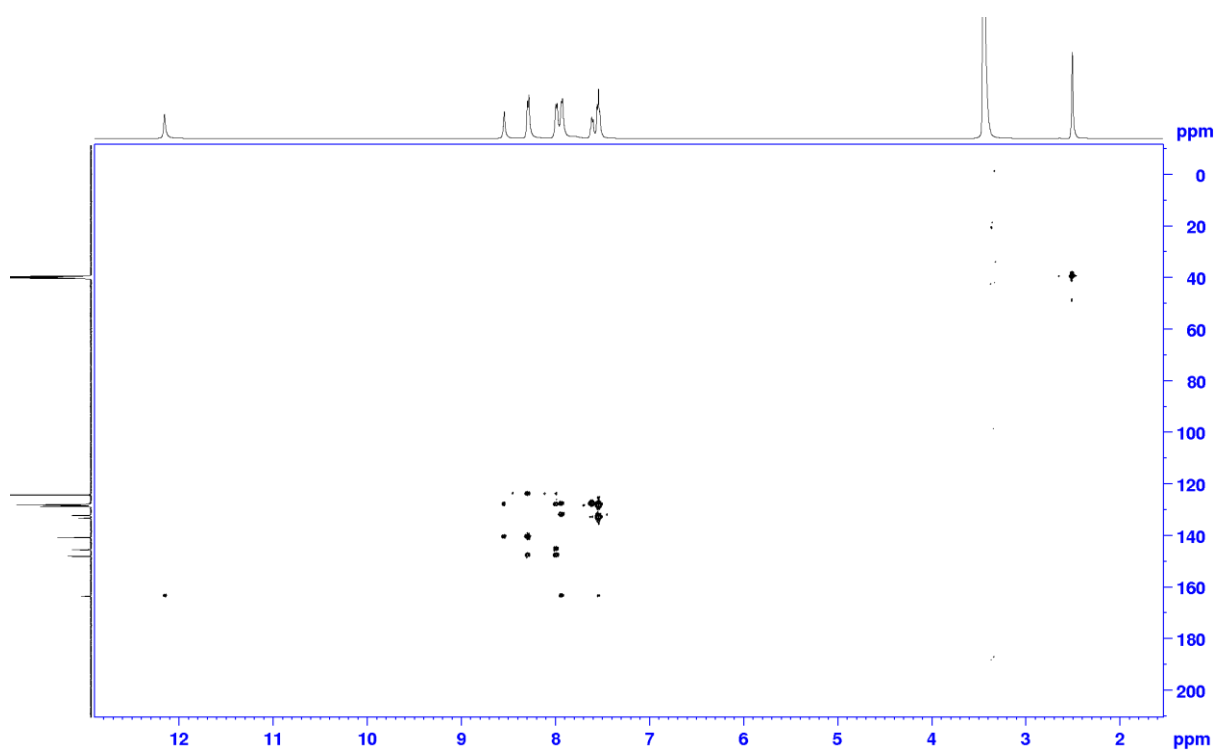


Figure S27: HMBC spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

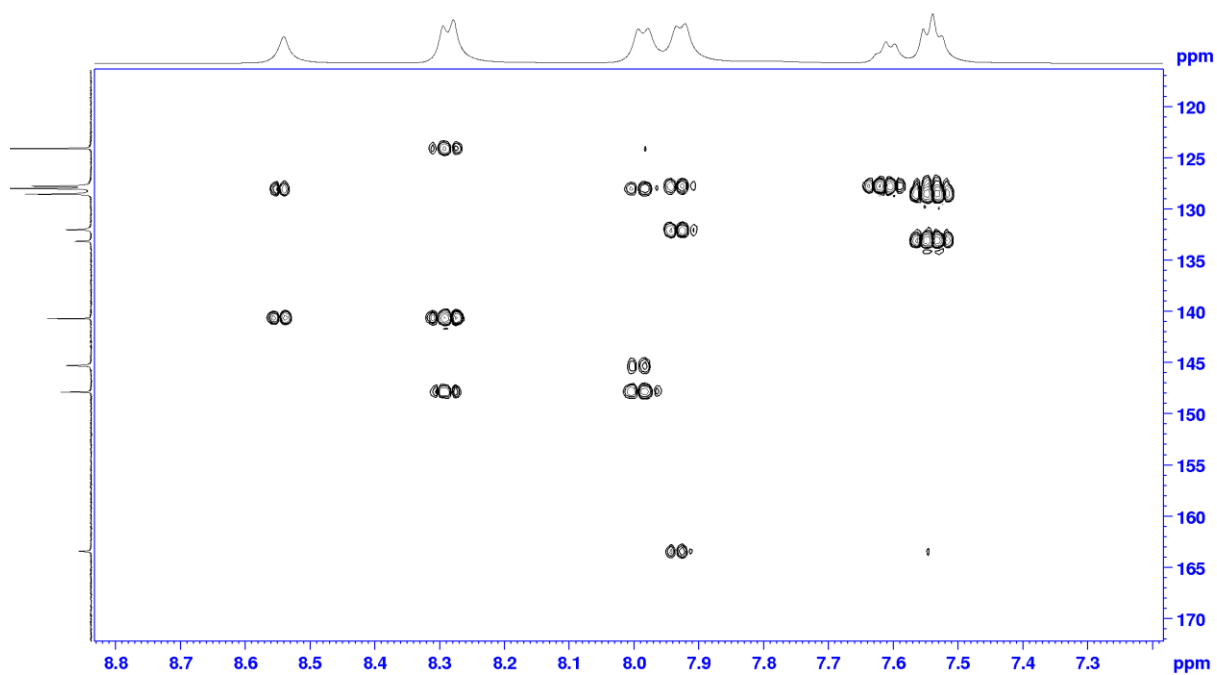


Figure S28: Expansion of the HMBC spectrum of *(Z)*-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

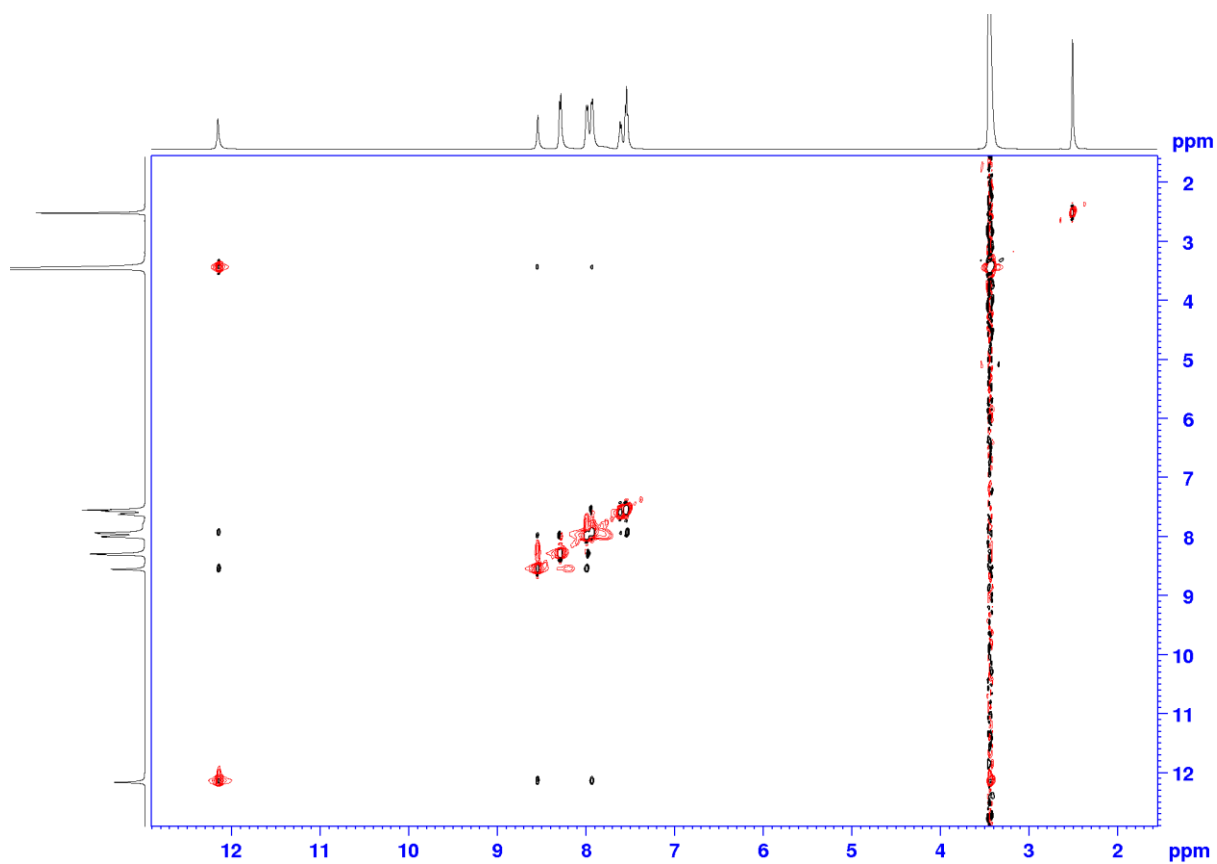


Figure S29: NOESY spectrum of *(Z)*-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

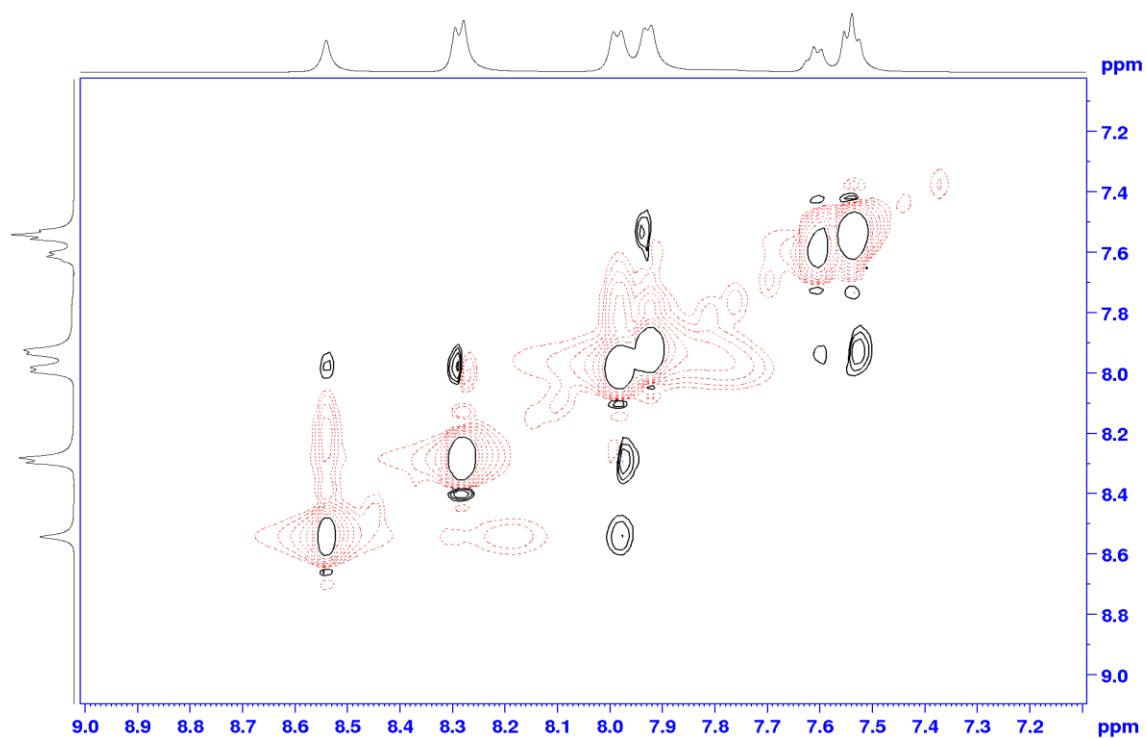


Figure S30: Expansion of the NOESY spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

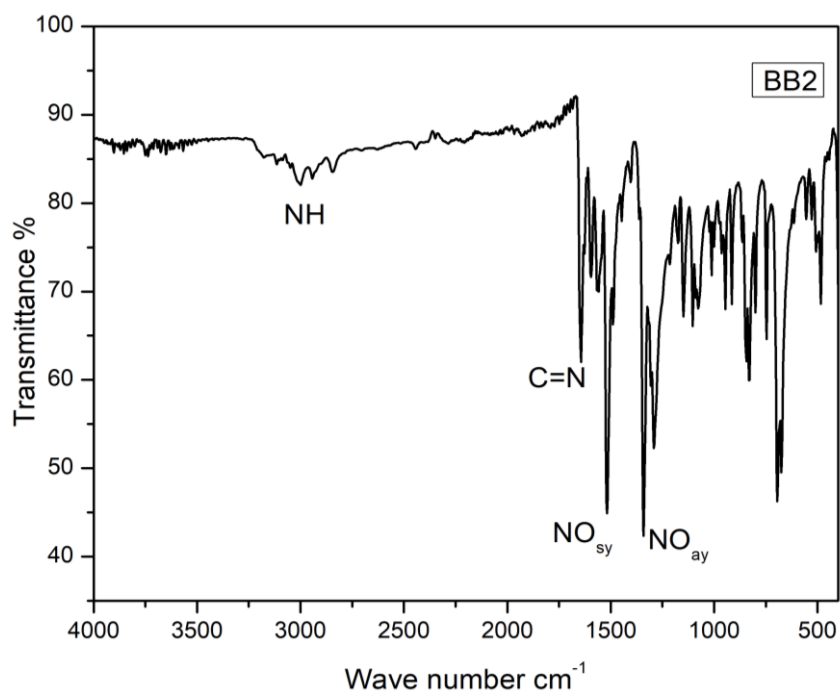


Figure S31: Infrared (IR) spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

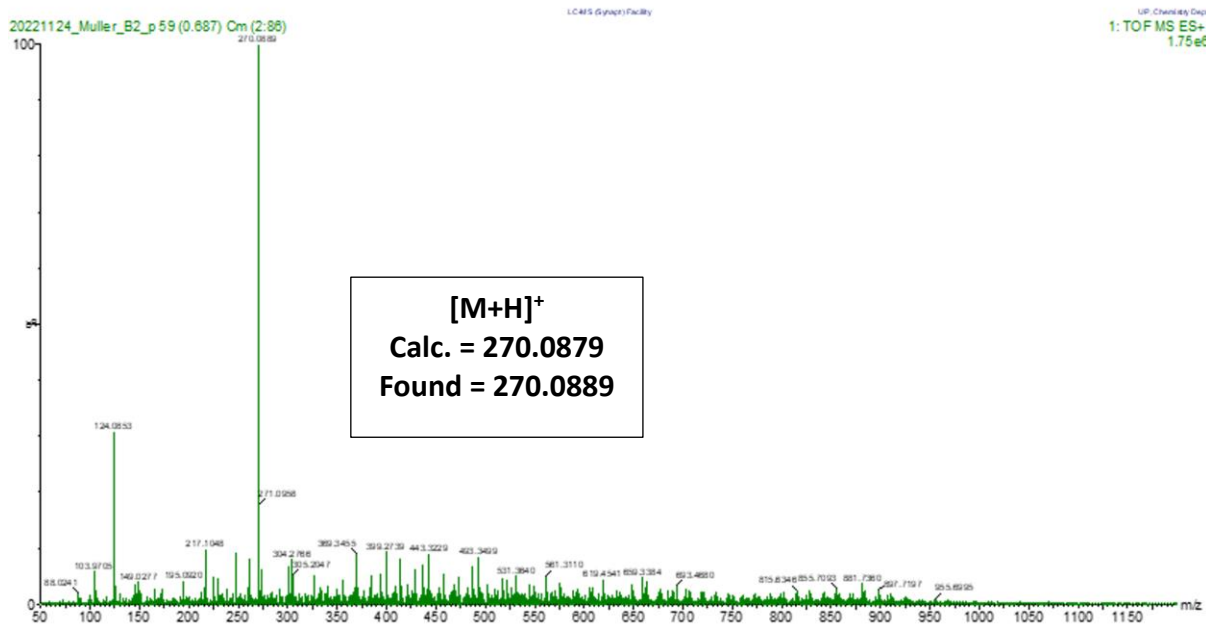


Figure S32: Mass spectrum of (*Z*)-*N*-(4-nitrobenzylidene)benzohydrazide **BB2**

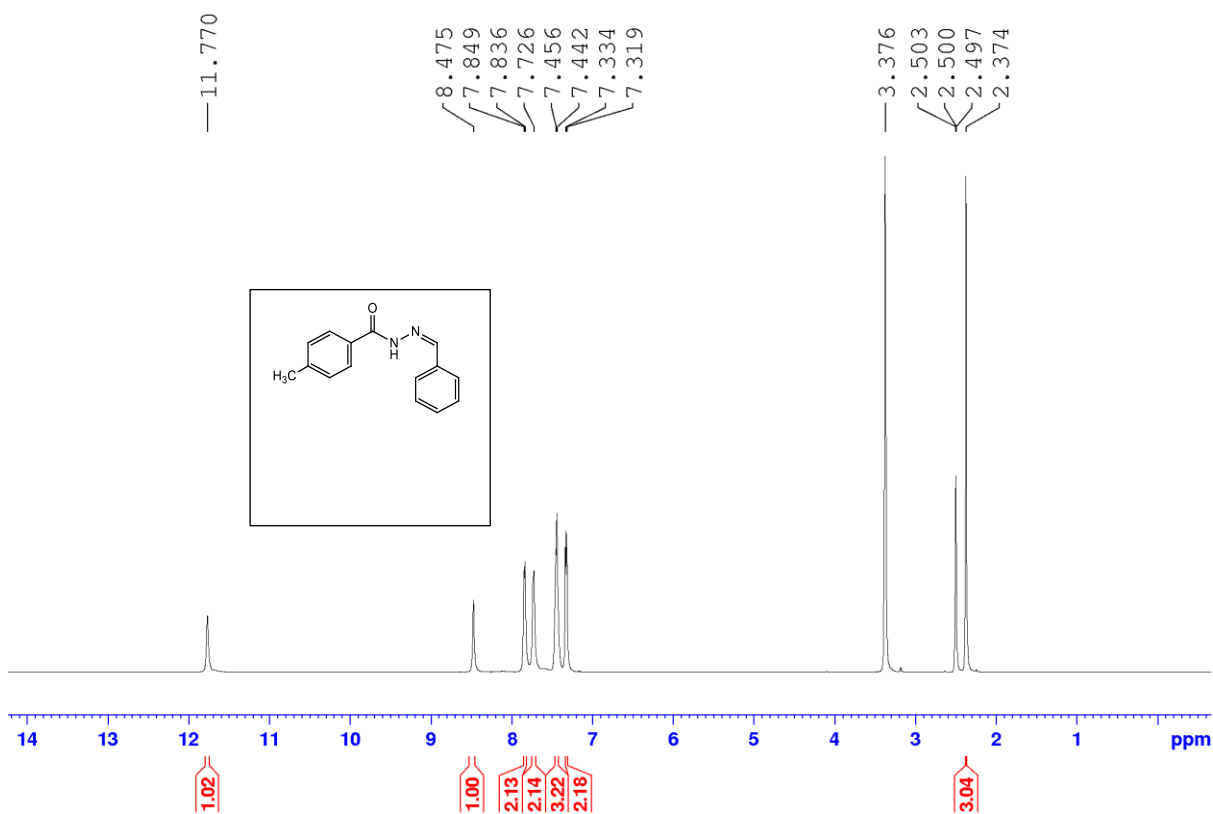


Figure S33: ¹H NMR spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

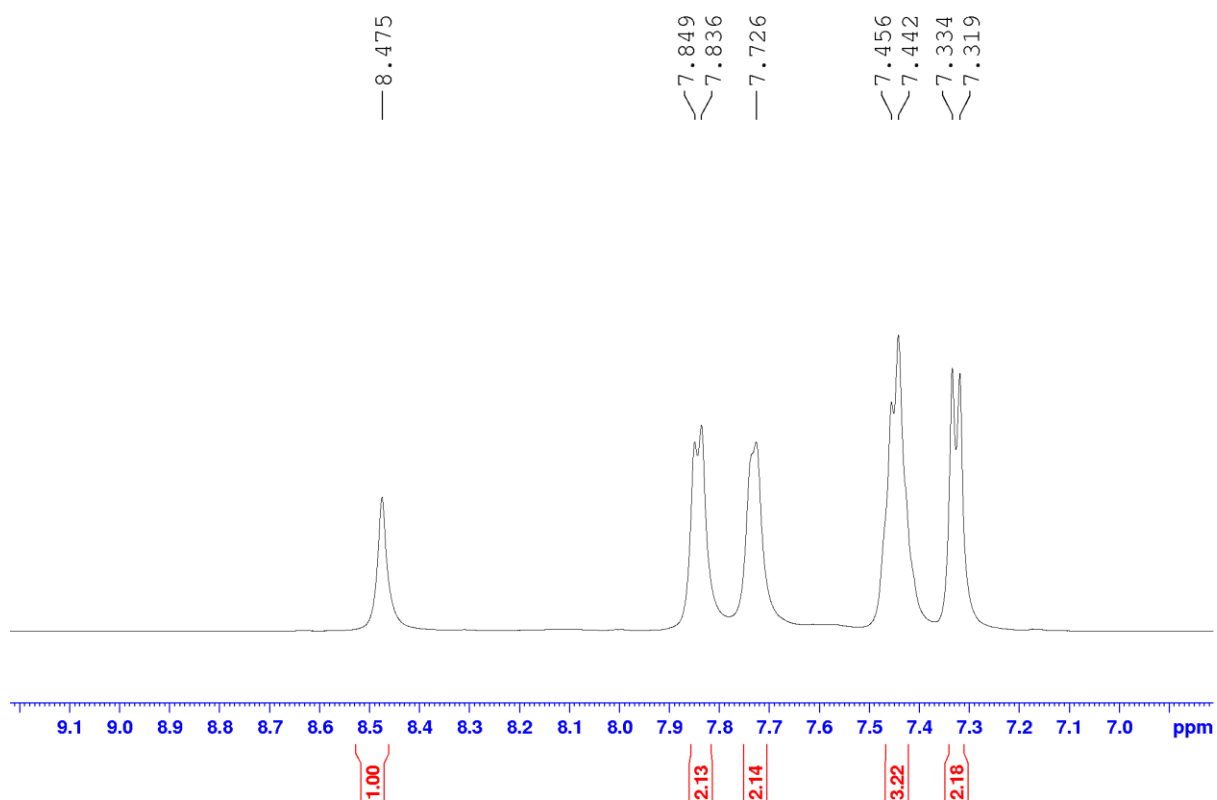


Figure S34: Expansion of the ^1H NMR spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

