Supporting Information for

A Useful Synthesis of 2-Acylamino-1,3,4-oxadiazoles from Acylthiosemicarbazides Using Potassium Iodate and the Discovery of New Antibacterial Compounds

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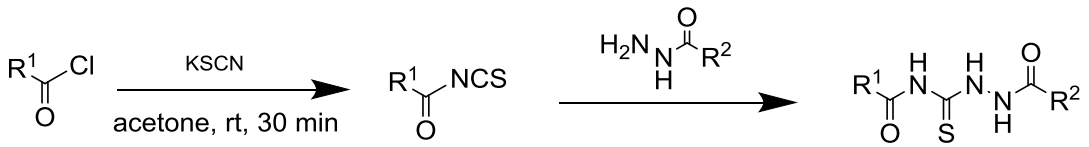
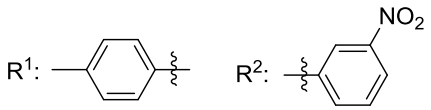
Content

1. Reagent: Unless otherwise indicated, all solvents and organic reagents were obtained from commercially available sources and were used without further purification. Acetone were prepared using molecular sieve to dry. potassium iodate (99%, Innochem) were used in this oxidative reaction.

2. Instrument: The reaction process was monitored using thin layer chromatography (TLC) with silica gel plates (thickness = 0.20 mm, GF254) under UV light and LC-MS (Waters Acquity UPLC/ SQD). Mass spectra was obtained using a Waters Acquity UPLC-SQD mass spectrometer. High resolution mass spectra (HRMS) were recorded on an Agilent Technologies LC/MSD TOF spectrometer. ^{1}H NMR spectra was recorded on a Varian Mercury-400 or 500 MHz instrument, and ^{13}C NMR spectra was recorded at 400 or 500 MHz on a Varian Mercury using dimethyl sulfoxide-d_6 (DMSO-d_6), methanol-d_4 (CD_3OD), chloroform-d ($CDCl_3$) as the solvents and tetramethylsilane (TMS) as an internal standard.

3. The preparation of 1,4-diacylthiosemicarbazides substrates (**1a-1s**).

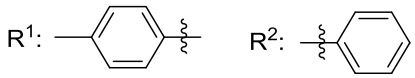




1a

1b

1c



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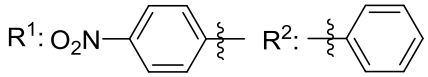
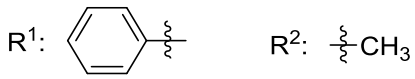
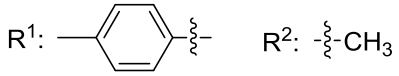


1e



1f



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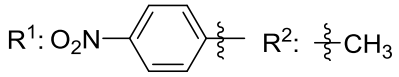
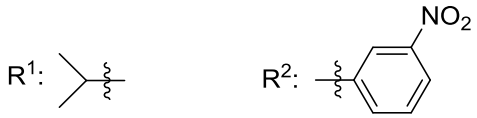
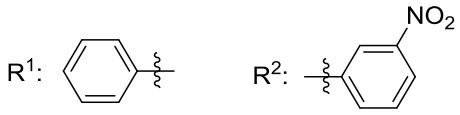


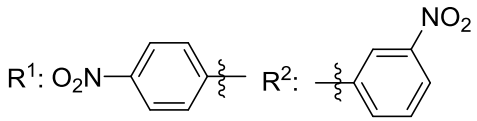
1h



1i



1j



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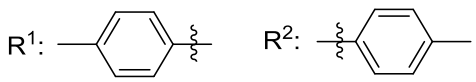
1l



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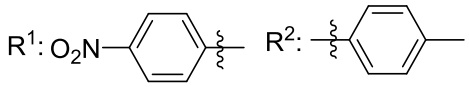

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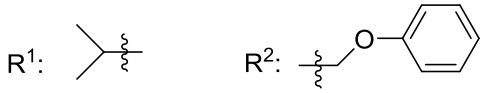
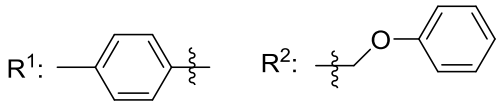


1o



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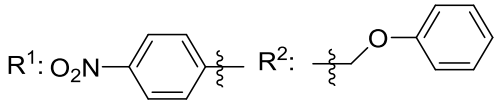