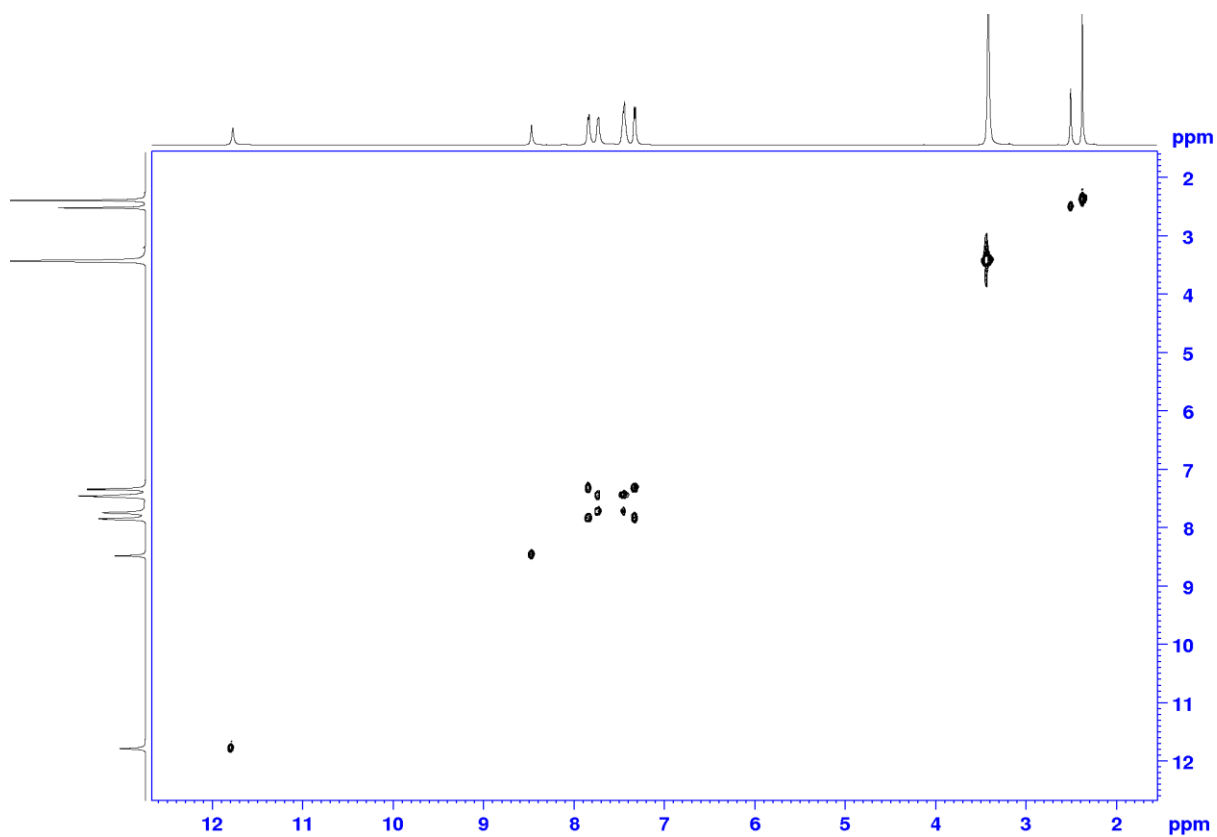


Figure S35: COSY spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

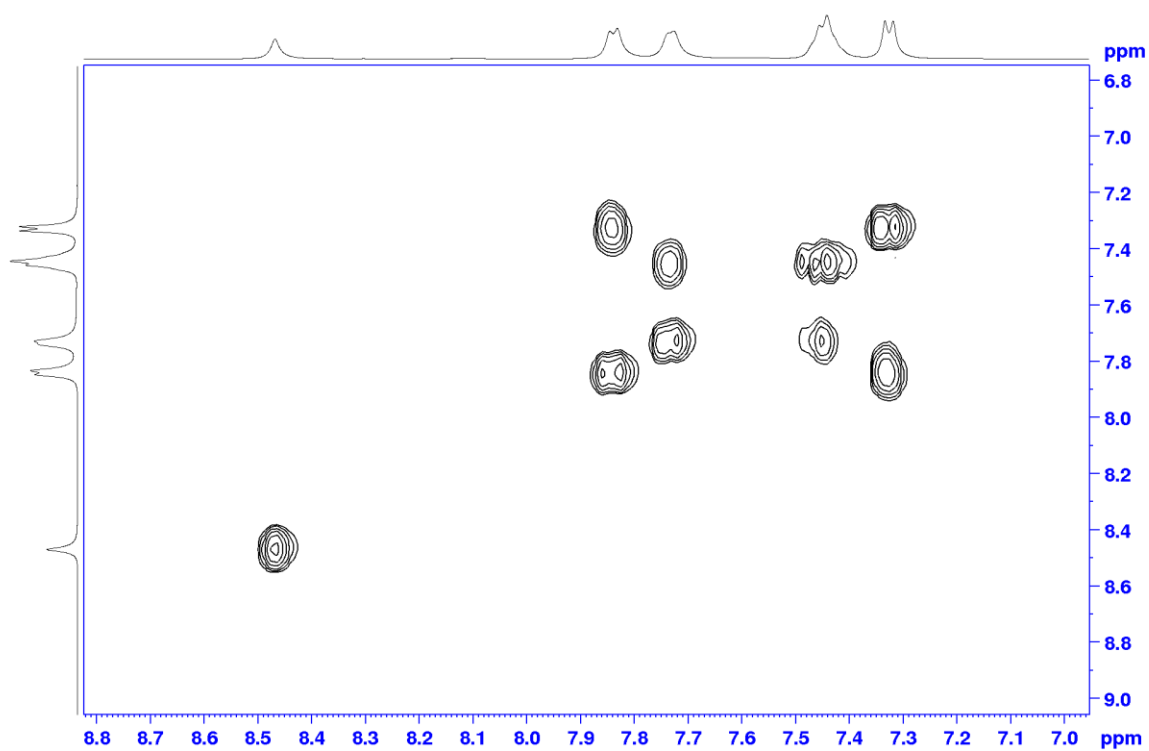


Figure S36: Expansion of the COSY spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

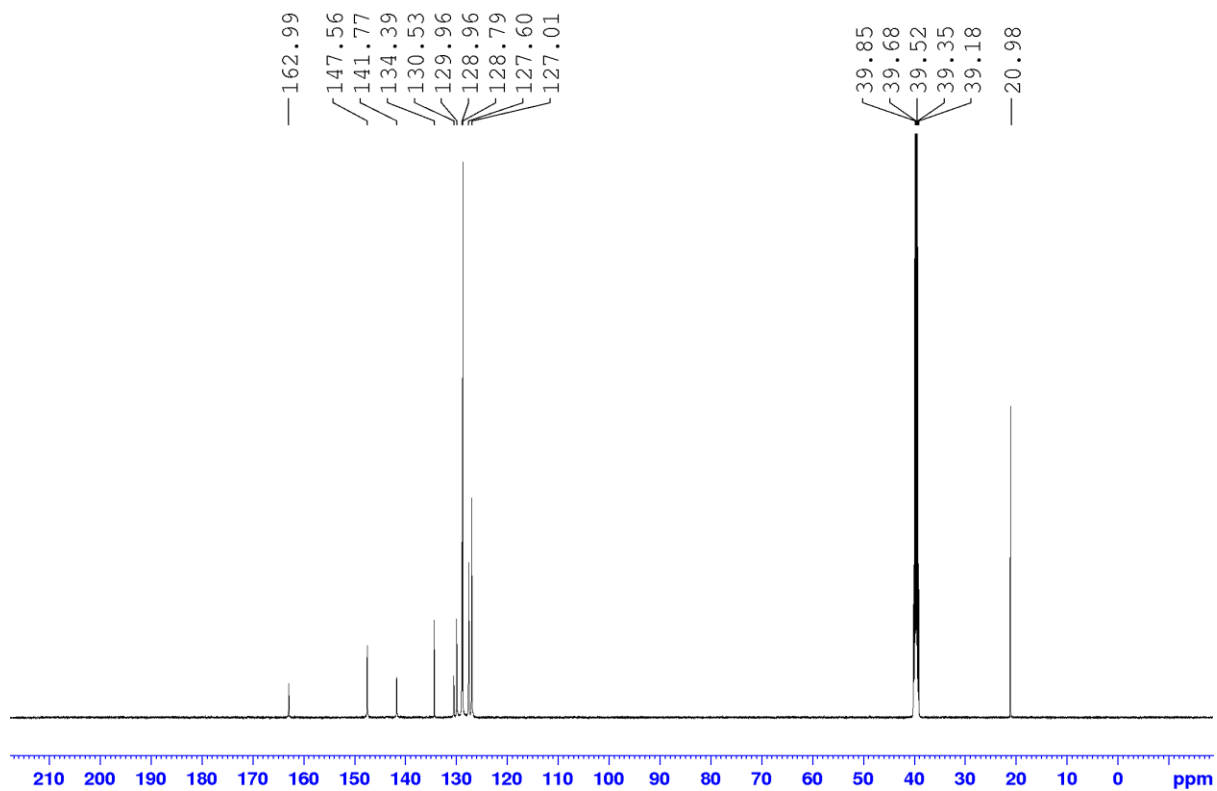


Figure S37: ^{13}C NMR spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

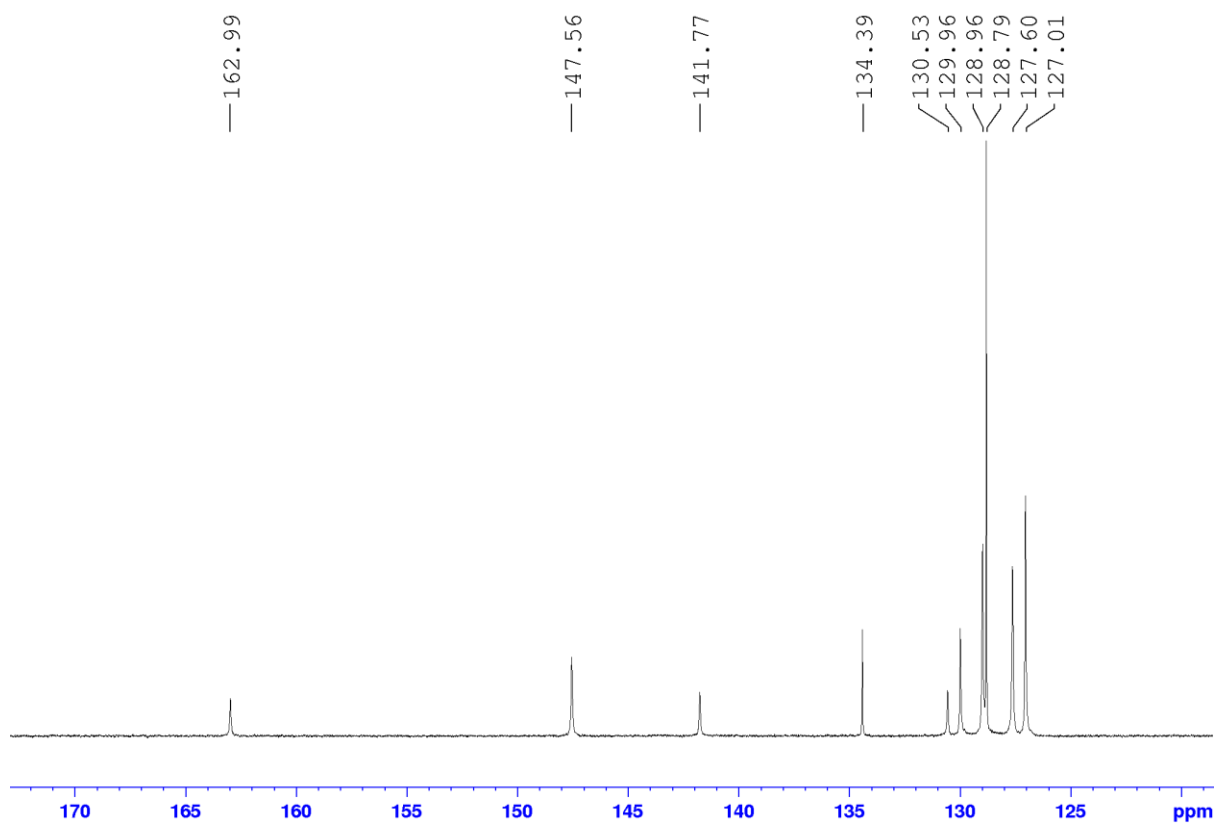


Figure S38: Expansion of the ^{13}C NMR spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

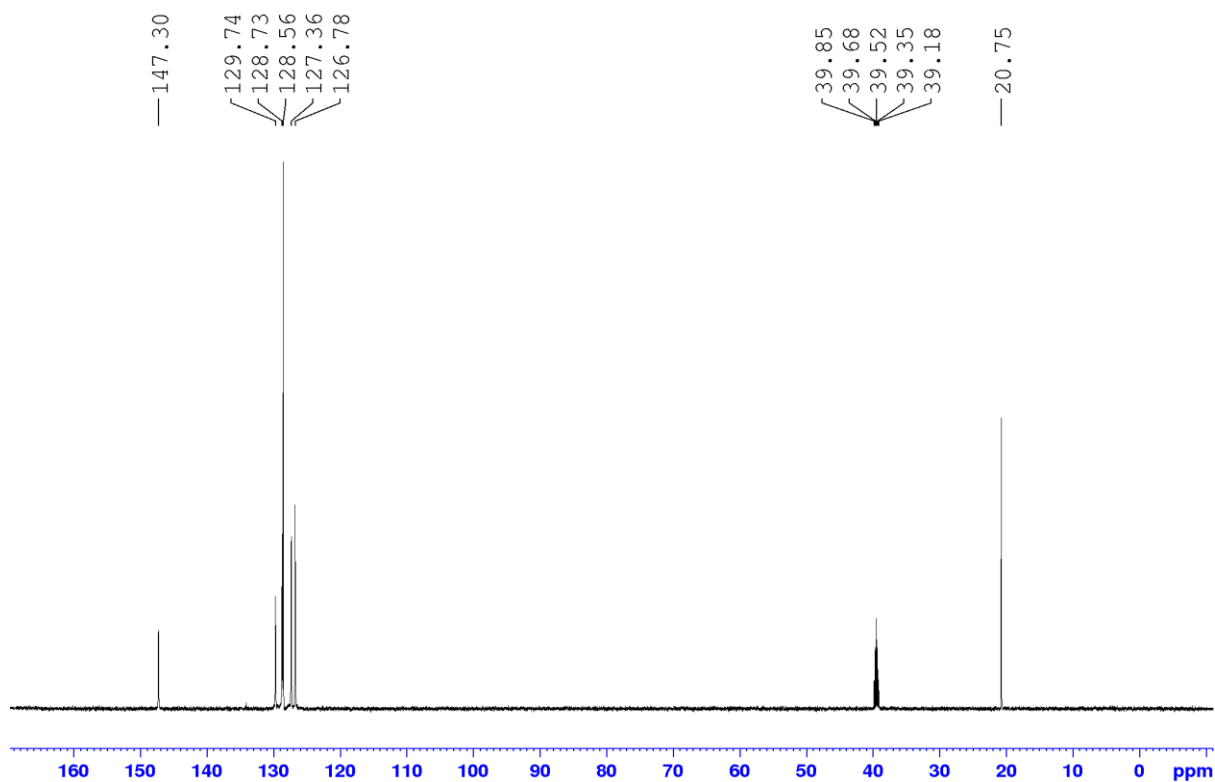


Figure S39: DEPT 135 spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

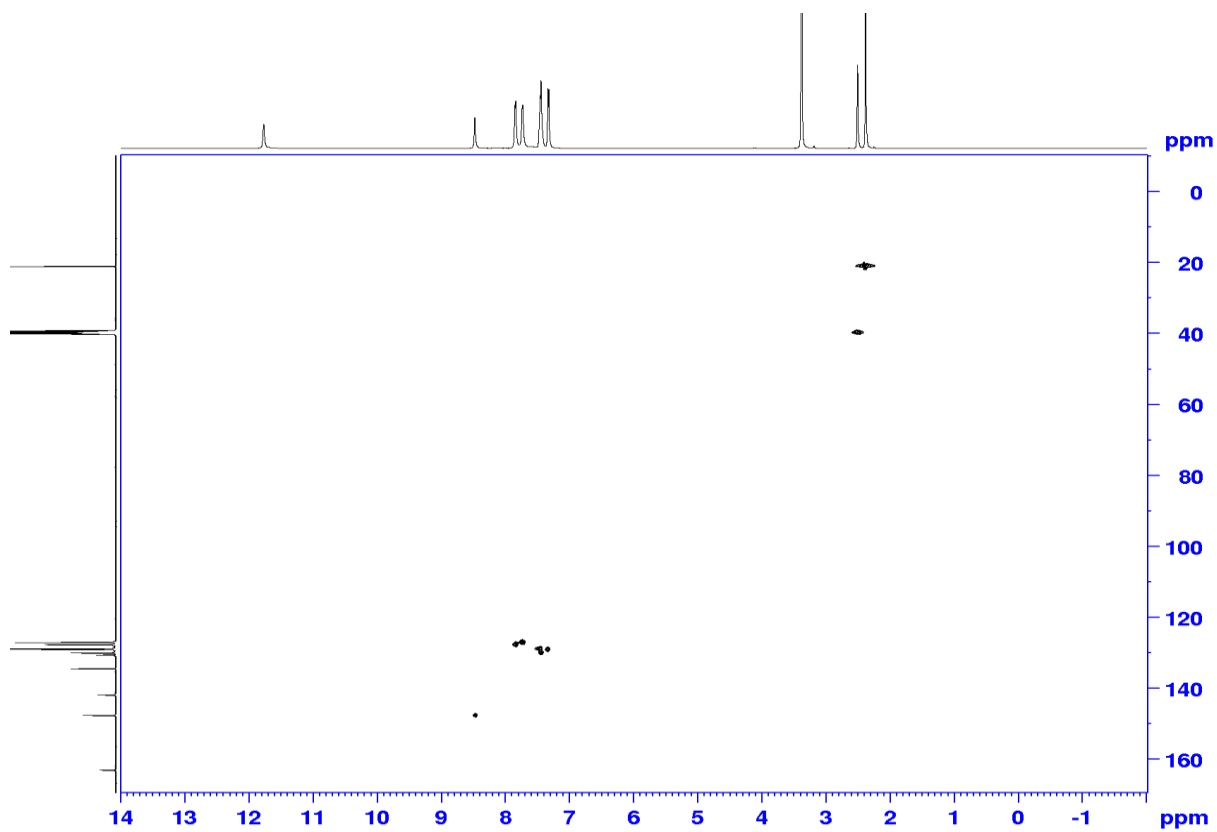


Figure S40: HSQC spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

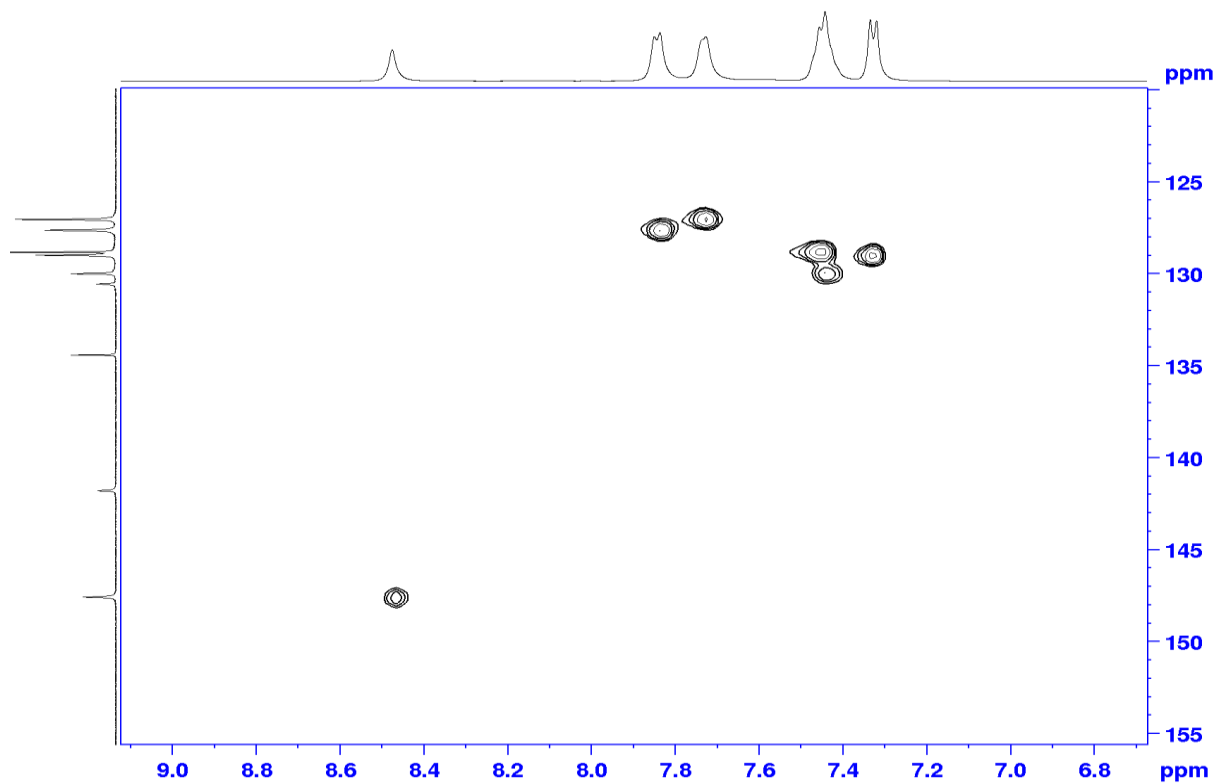


Figure S41: Expansion of the HSQC spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

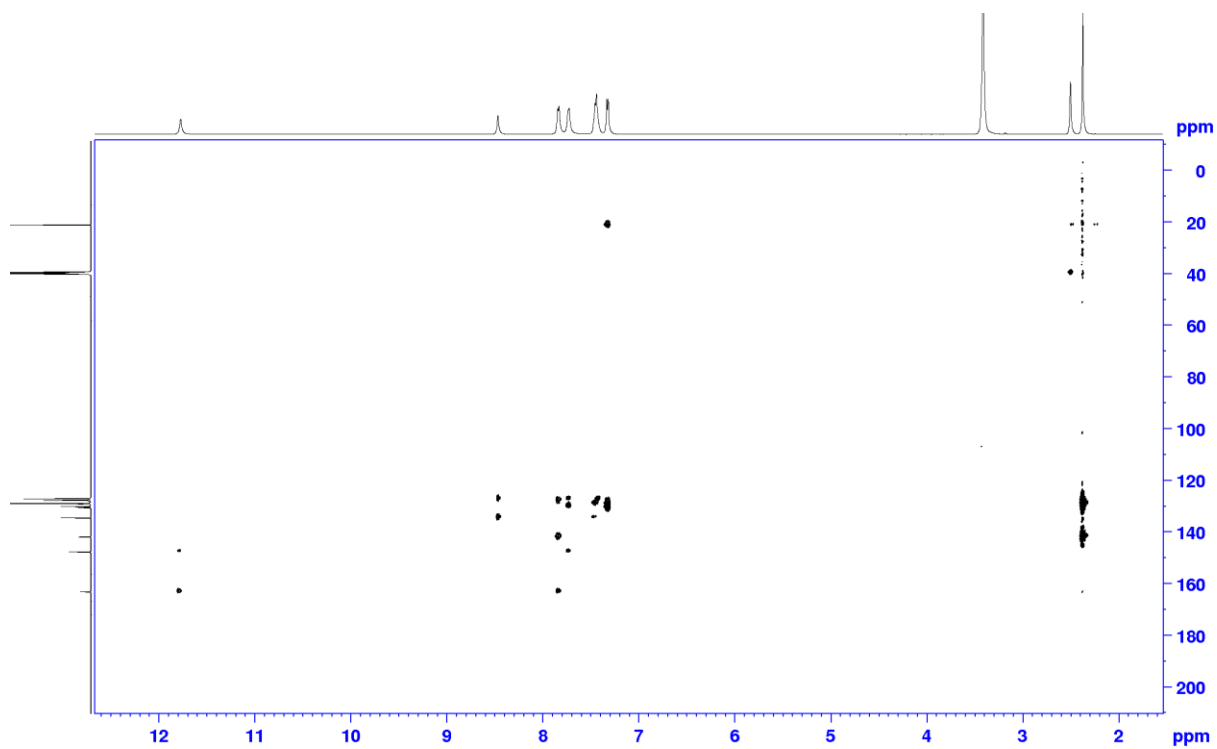


Figure S42: HMBC spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

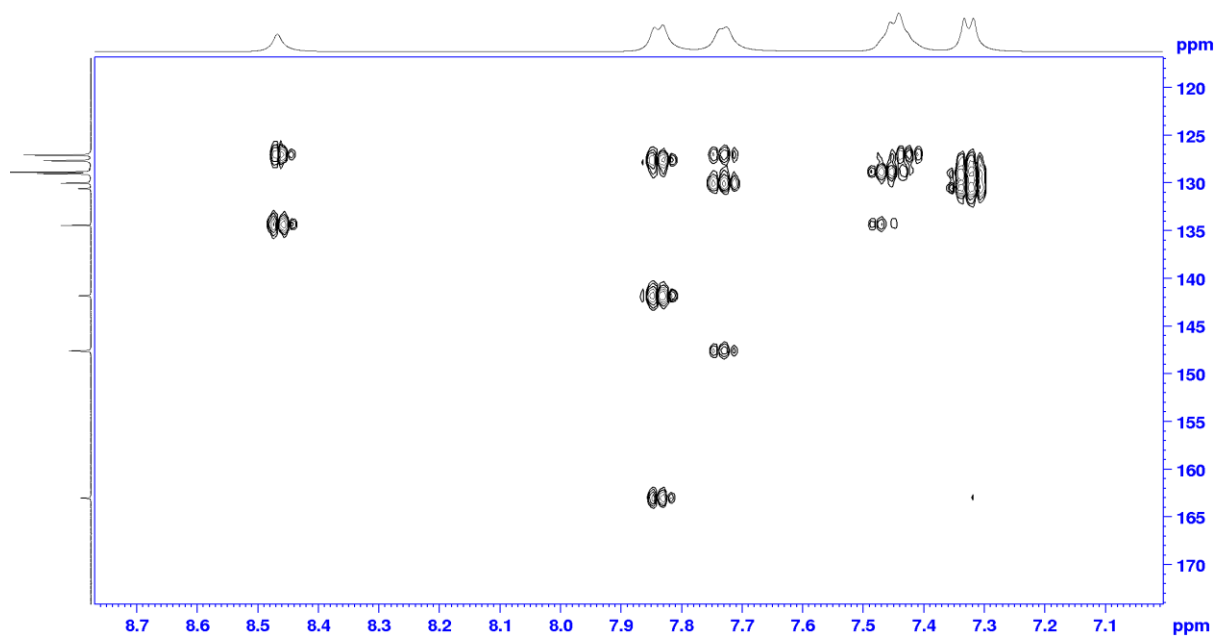


Figure S43: Expansion of the HMBC spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

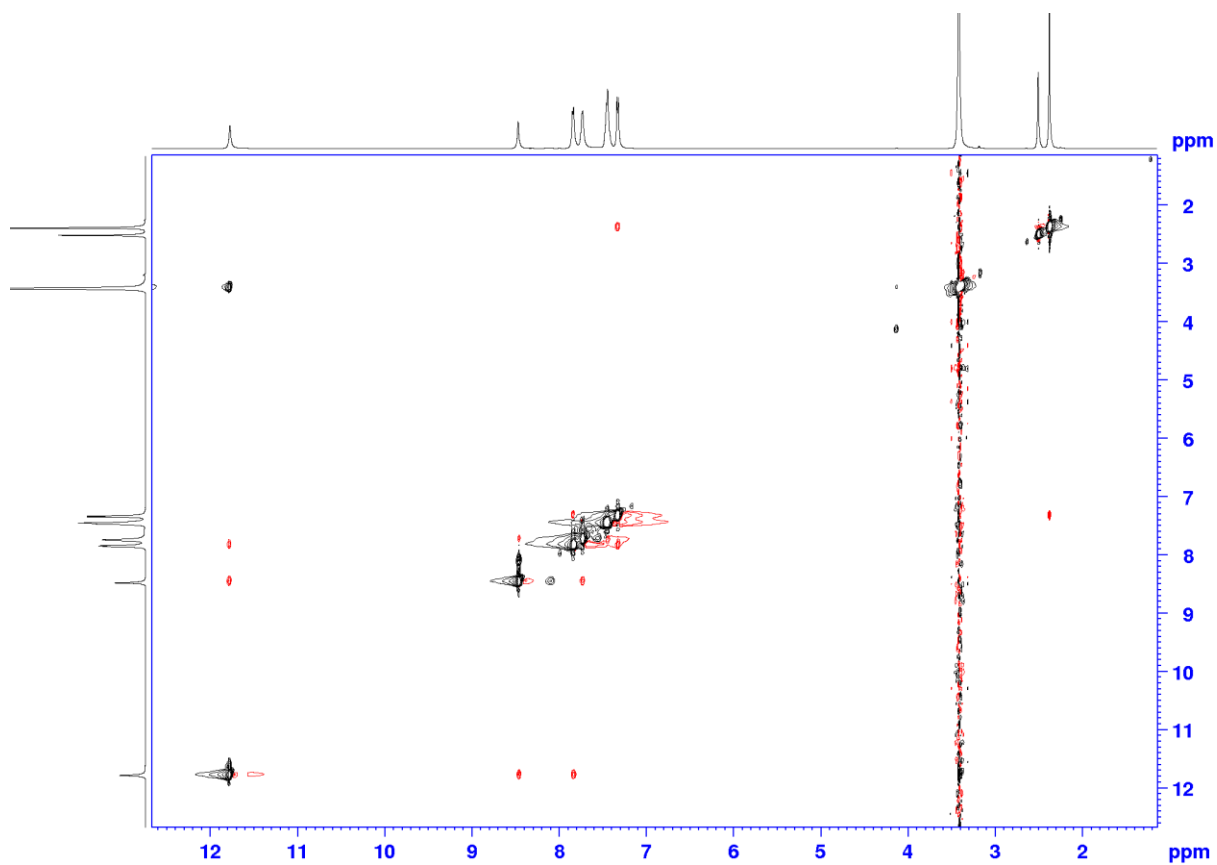


Figure S44: NOESY spectrum of (Z)-N-benzylidene-4-methylbenzohydrazide **BB3**

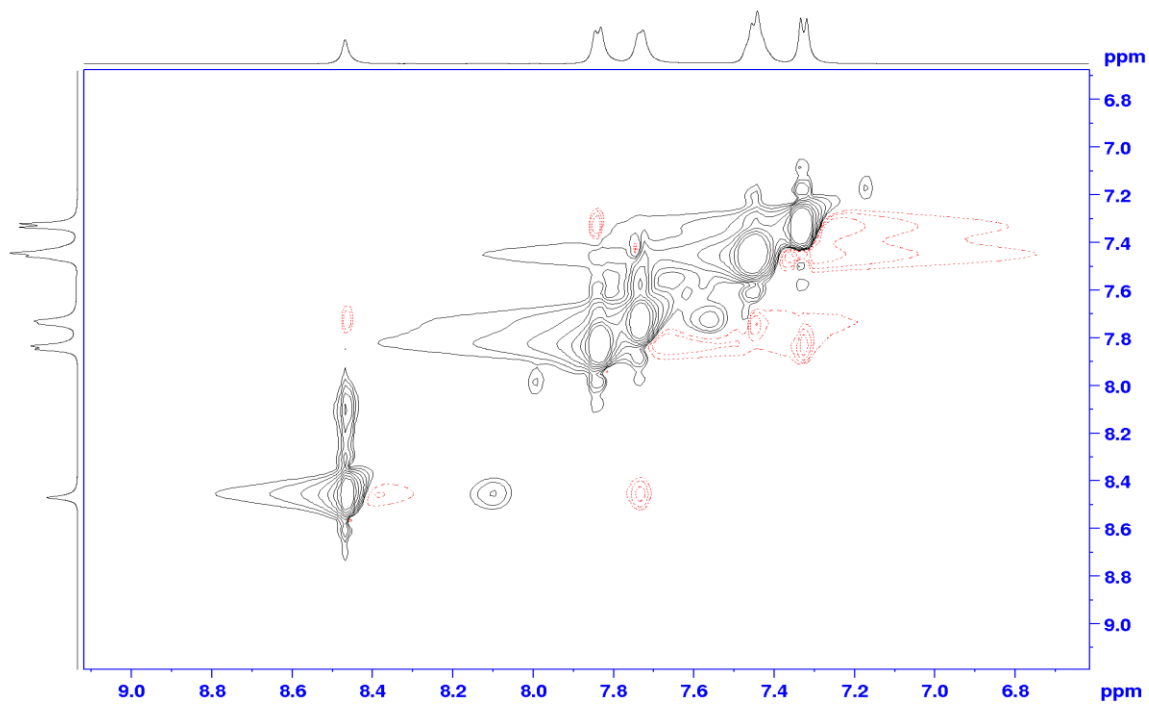


Figure S45: Expansion of the NOESY spectrum of (Z)-N-benzylidene-4-methylbenzohydrazide **BB3**

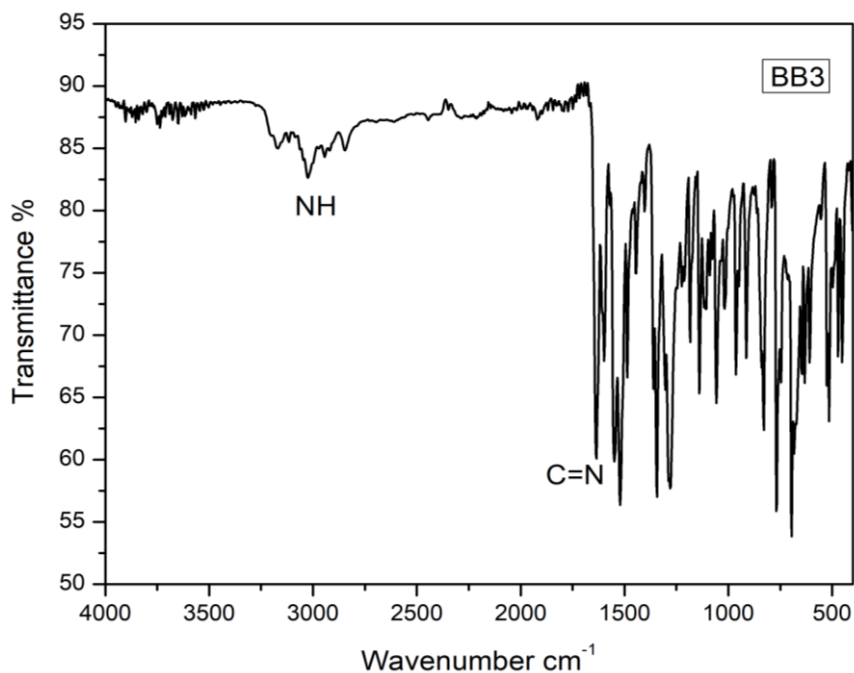


Figure S46: Infrared (IR) spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

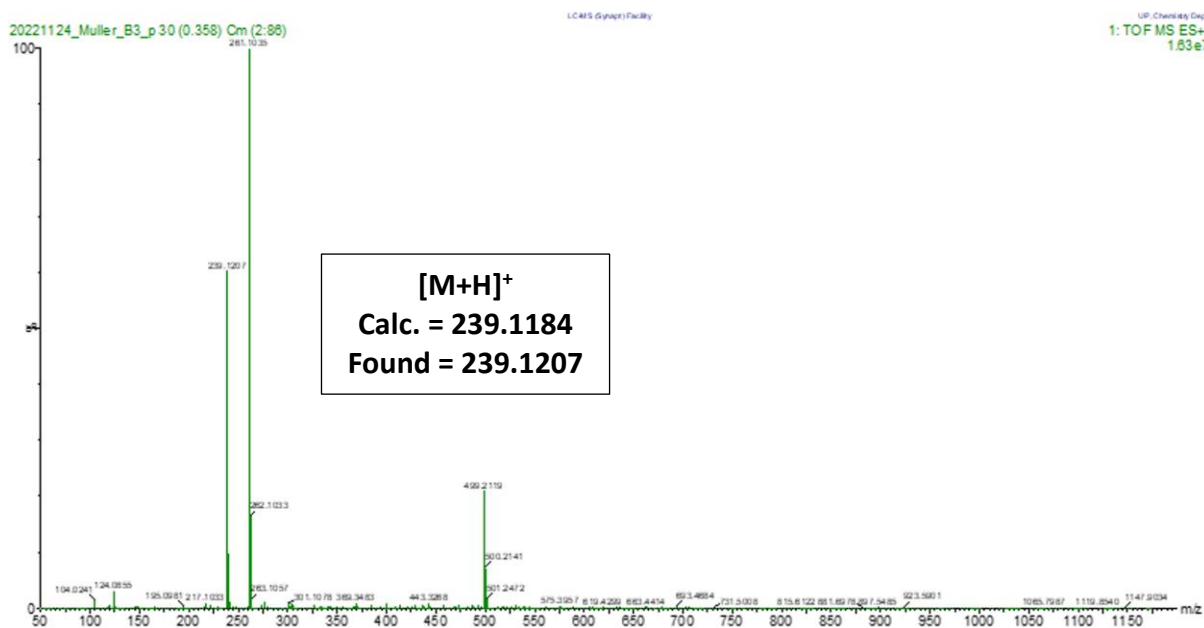


Figure S47: Mass spectrum of (*Z*)-*N*-benzylidene-4-methylbenzohydrazide **BB3**

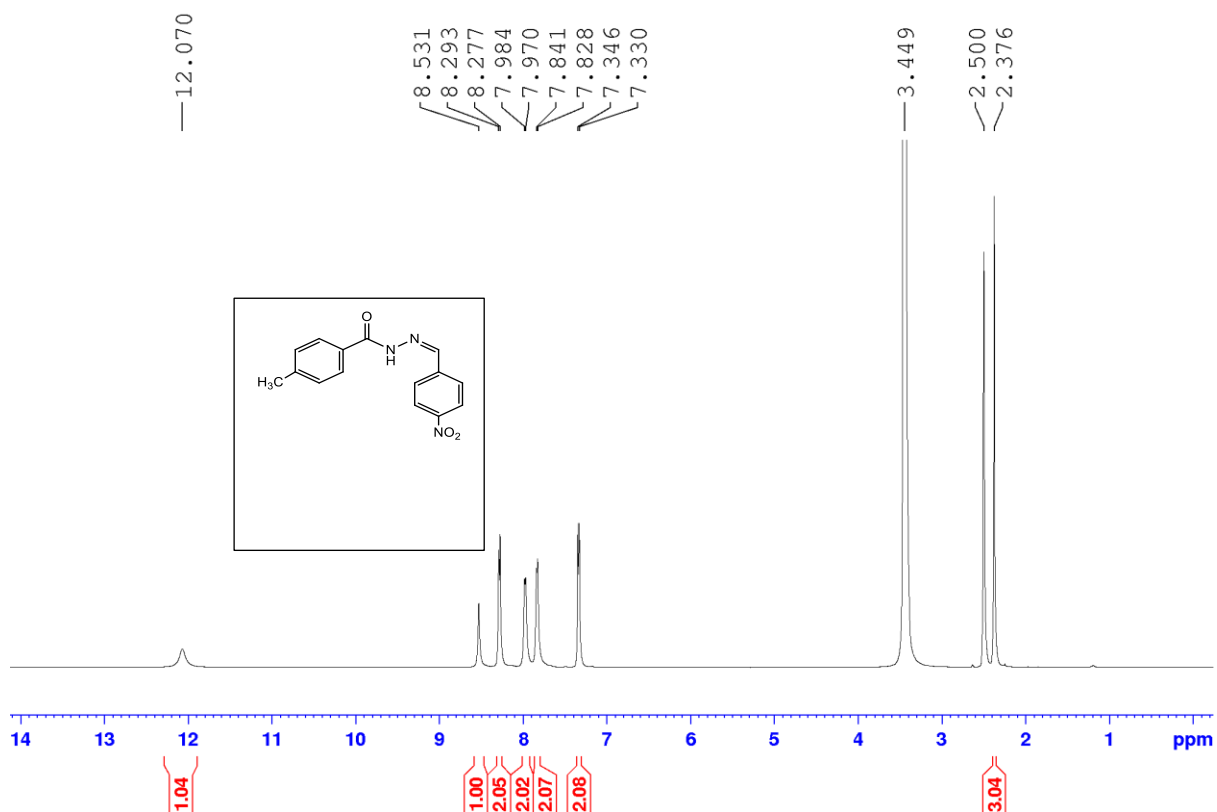


Figure S48: ^1H NMR spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

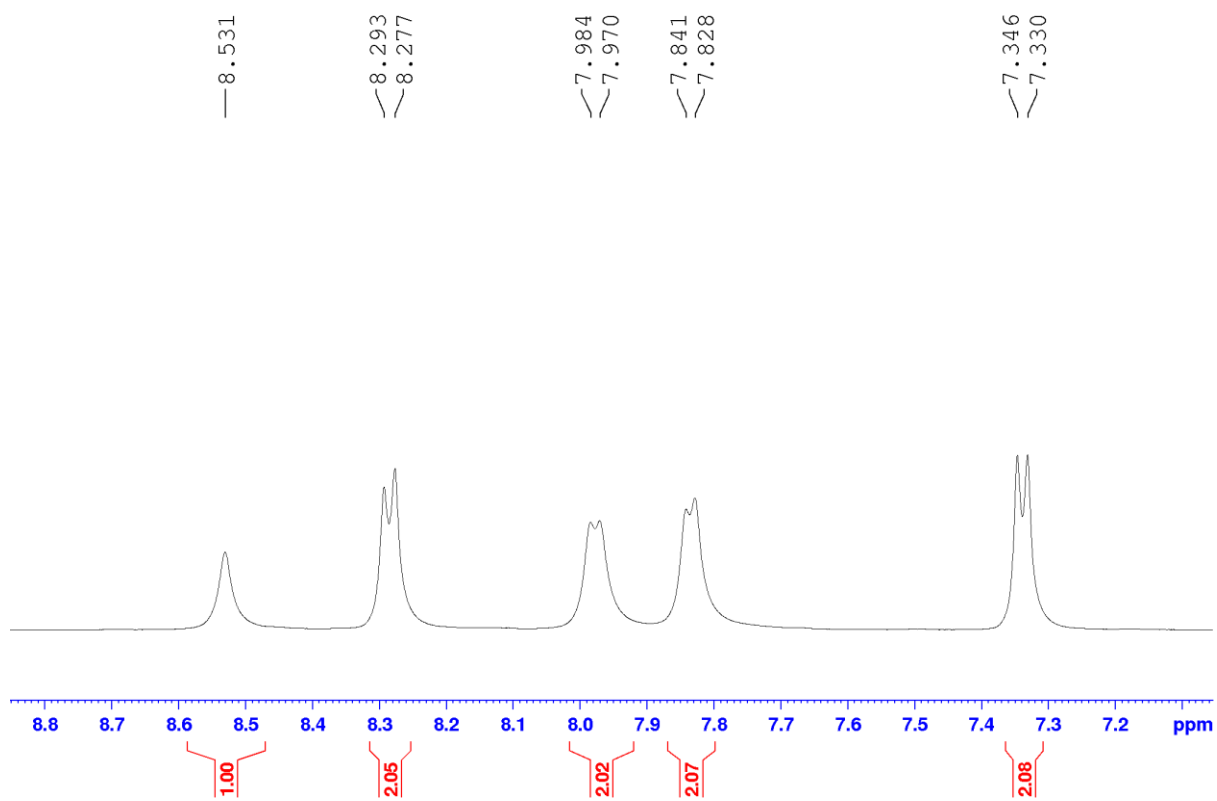


Figure S49: Expansion of the ^1H NMR spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

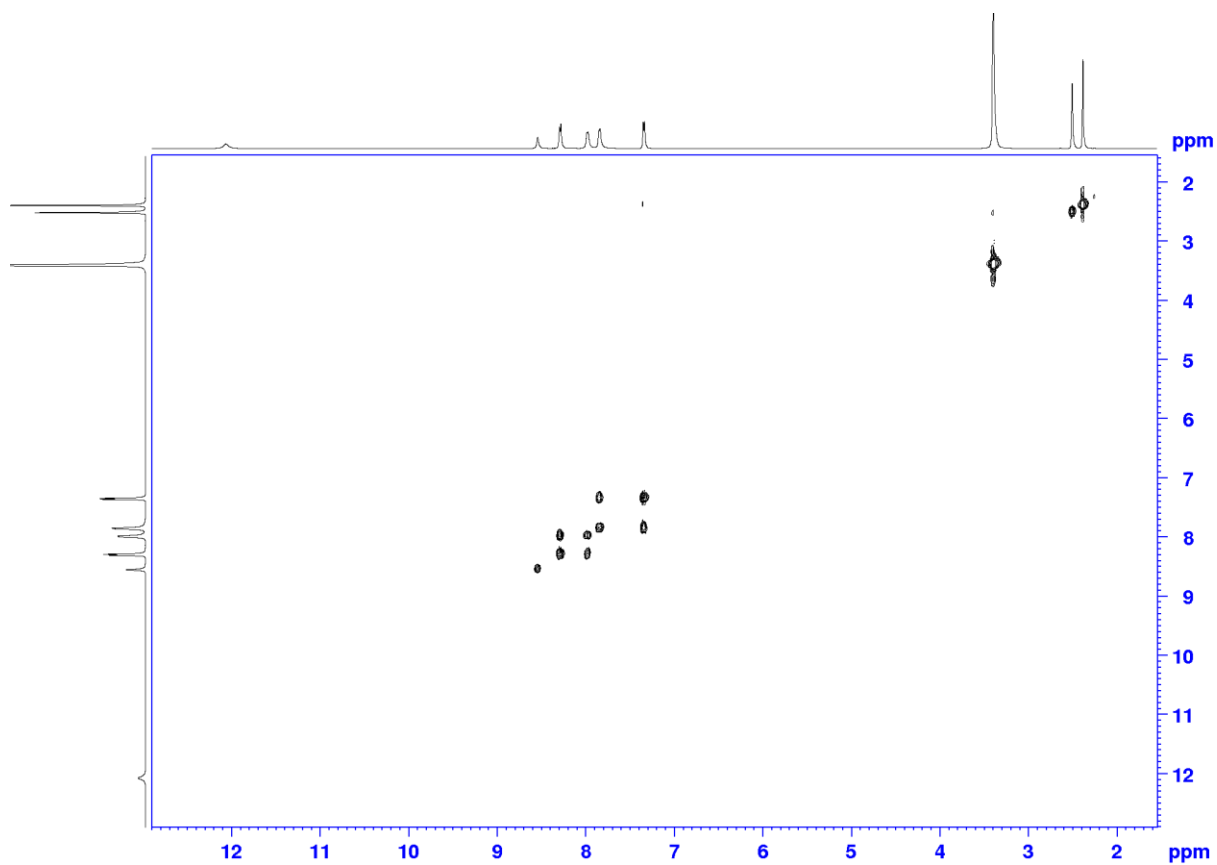


Figure S50: COSY spectrum of (Z)-4-methyl-N-(4-nitrobenzylidene)benzohydrazide **BB4**

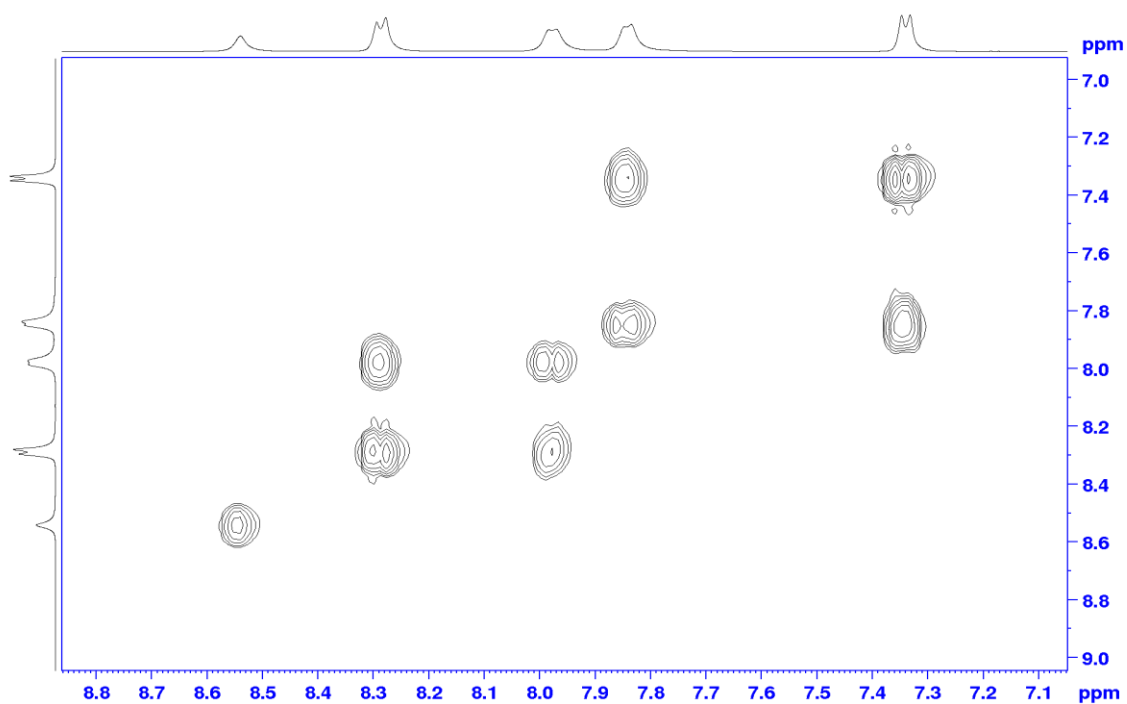


Figure S51: Expansion of the COSY spectrum of (Z)-4-methyl-N-(4-nitrobenzylidene)benzohydrazide **BB4**

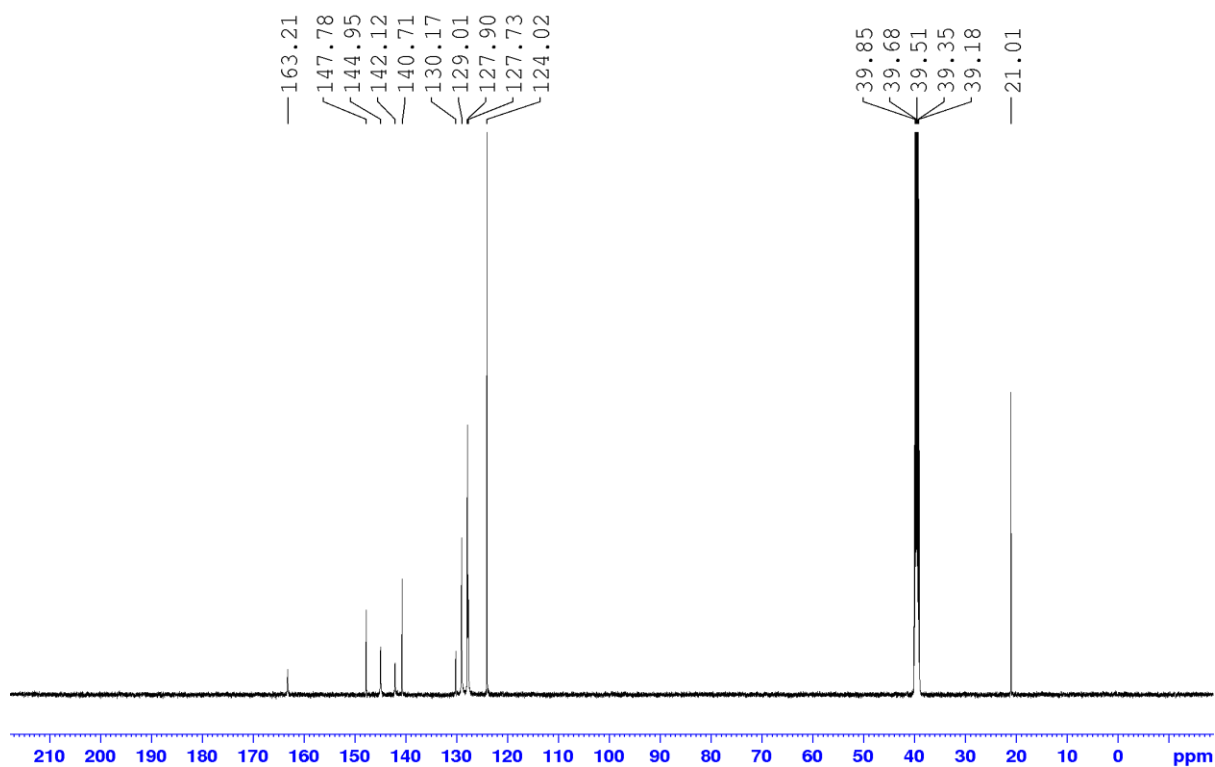


Figure S52: ^{13}C NMR spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

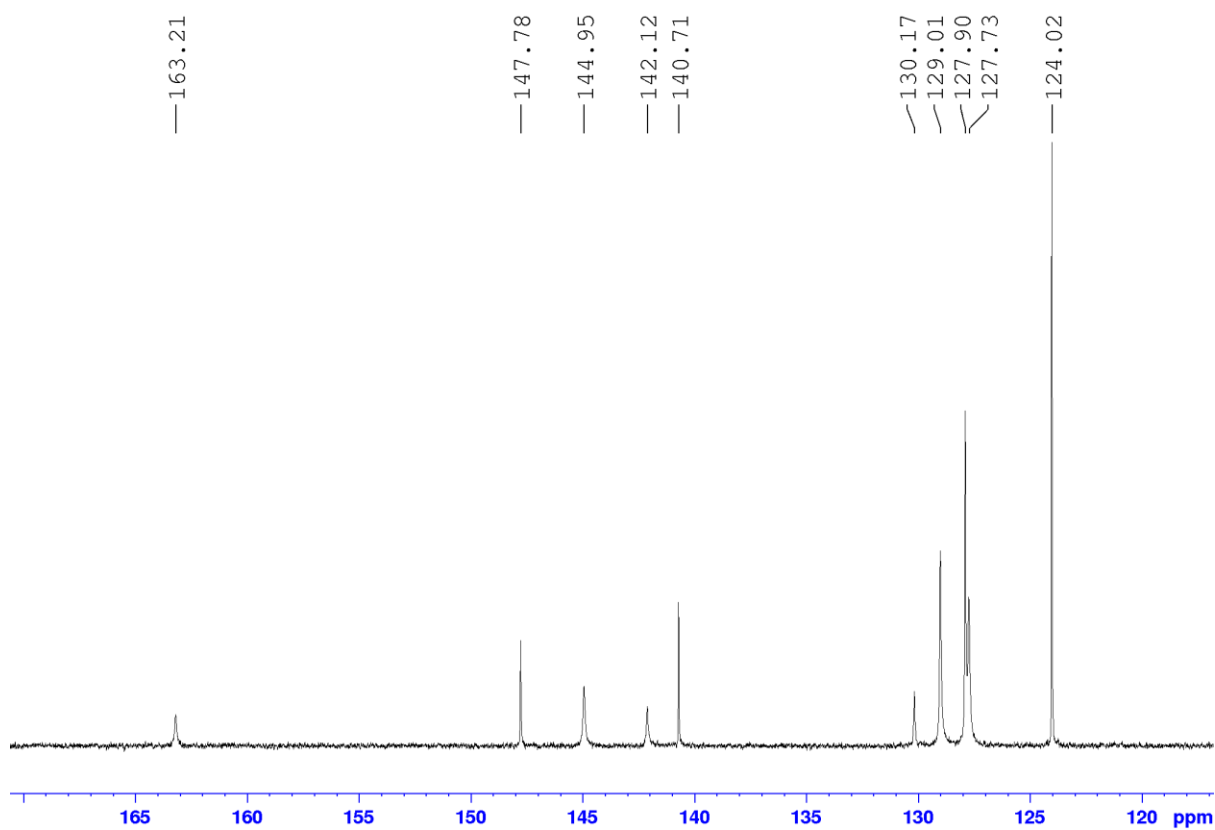


Figure S53: Expansion of the ^{13}C NMR spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

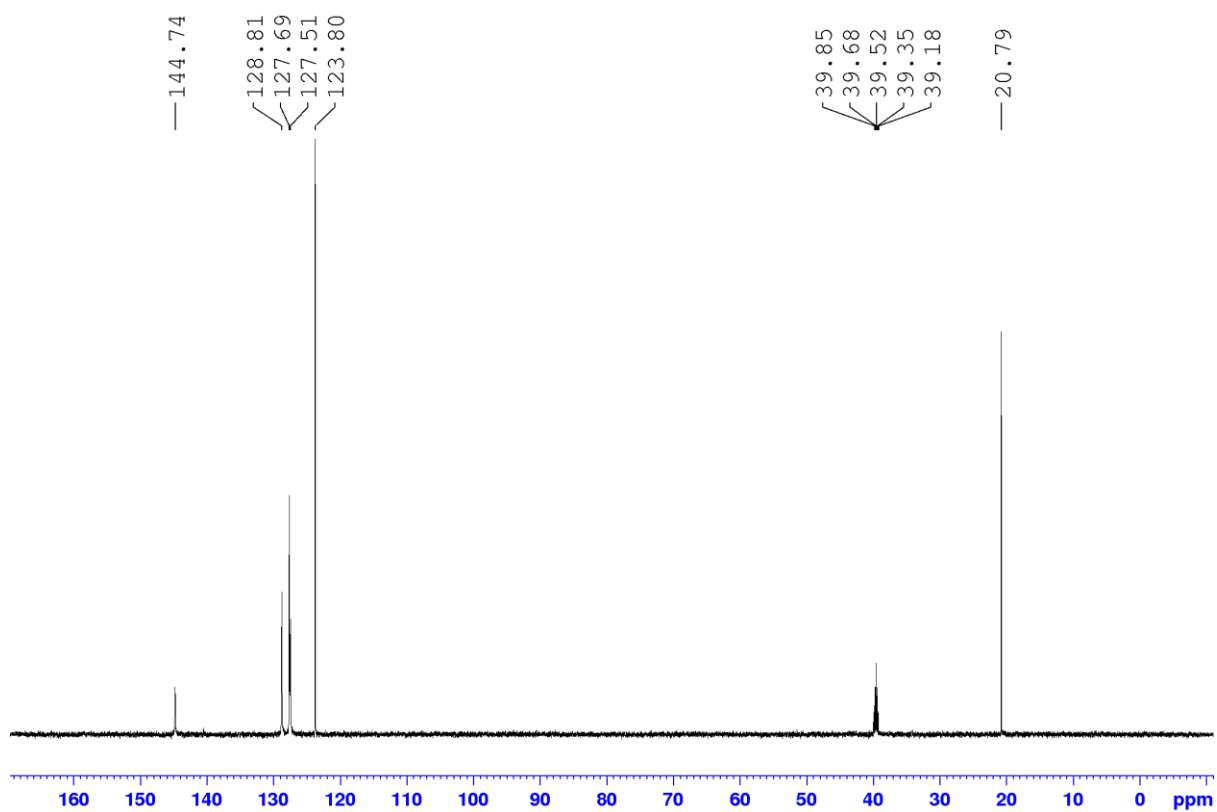


Figure S54: DEPT 135 spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

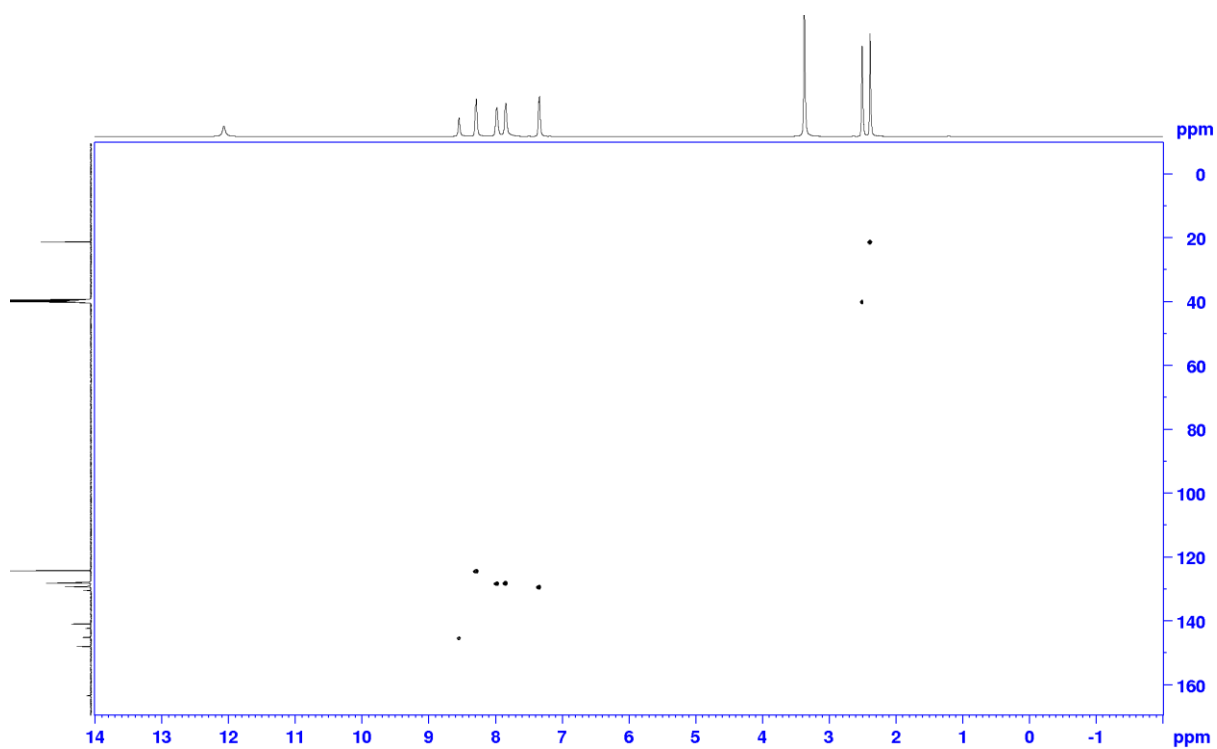


Figure S55: HSQC spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

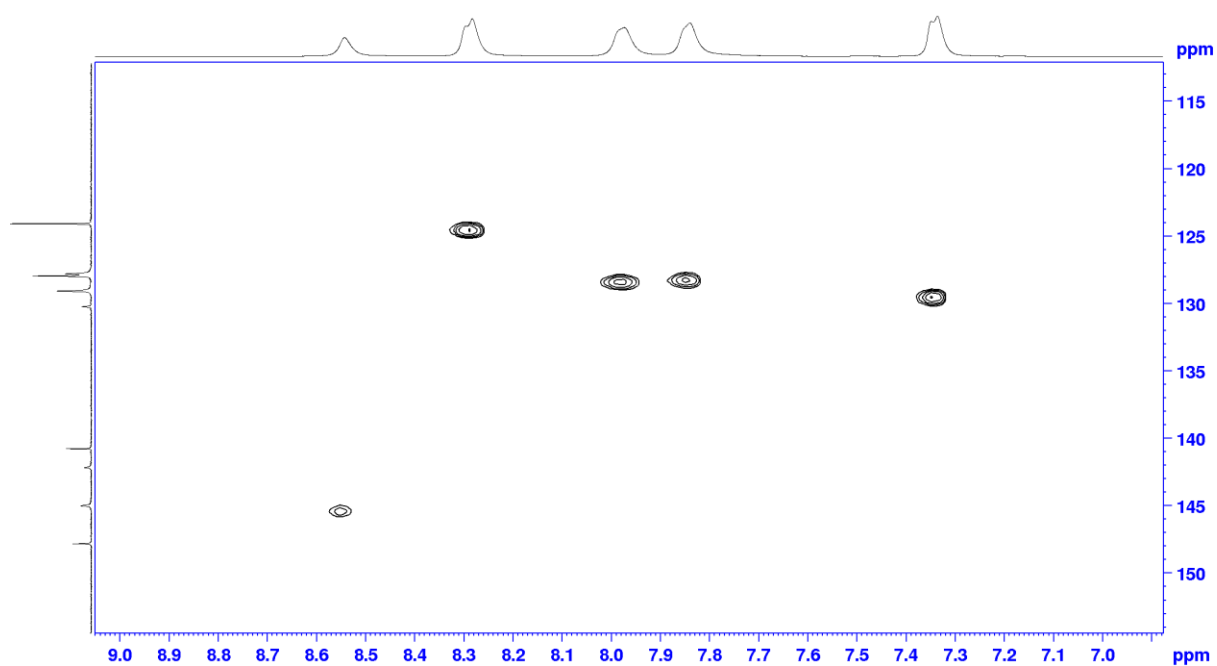


Figure S56: Expansion of the HSQC spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

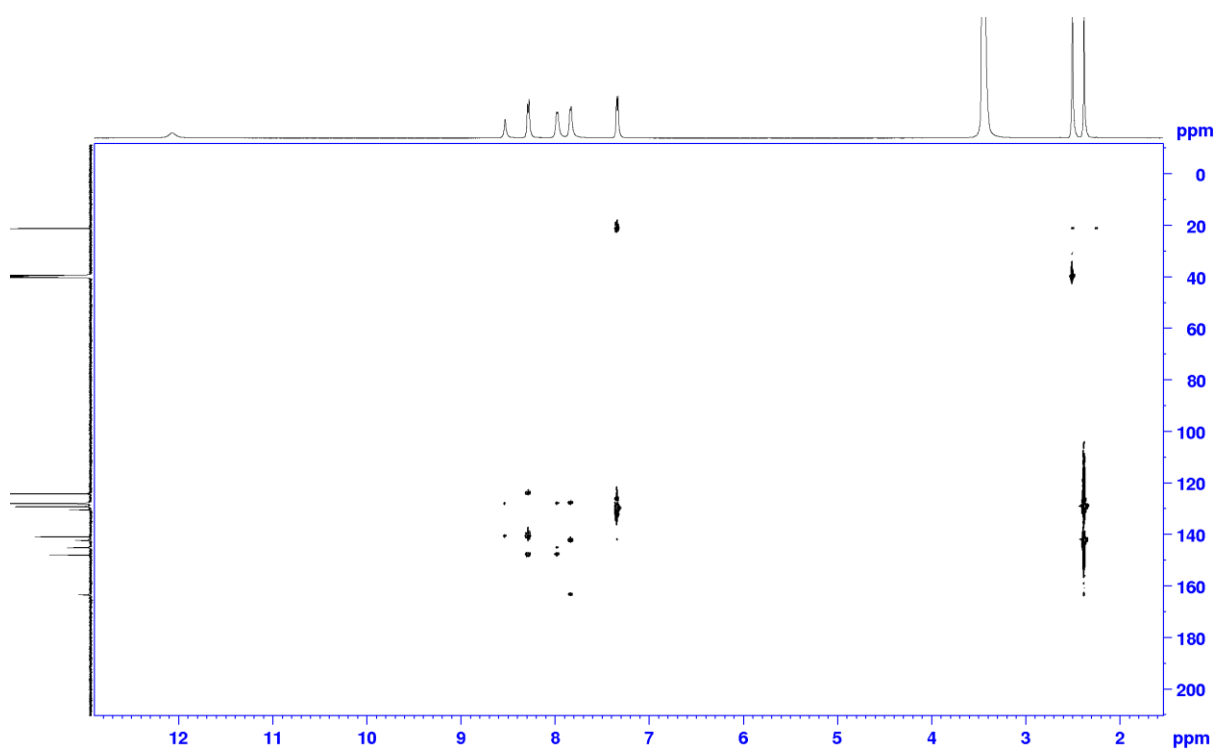


Figure S57: HMBC spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

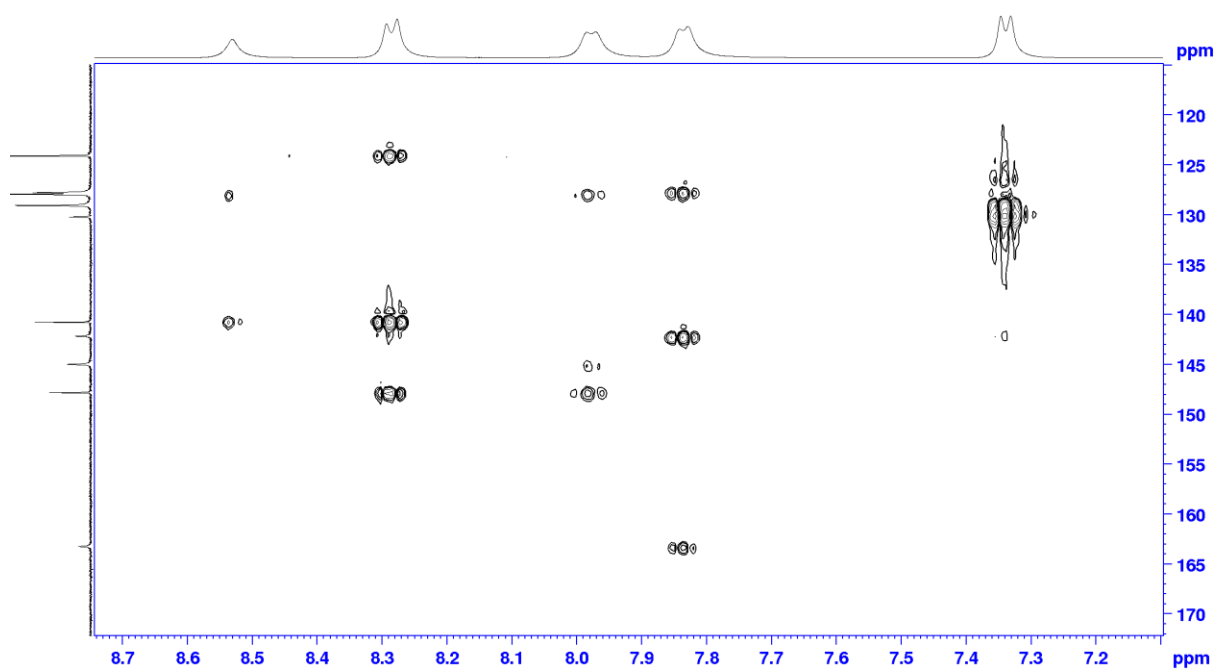


Figure S58: Expansion of the HMBC spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

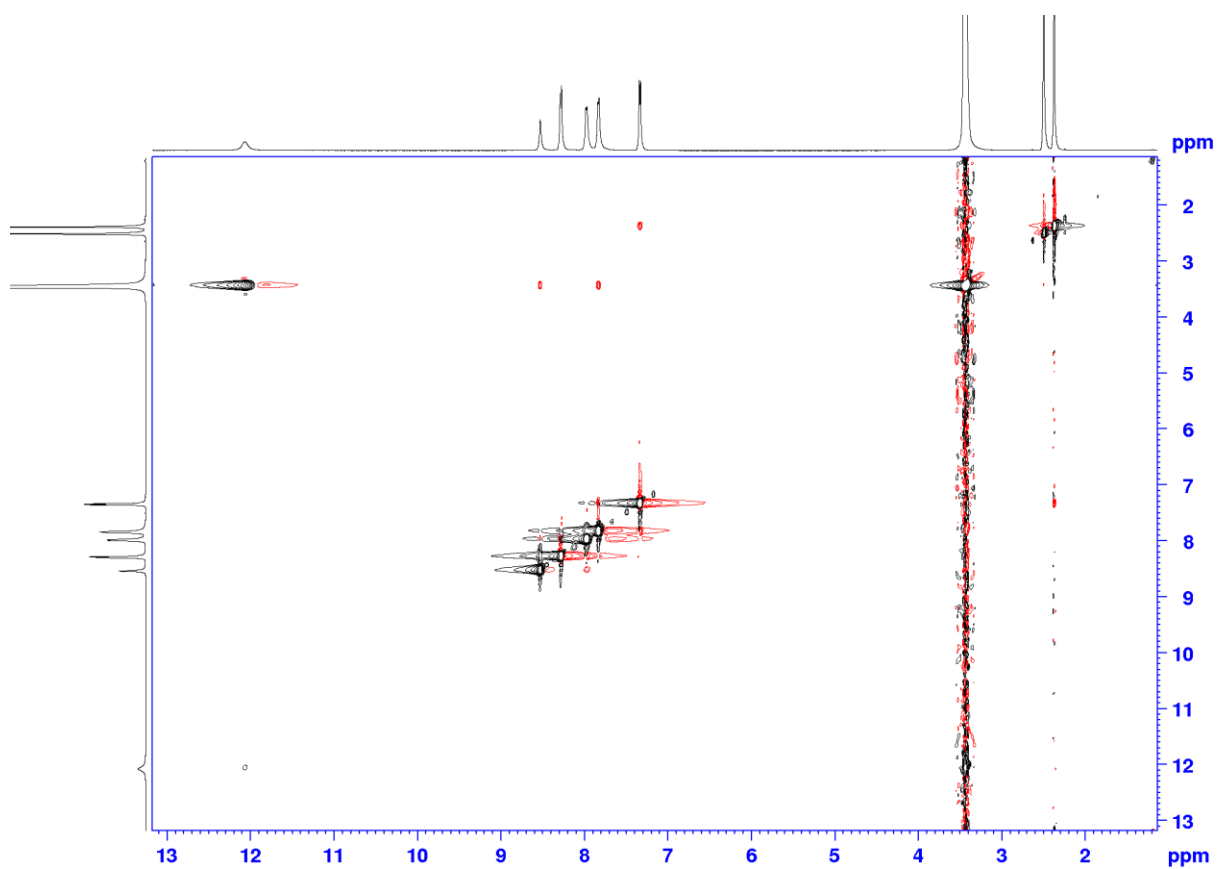


Figure S59: NOESY spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

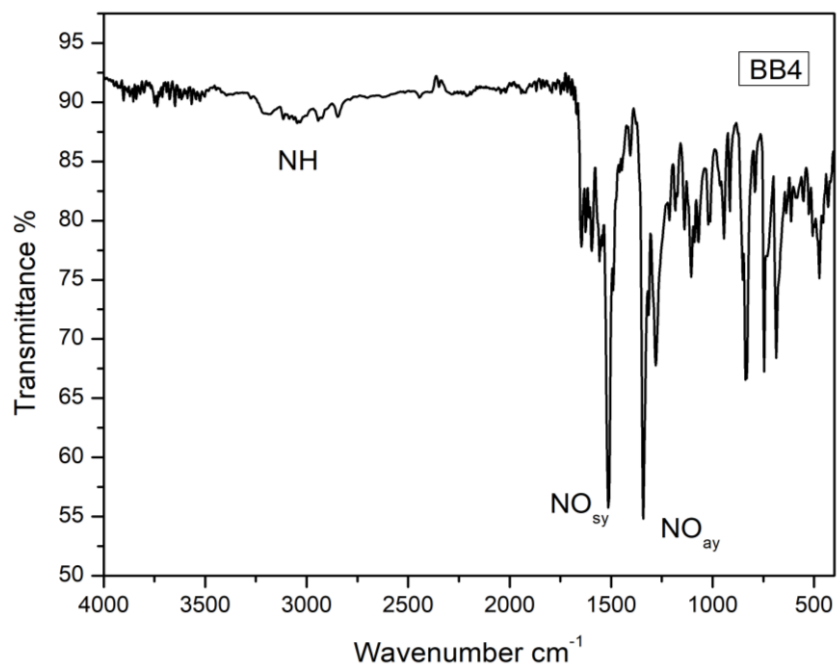


Figure S60: Infrared (IR) of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

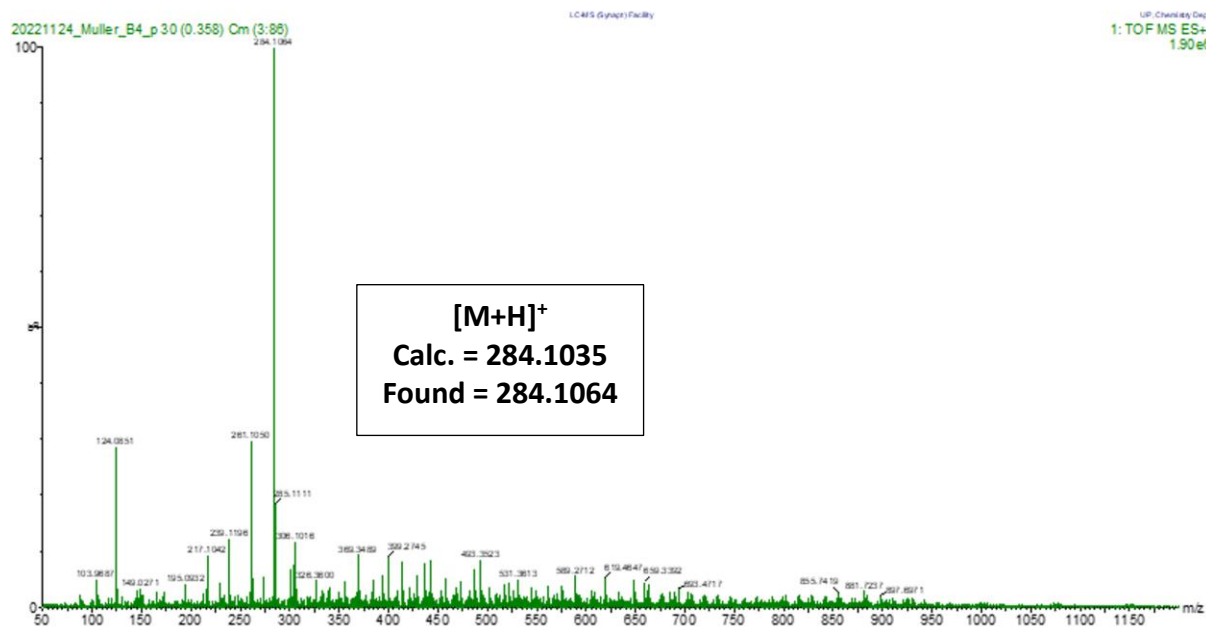


Figure S61: Mass spectrum of (*Z*)-4-methyl-*N*-(4-nitrobenzylidene)benzohydrazide **BB4**

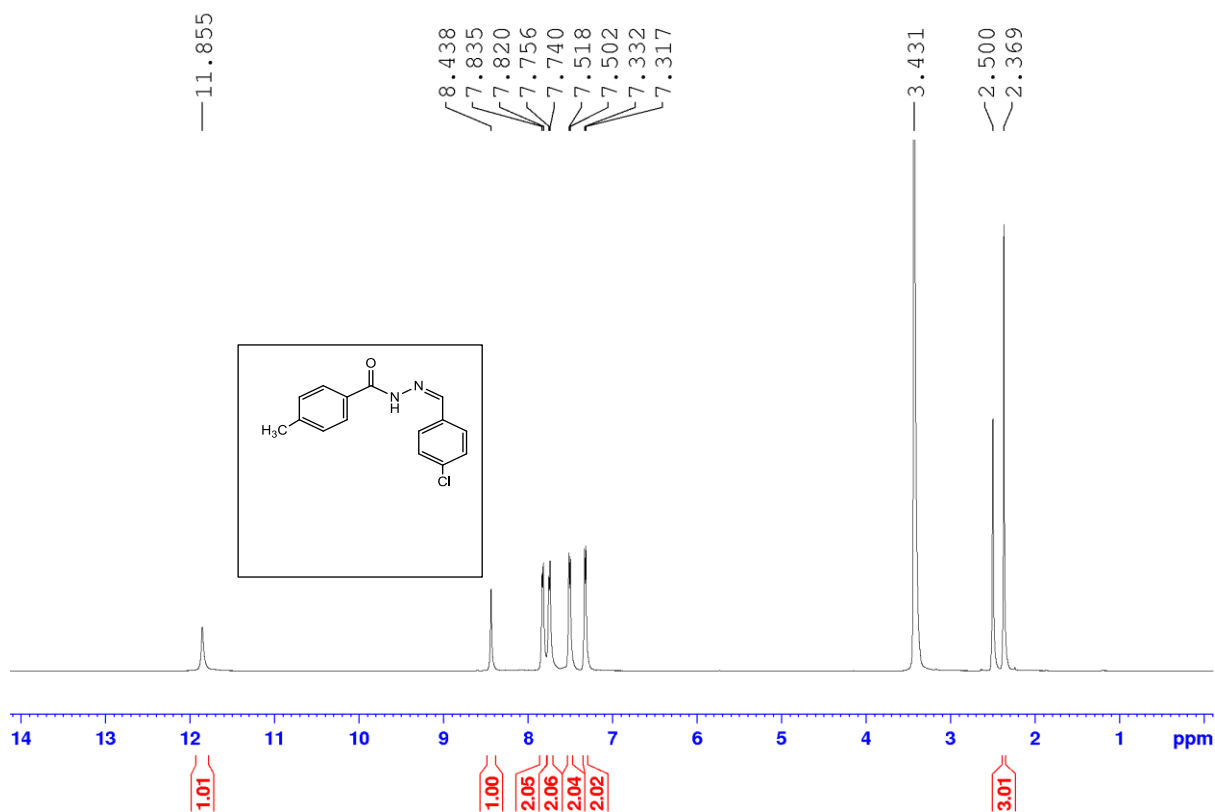


Figure S62: ^1H NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

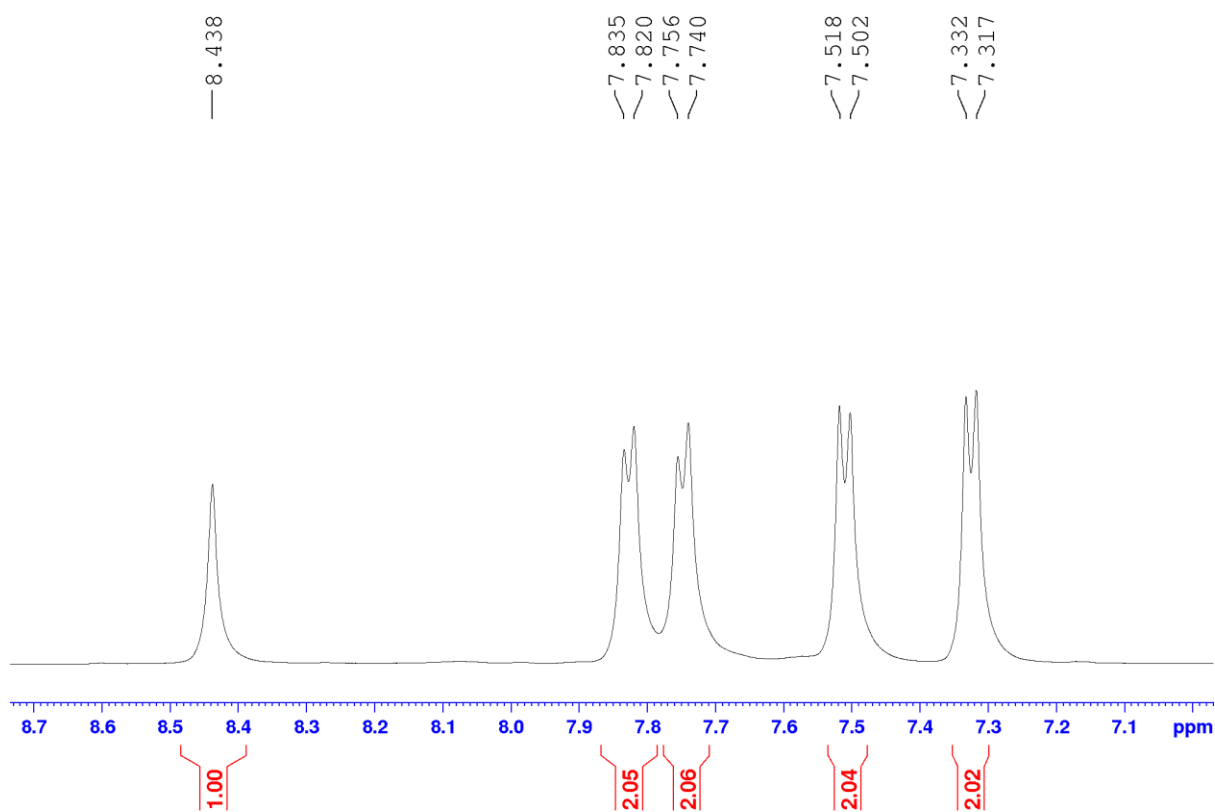


Figure S63: Expansion of the ^1H NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

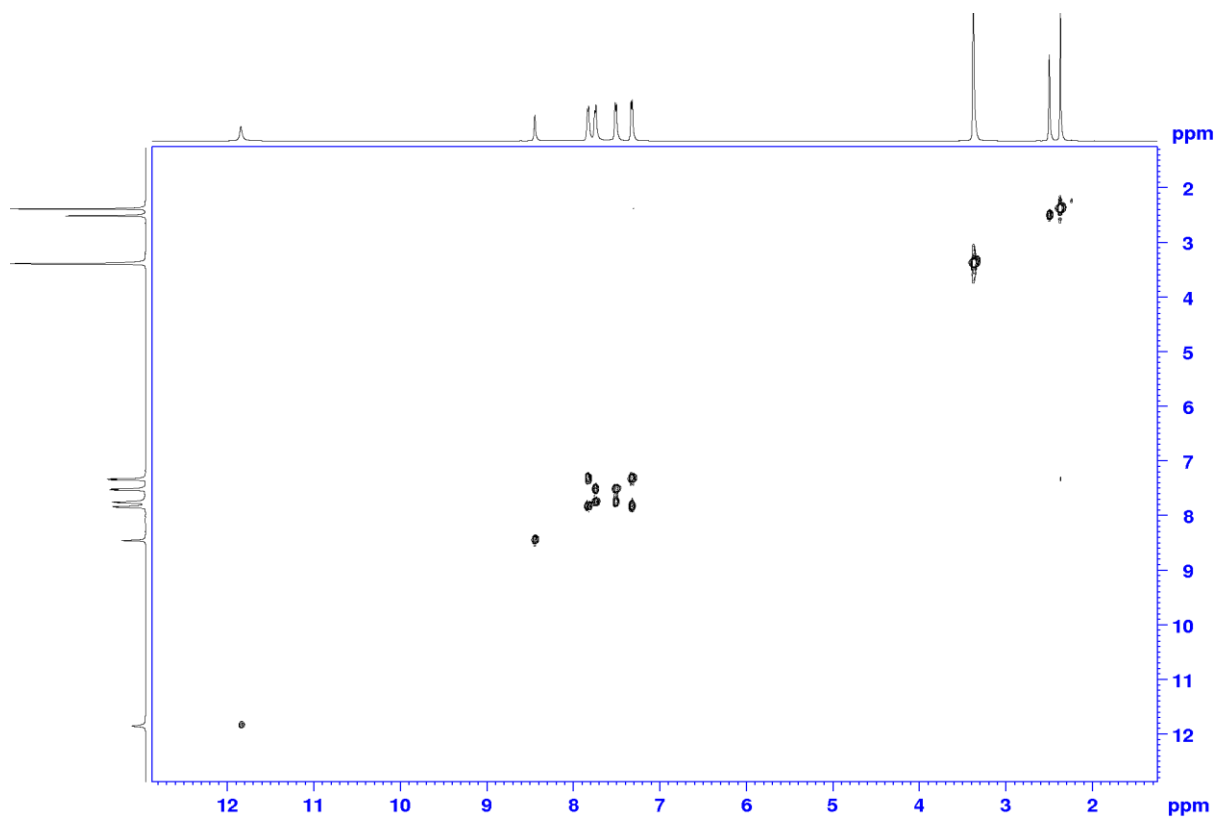


Figure S64: COSY spectrum of *(Z)*-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

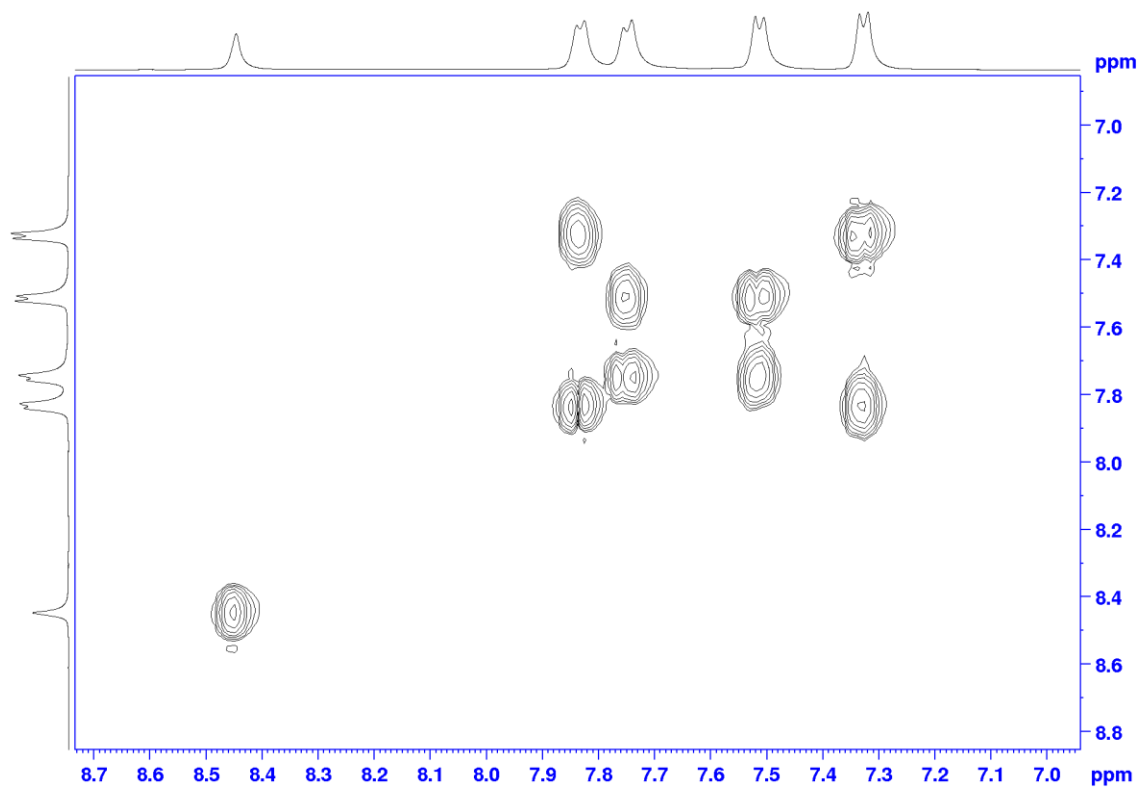


Figure S65: Expansion of the COSY spectrum of *(Z)*-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

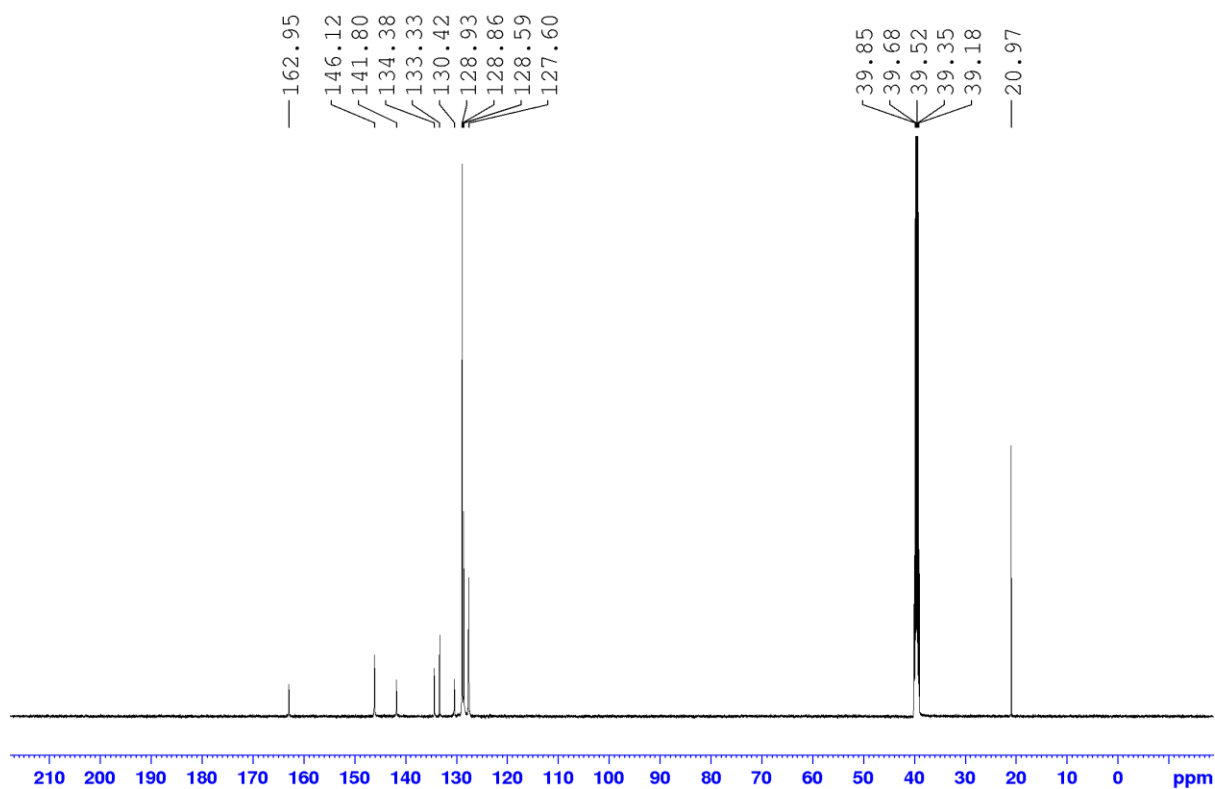


Figure S66: ^{13}C NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

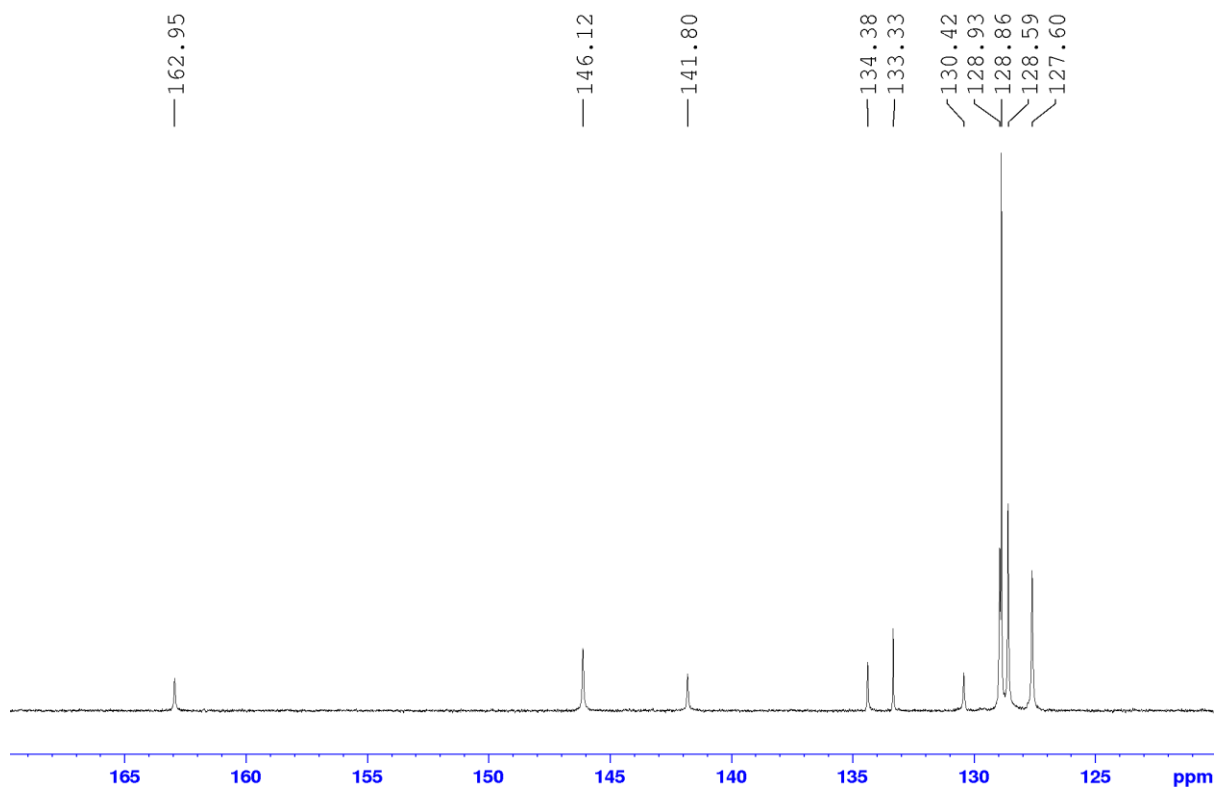


Figure S67: Expansion of the ^{13}C NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

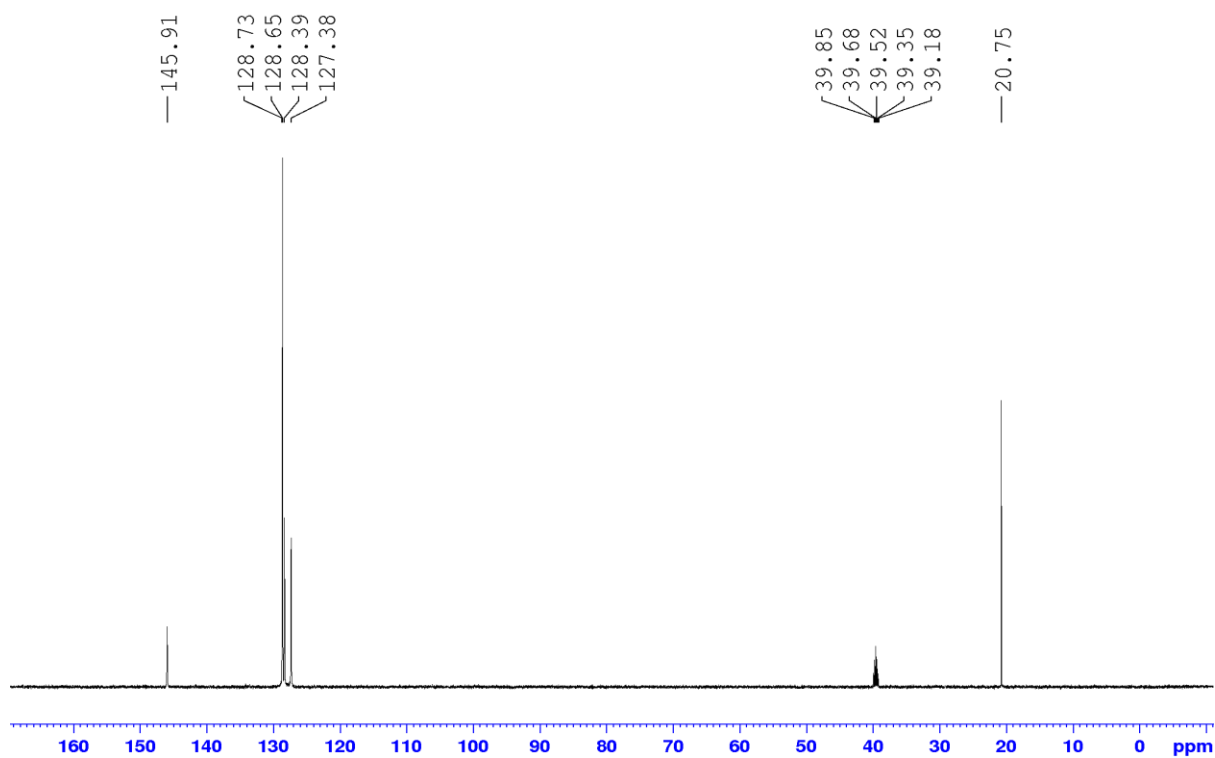


Figure S68: DEPT 135 spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

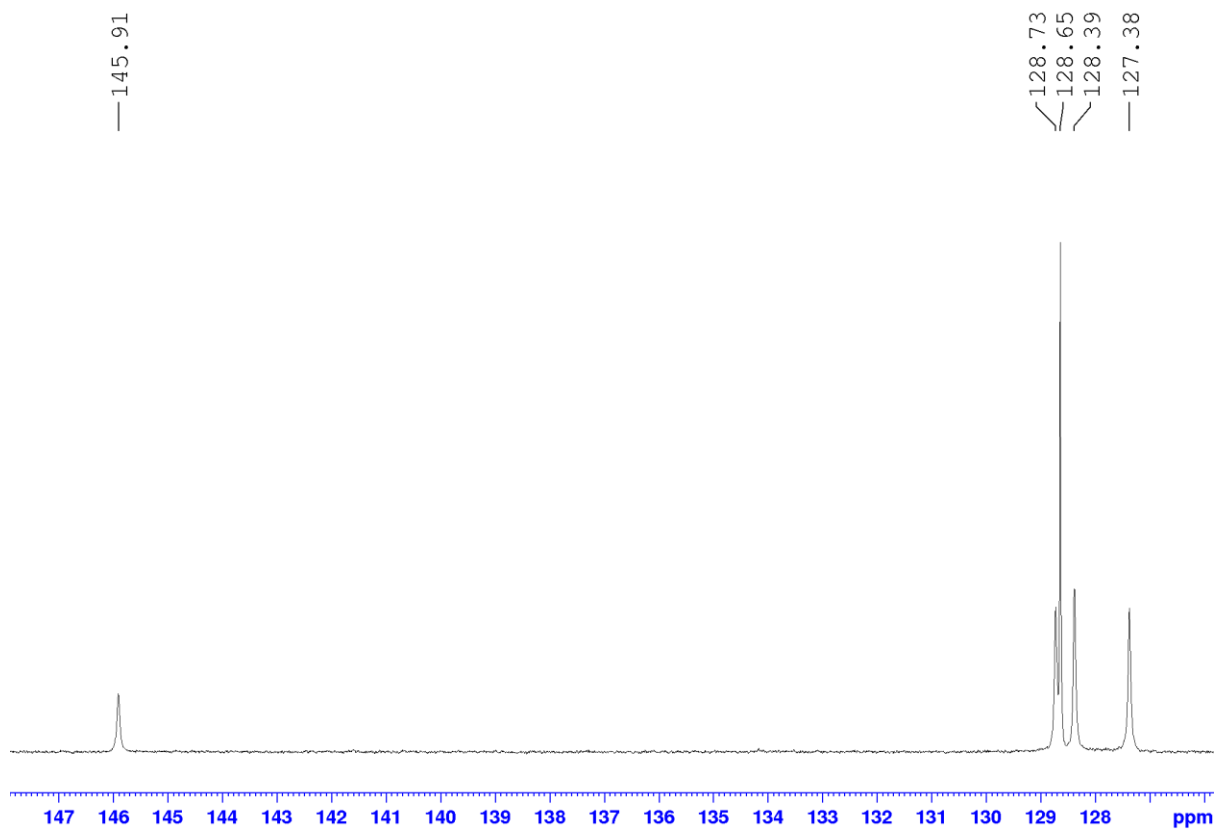


Figure S69: Expansion of the DEPT 135 spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

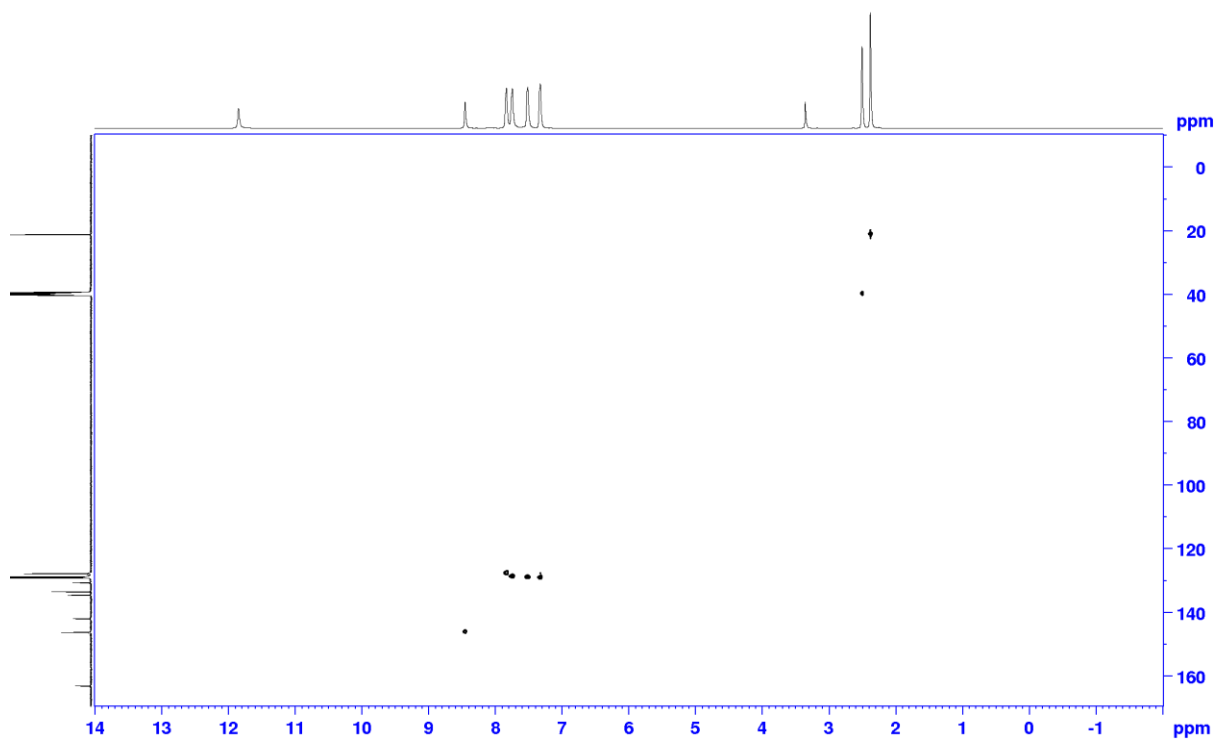


Figure S70: HSQC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

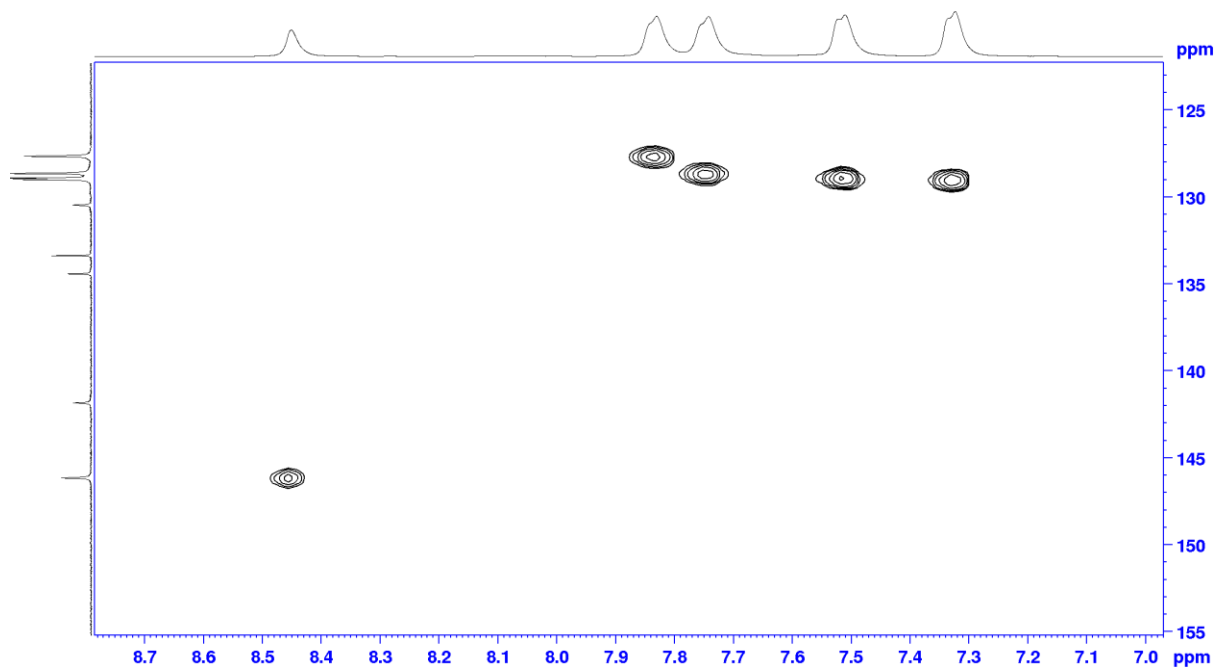


Figure S71: Expansion of the HSQC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

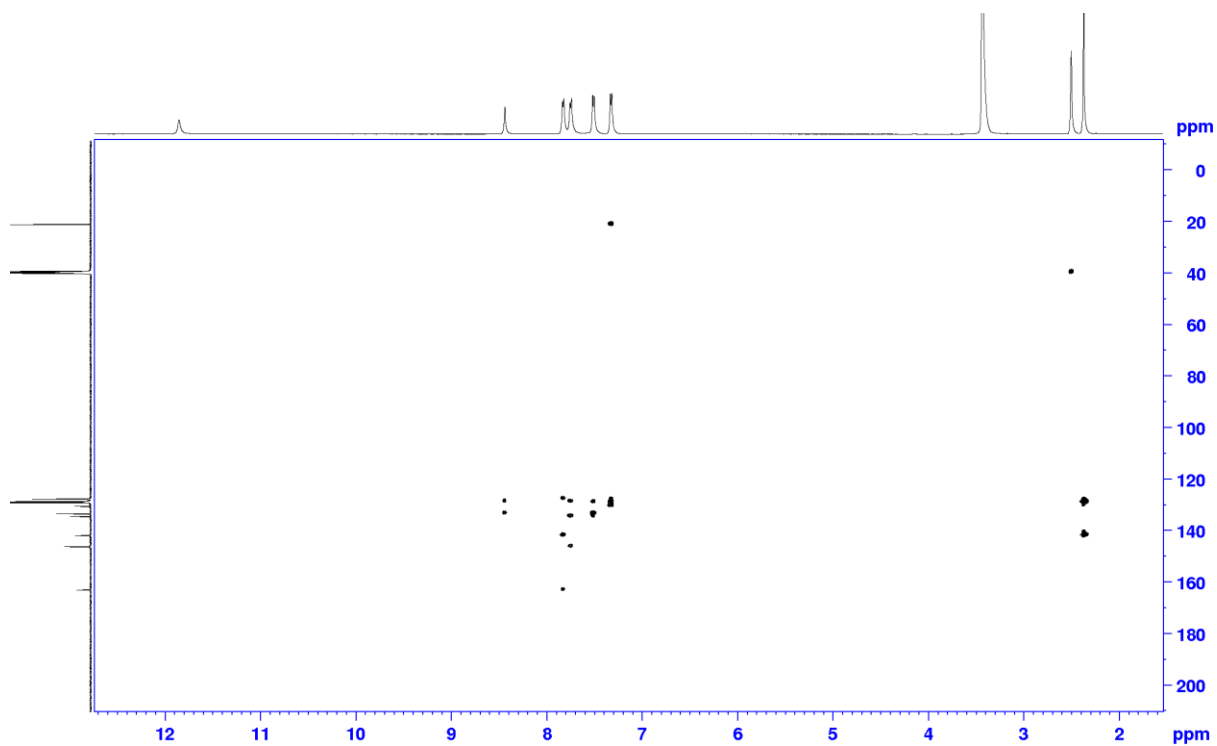


Figure S72: HMBC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

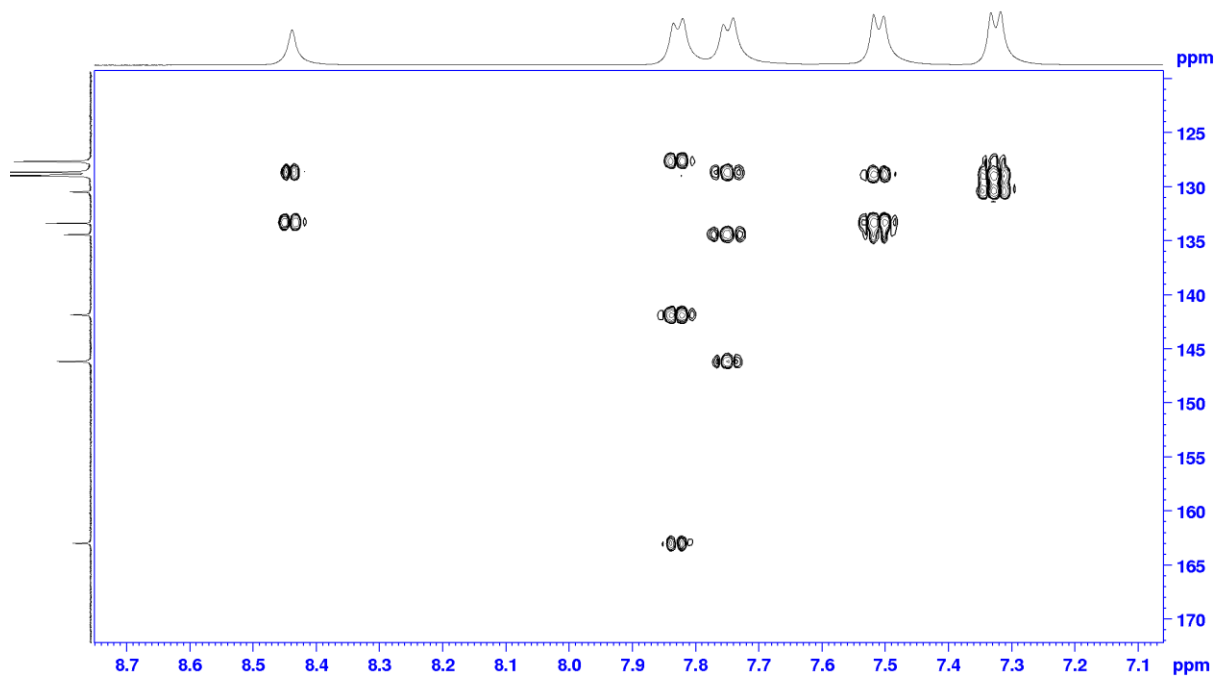


Figure S73: Expansion of the HMBC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

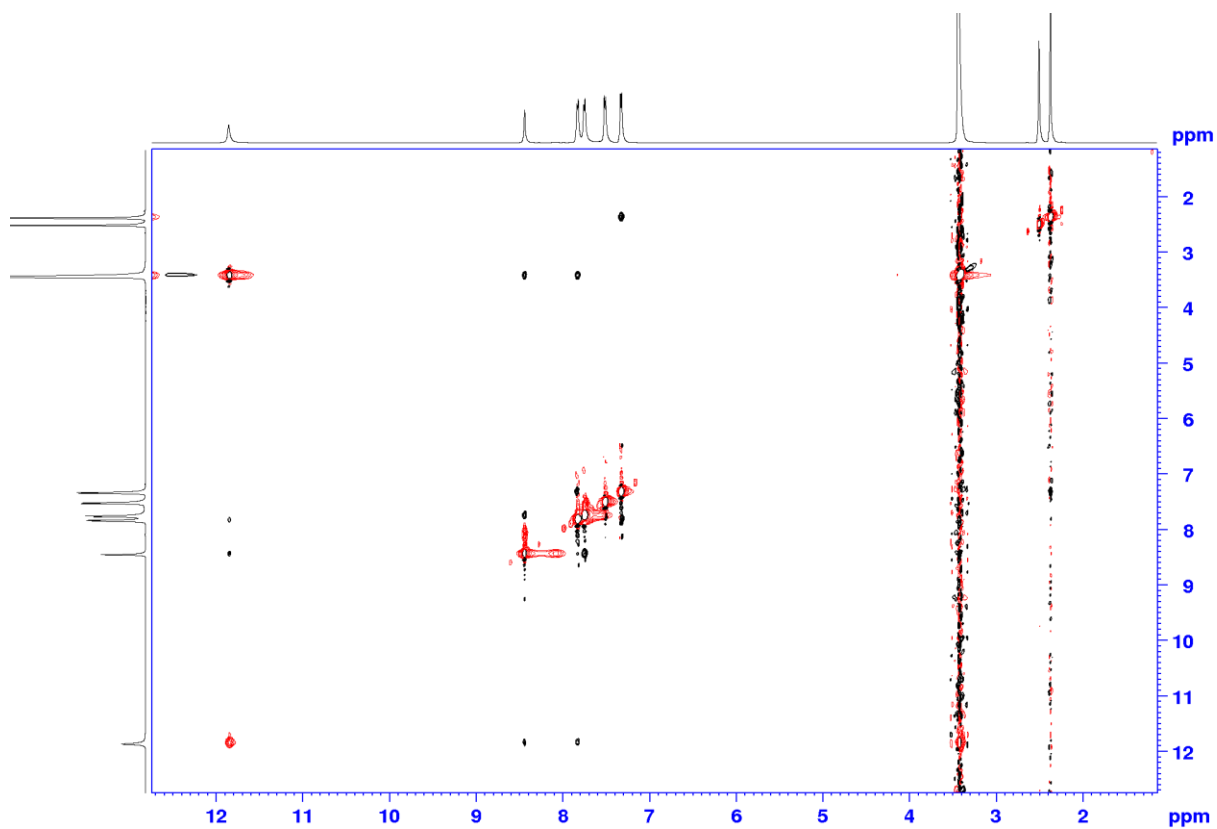


Figure S74: NOESY spectrum of (Z)-N-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

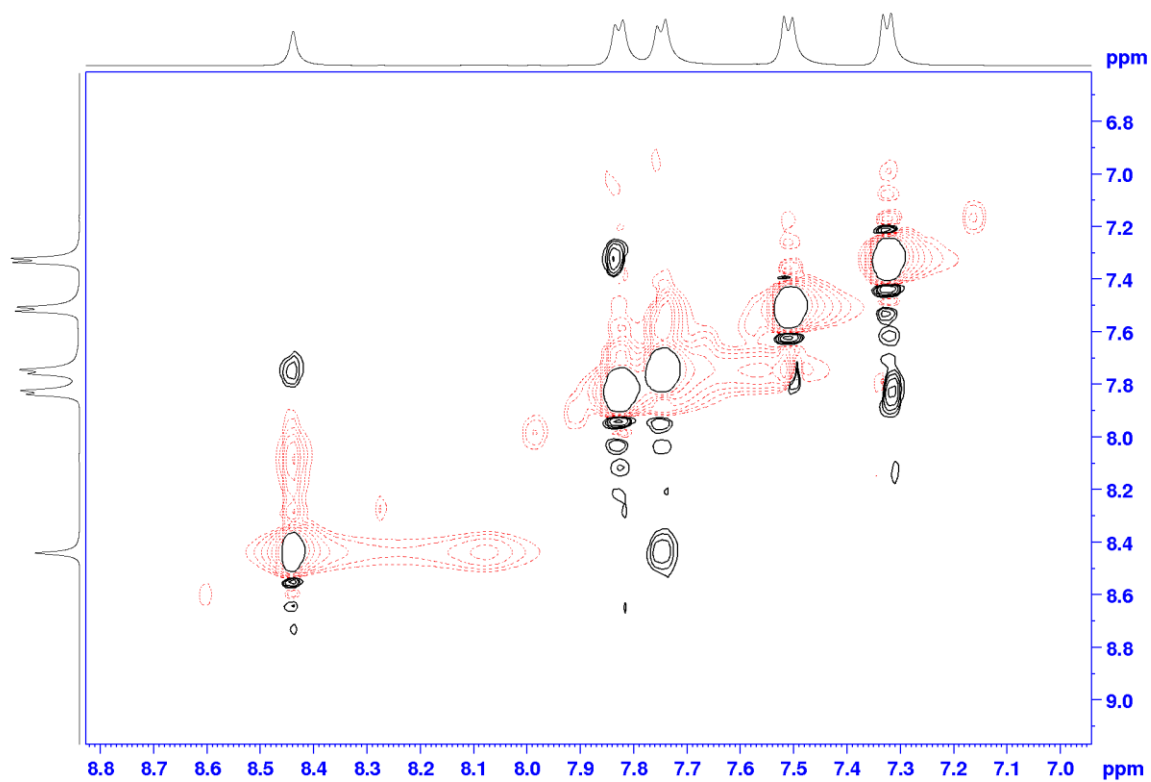


Figure S75: Expansion of the NOESY spectrum of (Z)-N-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

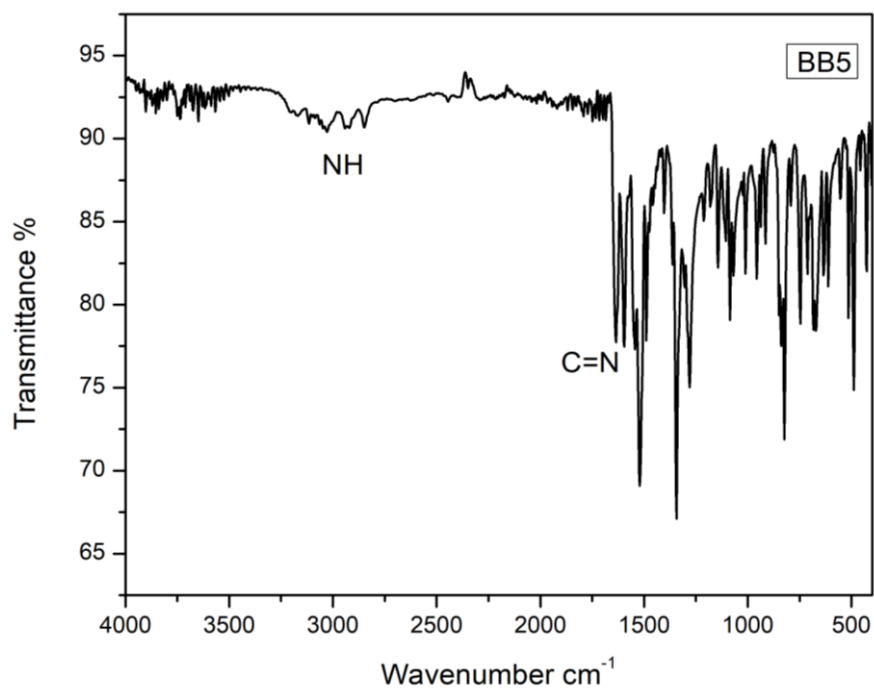


Figure S76: Infrared spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

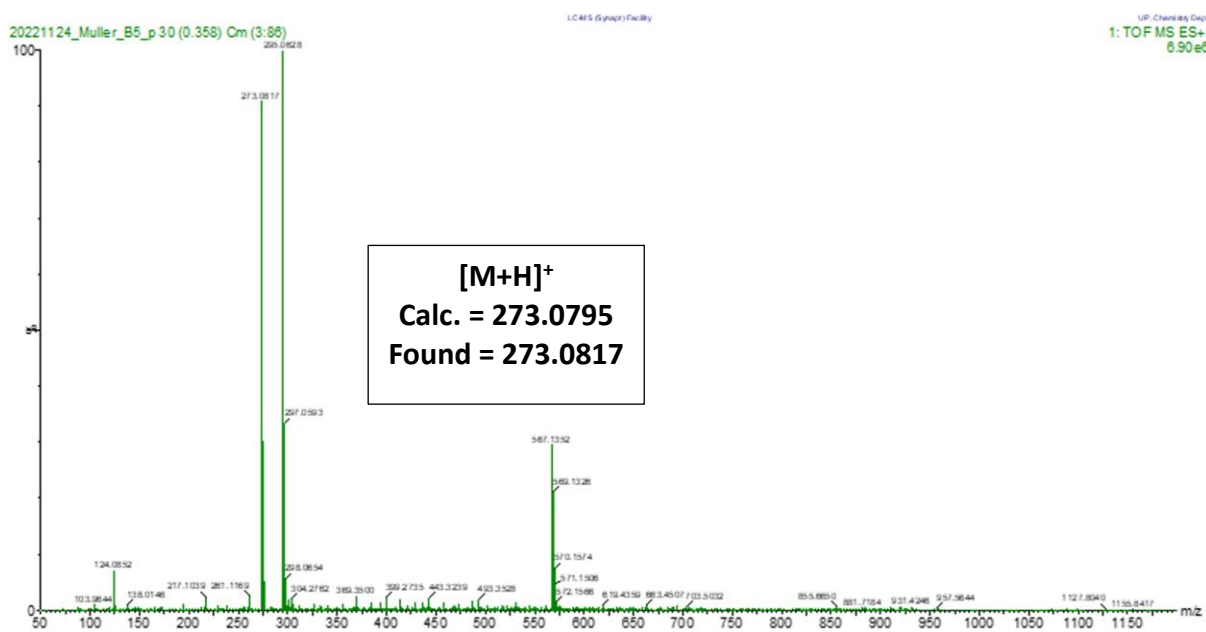


Figure S77: Mass spectrum of (*Z*)-*N*-(4-chlorobenzylidene)-4-methylbenzohydrazide **BB5**

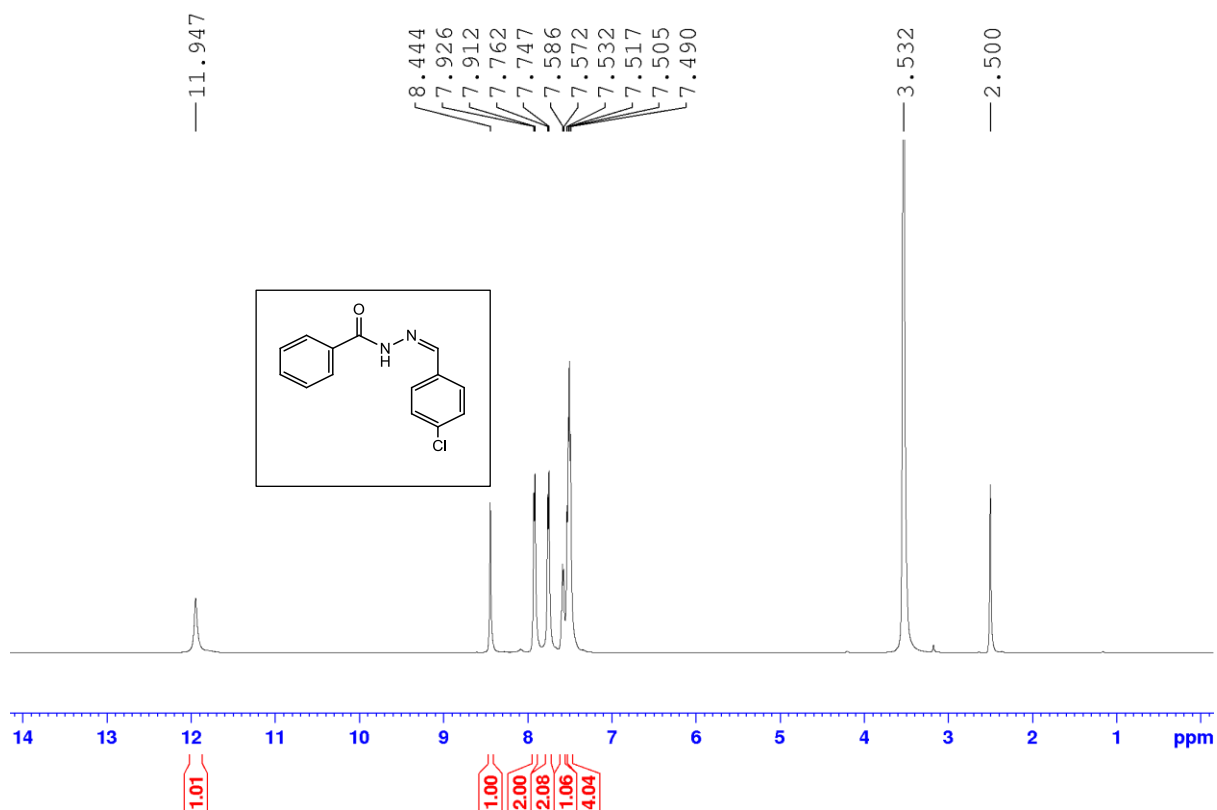


Figure S78: ¹H NMR spectrum of *(Z)*-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

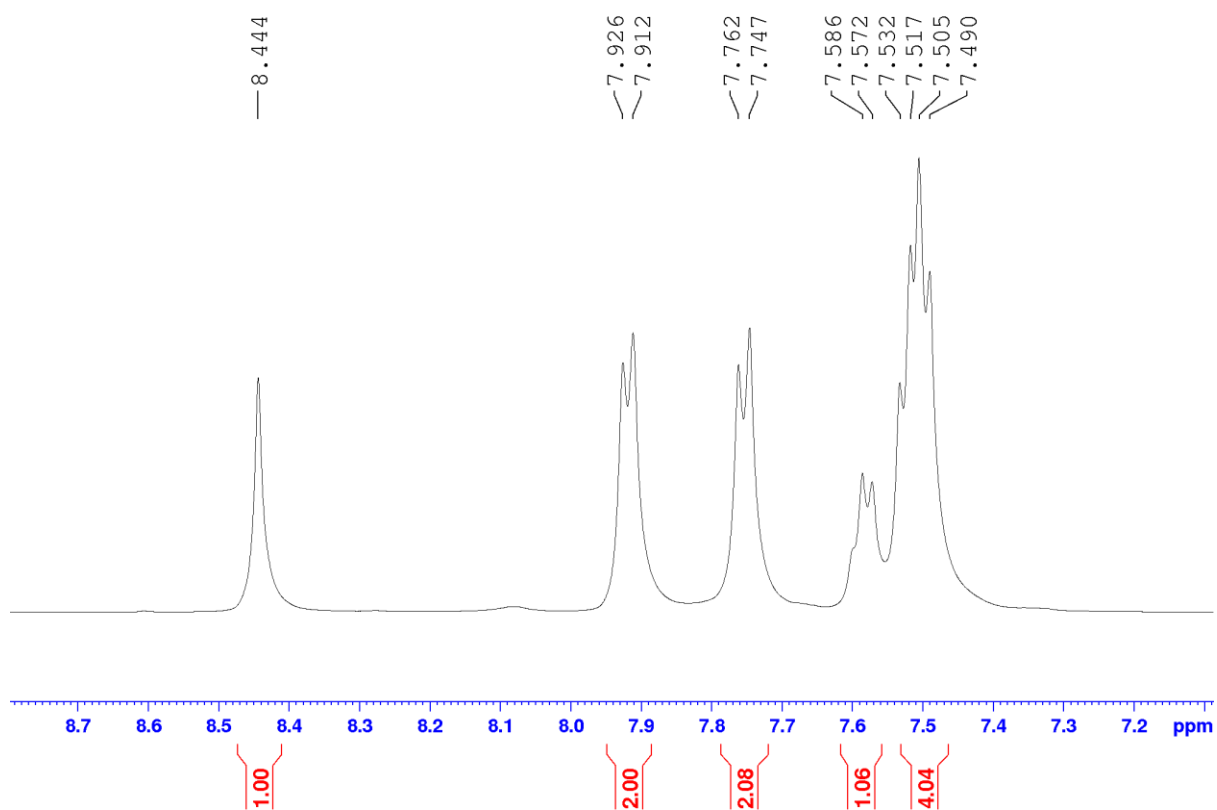


Figure S79: Expansion of the ¹H NMR spectrum of *(Z)*-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

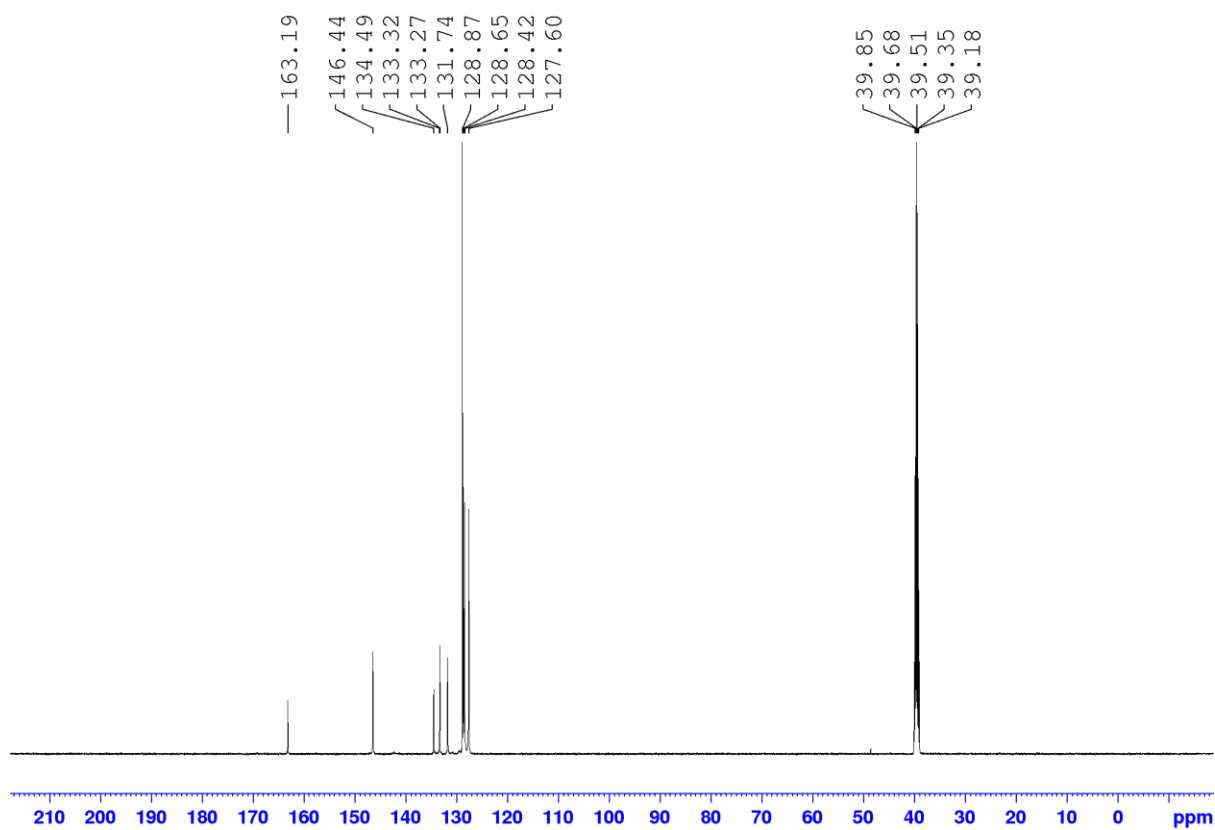


Figure S80: ^{13}C NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

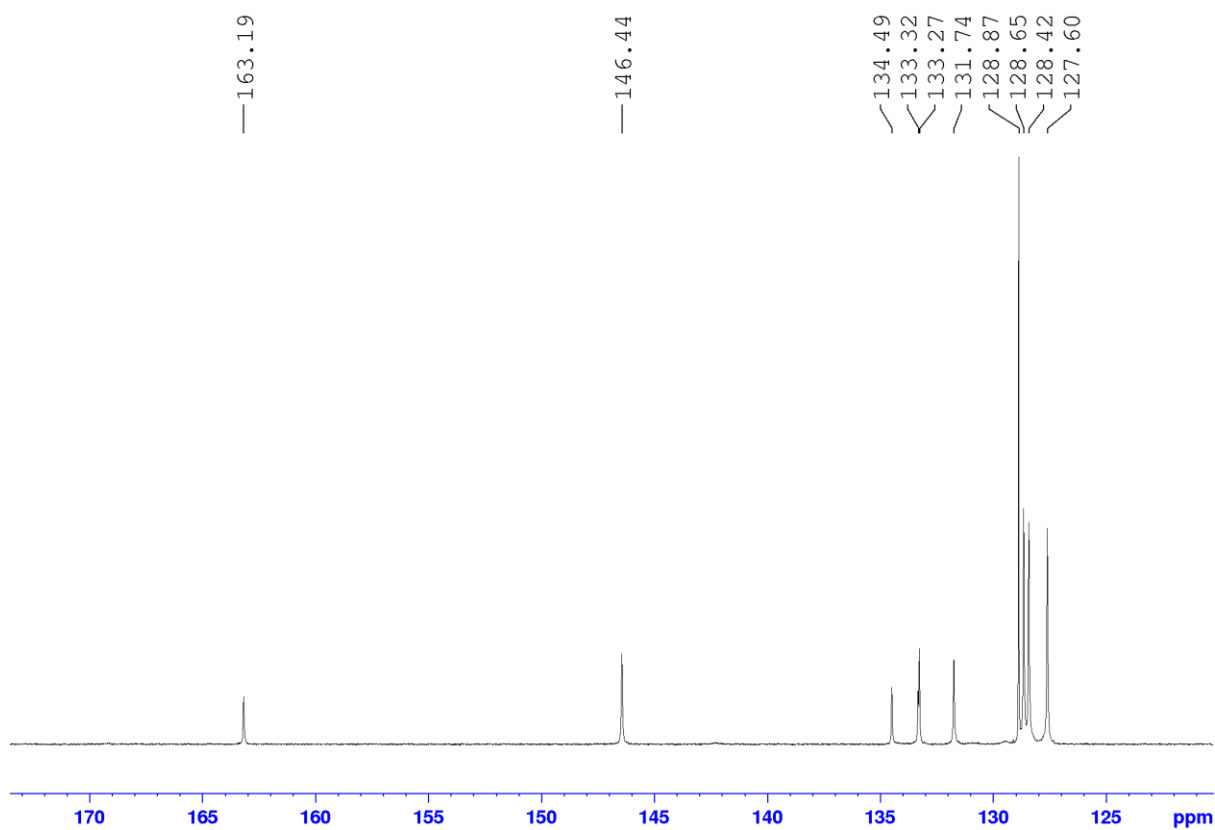


Figure S81: Expansion of the ^{13}C NMR spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

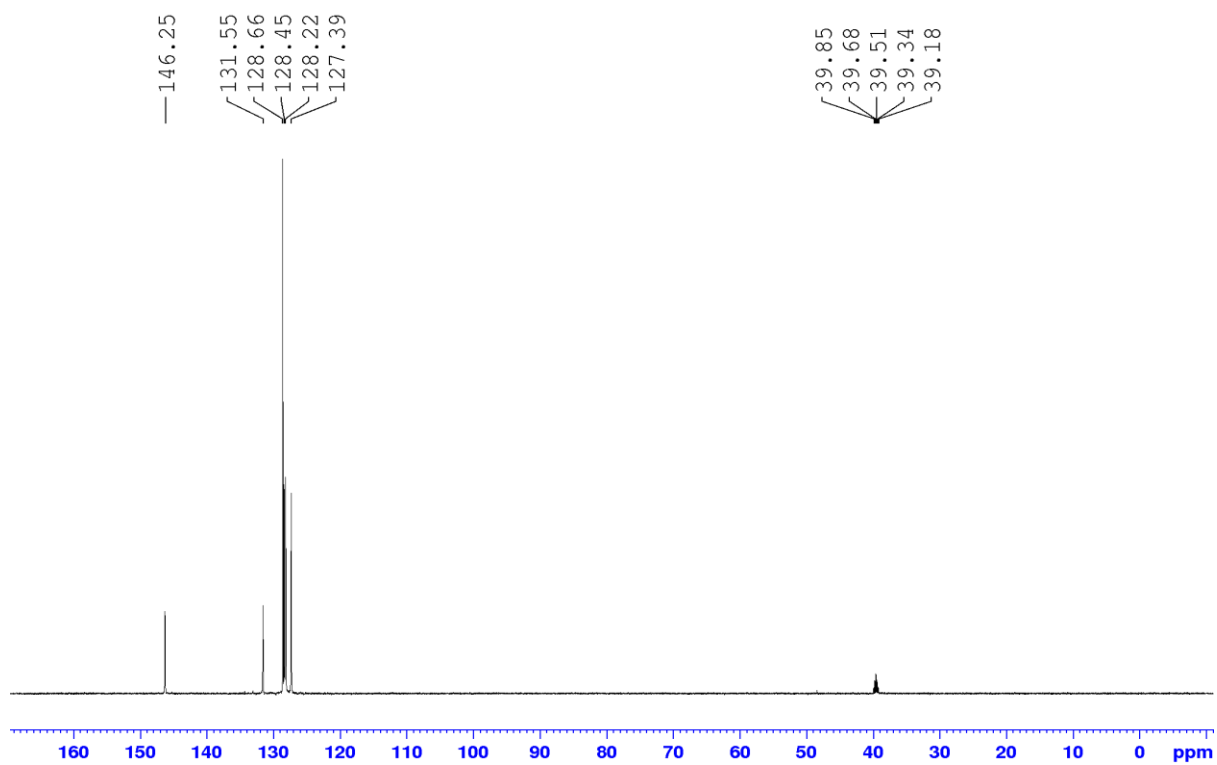


Figure S82: DEPT 135 spectrum of (Z)-N-(4-chlorobenzylidene)benzohydrazide **BB6**

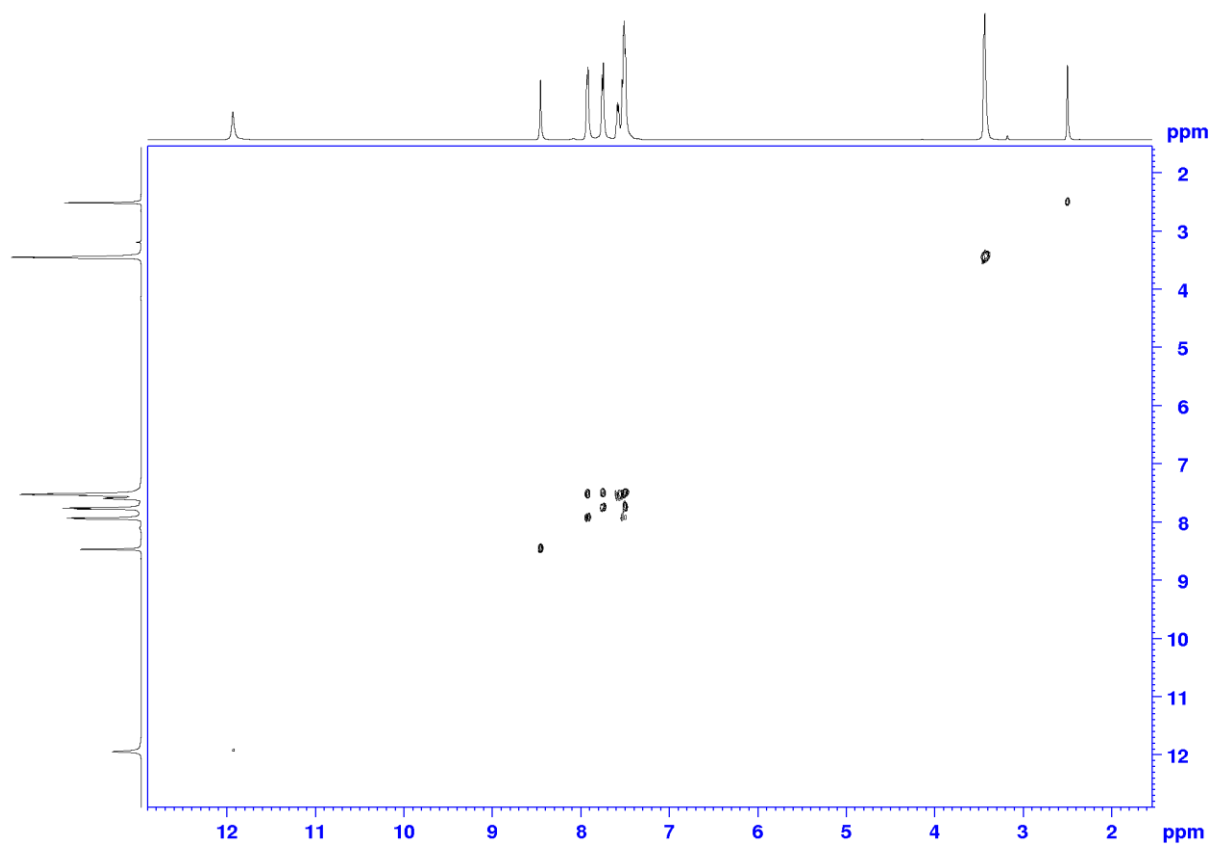


Figure S83: COSY spectrum of (Z)-N-(4-chlorobenzylidene)benzohydrazide **BB6**

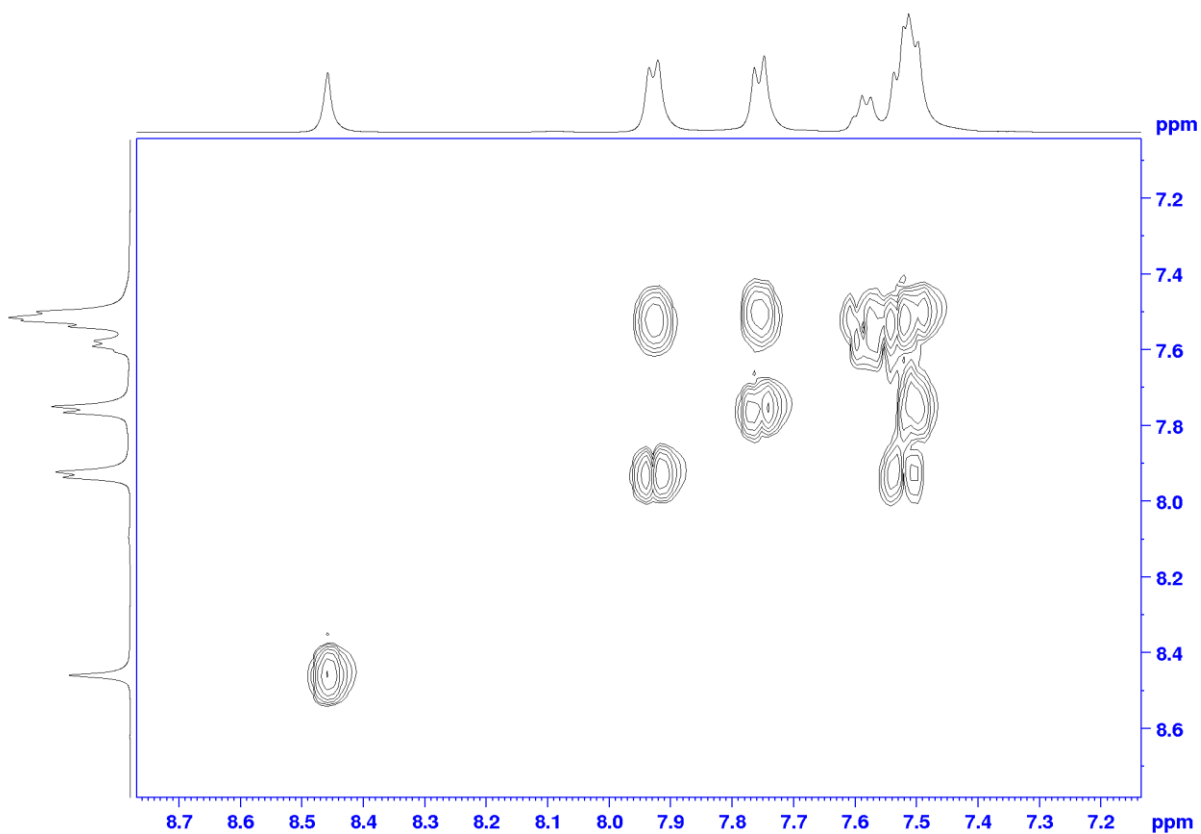


Figure S84: Expansion of the COSY spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

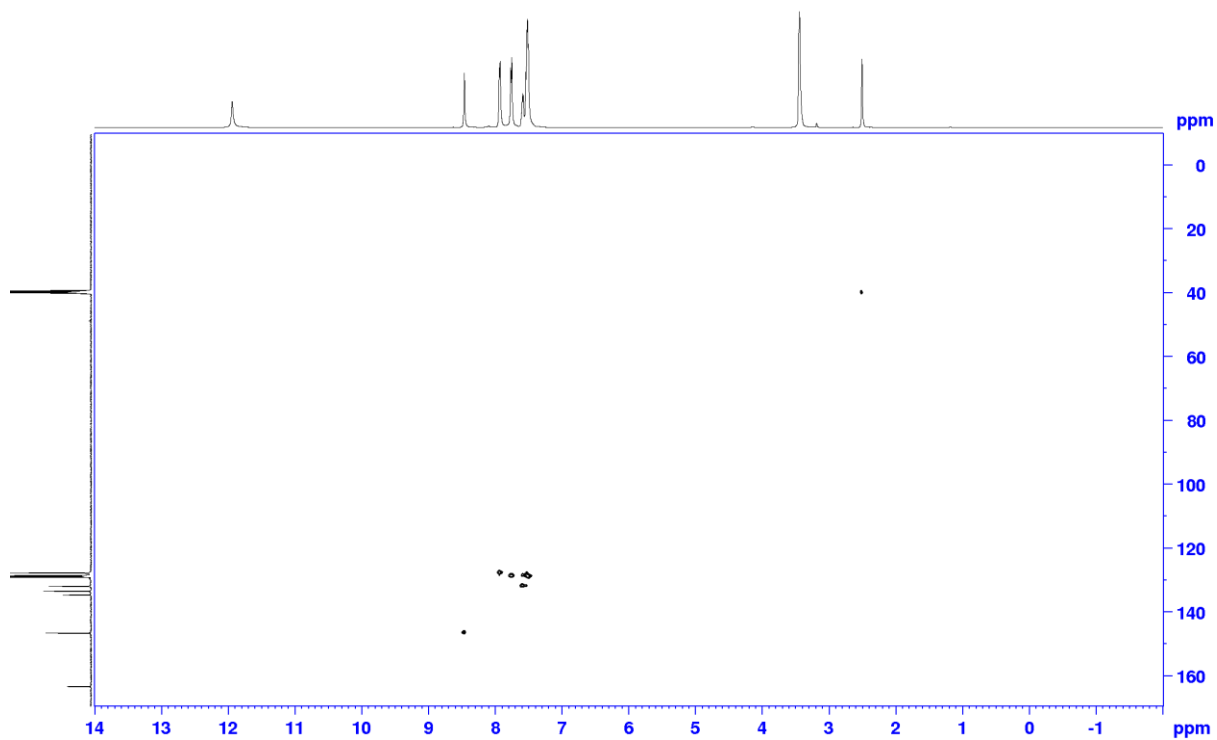


Figure S85: HSQC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

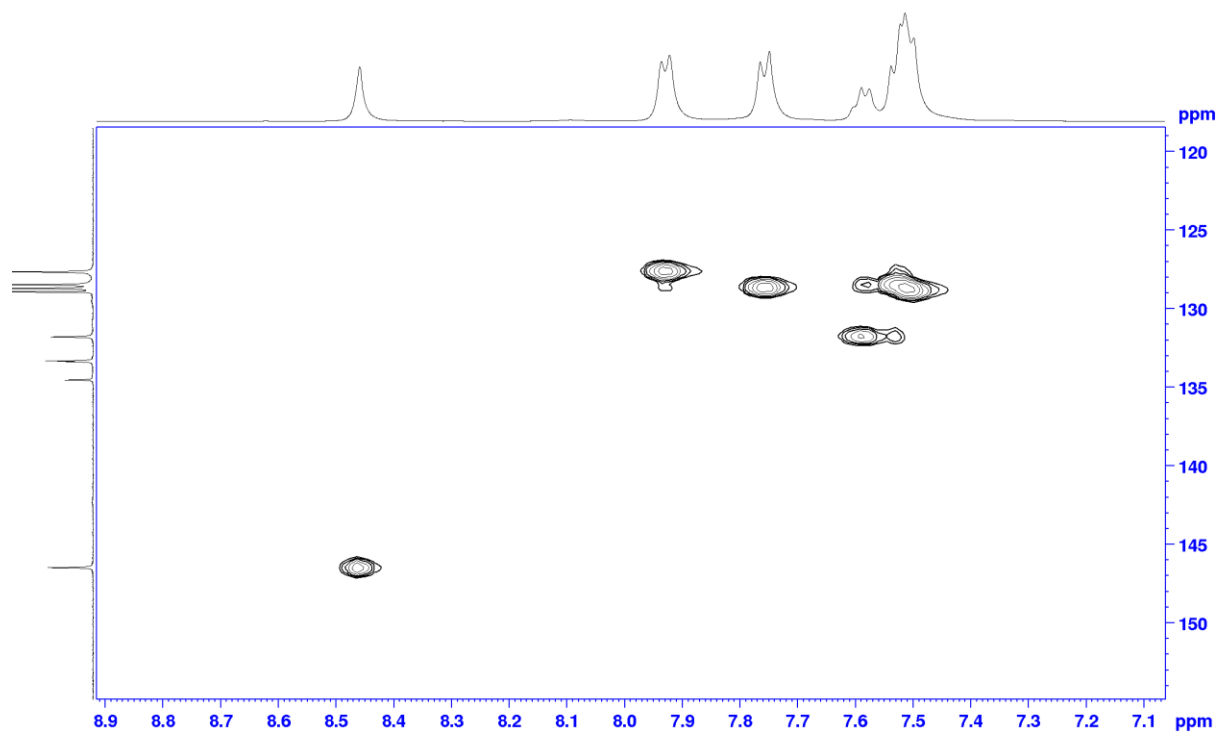


Figure S86: Expansion of the HSQC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

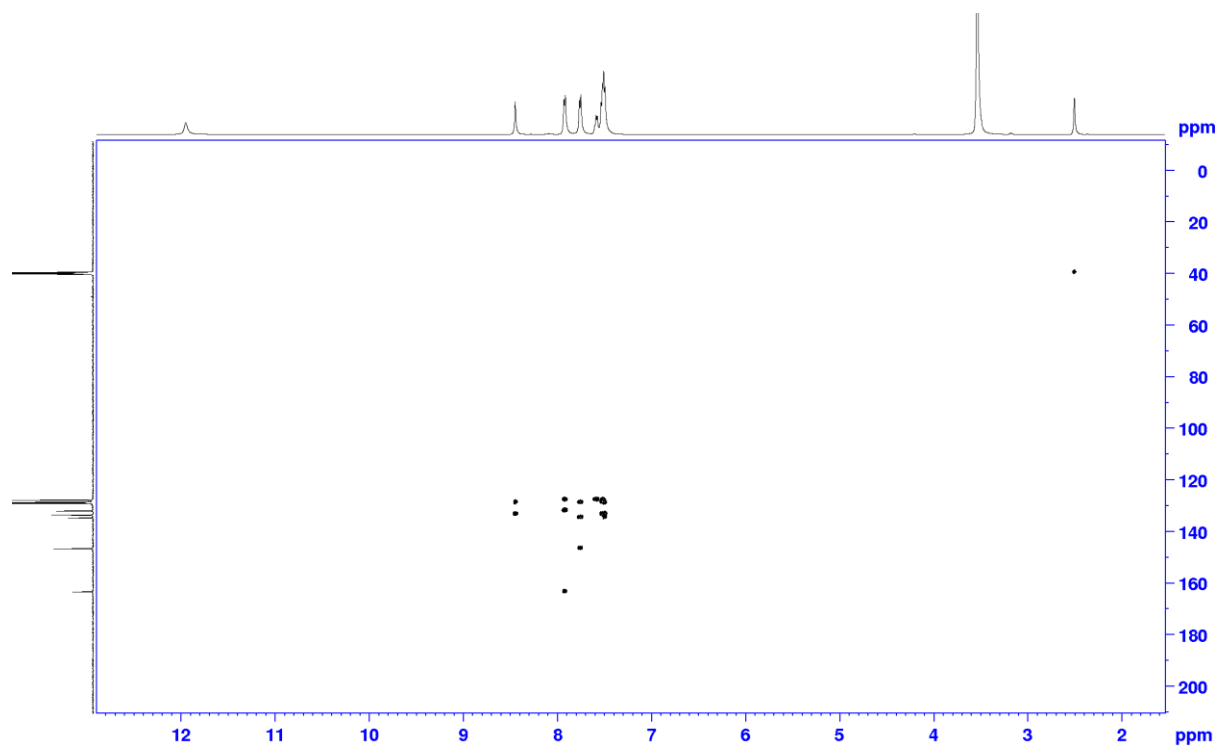


Figure S87: HMBC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

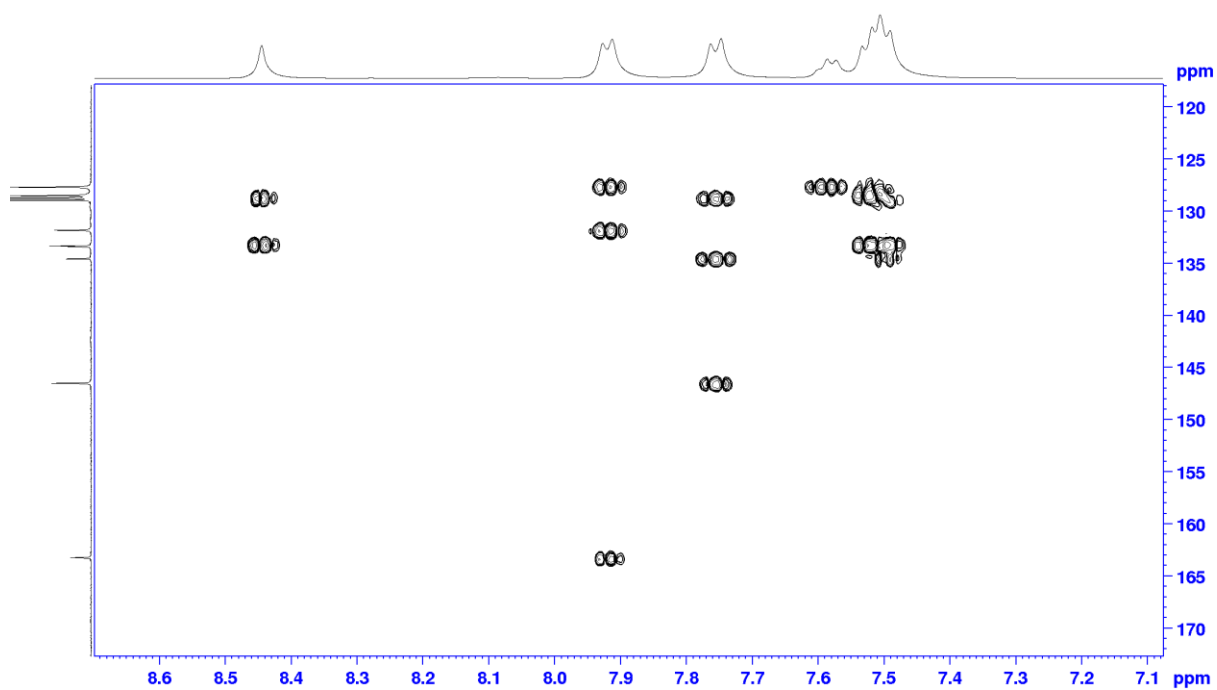


Figure S88: Expansion of the HMBC spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

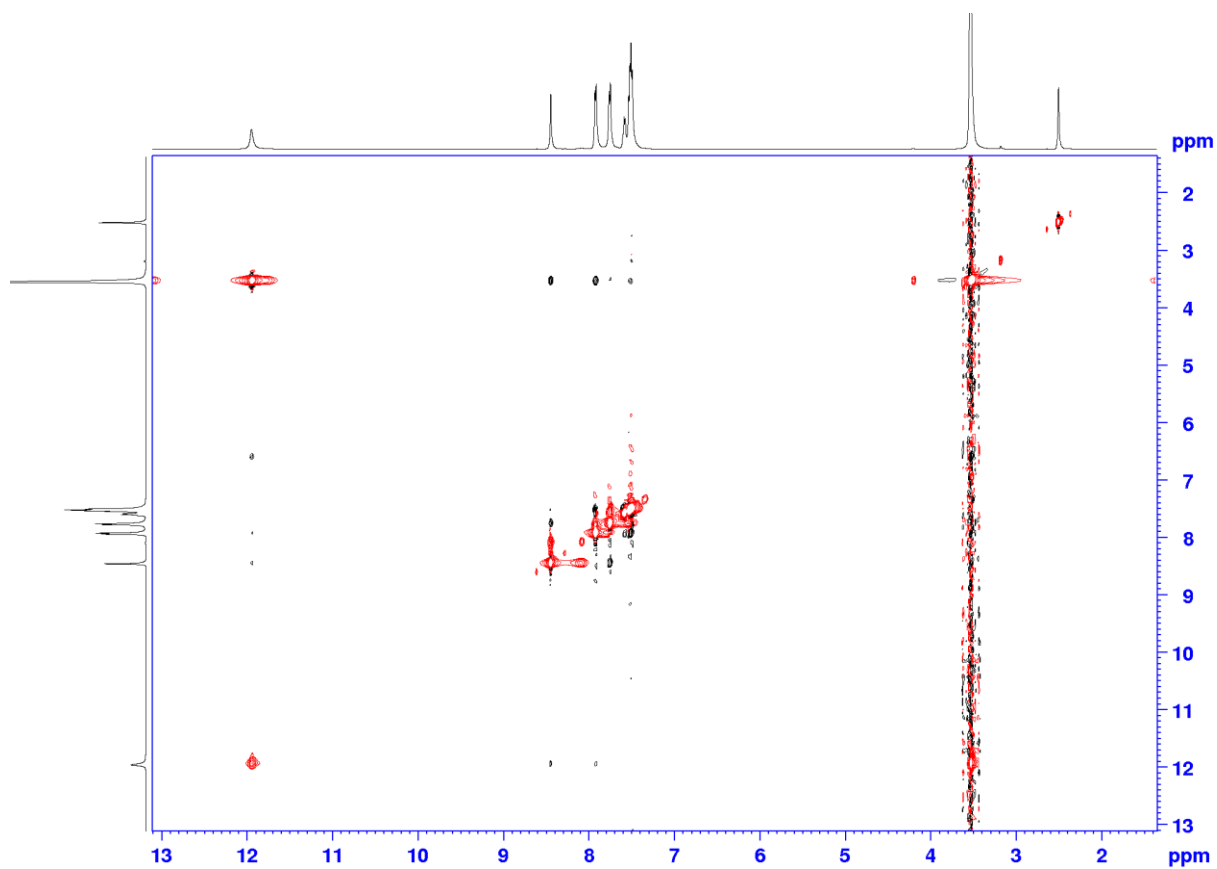


Figure S89: NOESY spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

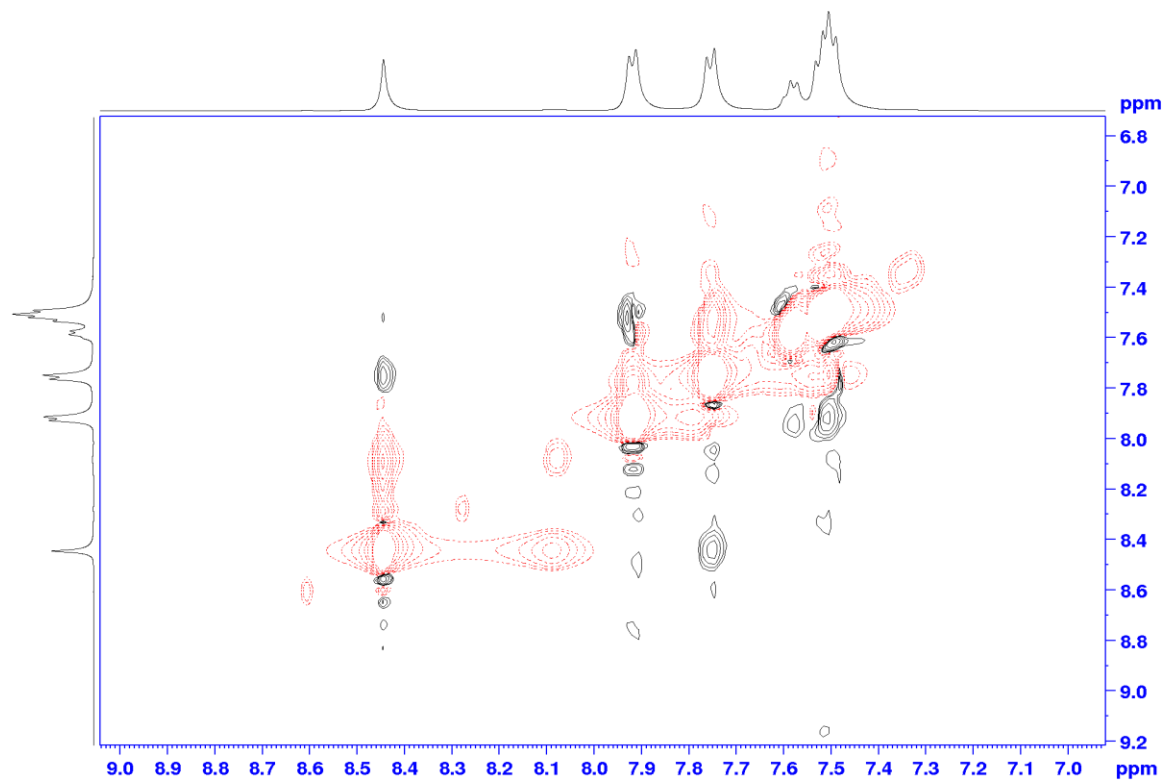


Figure S90: Expansion of the NOESY spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

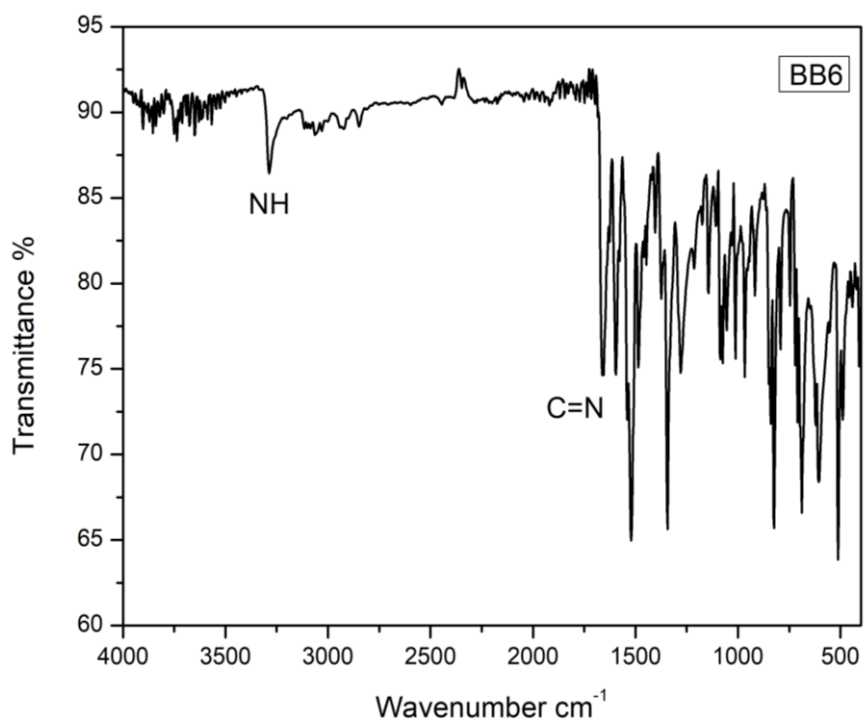


Figure S91: Infrared (IR) spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

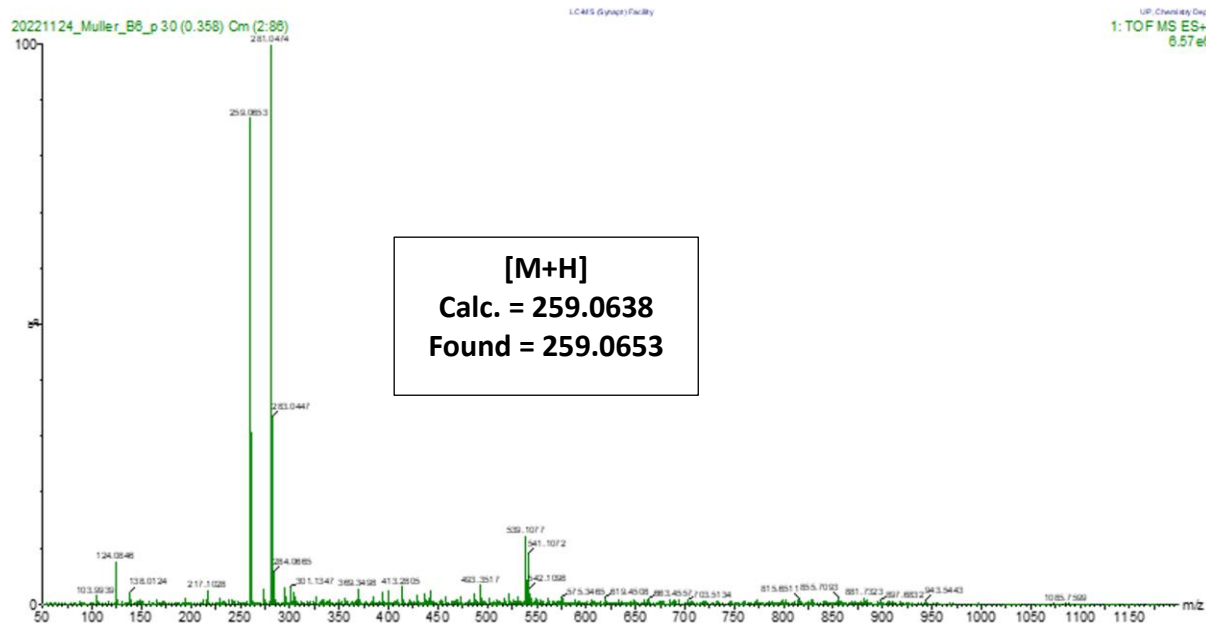


Figure S92: Mass spectrum of (*Z*)-*N*-(4-chlorobenzylidene)benzohydrazide **BB6**

Table S1: Selected Crystallographic Parameters

Identification code	BB2	BB4	BB6
Empirical formula	C ₁₄ H ₁₀ N ₃ O ₃	C ₁₇ H ₁₉ N ₃ O ₄ S	C ₁₄ H ₁₀ ClN ₂ O
Formula weight	268.254	361.41	257.701
Temperature/K	273.15	273.15	273.15
Crystal system	monoclinic	monoclinic	triclinic
Space group	<i>P2</i> ₁ / <i>n</i>	<i>P2</i> ₁ / <i>c</i>	<i>P</i> -1
<i>a</i> /Å	7.0964(3)	18.9884(9)	5.3817(3)
<i>b</i> /Å	25.4408(10)	10.0636(4)	7.8417(4)
<i>c</i> /Å	7.7227(3)	9.5765(4)	14.9872(7)
α /°	90	90	100.623(2)
β /°	112.334(1)	103.022(2)	92.791(2)
γ /°	90	90	90.678(2)
Volume/Å ³	1289.65(9)	1782.93(13)	620.77(6)
<i>Z</i>	4	4	2
ρ_{calc} /cm ³	1.382	1.346	1.379
μ /mm ⁻¹	0.100	0.208	0.295
<i>F</i> (000)	556.4	760.0	266.4
Crystal size/mm ³	0.122 × 0.032 × 0.011	0.23 × 0.07 × 0.05	0.43 × 0.05 × 0.03
Radiation	Mo K α (λ = 0.71073)	MoK α (λ = 0.71073)	Mo K α (λ = 0.71073)
2 Θ range for collection/°	5.92 to 56.82	4.404 to 56.606	5.28 to 56.7
Index ranges	-9 ≤ <i>h</i> ≤ 9, -33 ≤ <i>k</i> ≤ 33, 10 ≤ <i>l</i> ≤ 10	-25 ≤ <i>h</i> ≤ 25, -13 ≤ <i>k</i> ≤ 7, 13, -12 ≤ <i>l</i> ≤ 12	-7 ≤ <i>h</i> ≤ 7, -10 ≤ <i>k</i> ≤ 10, 19 ≤ <i>l</i> ≤ 20

Reflections collected	37056	64008	17106
Independent reflections	3164 [R _{int} = 0.0517, R _{sigma} = 0.0241]	4414 [R _{int} = 0.0820, R _{sigma} = 0.0323]	3036 [R _{int} = 0.0647, R _{sigma} = 0.0460]
Data/restraints/parameters	3164/0/181	4414/0/229	3036/0/163
Goodness-of-fit on F ²	1.046	1.052	1.071
Final R indexes [I ≥ 2σ(I)]	R ₁ = 0.0512, wR ₂ = 0.1428	R ₁ = 0.0462, wR ₂ = 0.1167	R ₁ = 0.0458, wR ₂ = 0.1170
Final R indexes [all data]	R ₁ = 0.0603, wR ₂ = 0.1539	R ₁ = 0.0782, wR ₂ = 0.1379	R ₁ = 0.0564, wR ₂ = 0.1258
Largest diff. peak/hole / e Å ⁻³	0.53/-0.25	0.38/-0.24	0.74/-0.29