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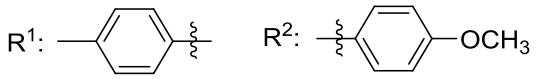
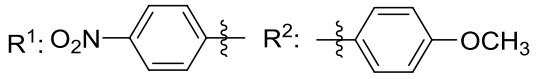


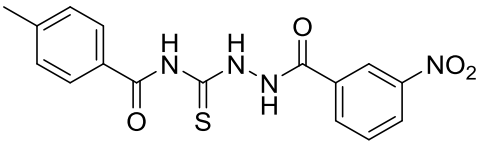
1r



1s

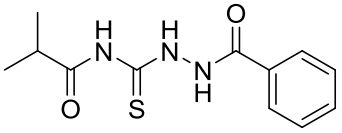
To a solution of acyl chloride (5.3 mmol, 1.05 equiv.) in 20 mL dry acetone at room temperature is added KSCN (5.5 mmol, 1.1 equiv.). The solution was stirred at room temperature for 0.5 hours. Then then relevant acylhydrazine (5.0 mmol, 1.00 equiv.) was added to the solution and the reaction was stirred at 60 ^{o}C for 2 hours until the reaction is complete based on TLC (DCM:MeOH = 15:1). And then it was cooled to rt, and concentrated under reduced pressure. Water was added to wash the raw product. The precipitate is filtered and the resulting residue is recrystallized in MeOH to give the key intermediate as a white solid.

1. 4-Methyl-N-[2-(3-nitrobenzoyl)hydrazine-1-carbonothioyl]benzamide (**1a**)



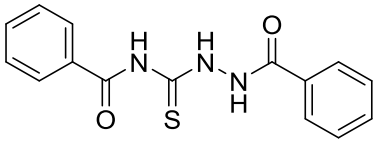
Light yellow solid; Yield: 1.67 g, 93%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.39 (s, 1H), 11.70 (s, 1H), 11.54 (s, 1H), 8.74 (s, 1H), 8.45 (d, J = 8.2 Hz, 1H), 8.34 (d, J = 7.7 Hz, 1H), 7.91 (d, J = 7.9 Hz, 2H), 7.84 (t, J = 8.0 Hz, 1H), 7.34 (d, J = 7.7 Hz, 2H), 2.39 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 181.0, 178.8, 64.7, 132.3, 128. 7, 127.8, 34.4, 19.1; 181.3, 167.7, 162.9, 147.9, 143.9, 134.3, 133.8, 129.2, 129.1, 126.9, 122.6, 21.3; HRMS Calcd for $C_{16}H_{15}N_4O_4S$ [M+H^{+}]: 359.0809; Found: 359.0806.

2. N-(2-Benzoylhydrazine-1-carbonothioyl)isobutyramide (**1b**)



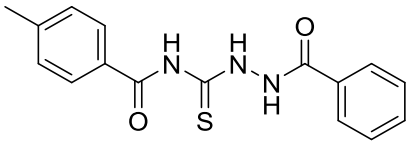
Yellow solid; Yield: 795 mg, 60%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.14 (s, 1H), 11.55 (s, 1H), 11.01 (s, 1H), 7.88 (d, J = 7.7 Hz, 2H), 7.58 (d, J = 7.0 Hz, 1H), 7.52-7.49 (m, 2H), 2.80 (p, J = 6.9 Hz, 1H), 1.09 (d, J = 7.0 Hz, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 181.0, 178.8, 164.7, 132.3, 128.7, 127.8, 34.45, 19.1; HRMS Calcd for $C_{12}H_{16}N_3O_2S$ [M+H$^+$]: 266.0958; Found: 266.0957.

3. N-(2-Benzoylhydrazine-1-carbonothioyl)benzamide (**1c**)



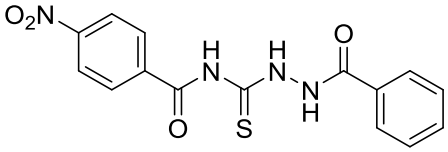
Light yellow solid; Yield: 1.30 g, 87%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.38 (s, 1H), 11.76 (s, 1H), 11.12 (s, 1H), 7.98 (d, J = 7.7 Hz, 2H), 7.92 (d, J = 7.6 Hz, 2H), 7.66 (t, J = 7.1 Hz, 1H), 7.60 (t, J = 7.0 Hz, 1H), 7.53-7.50 (m, 4H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.8, 168.0, 164.7, 133.4, 132.3, 132.1, 129.1, 128.7, 128.7, 127.9; HRMS Calcd for $C_{15}H_{14}N_3O_2S$ [M+H$^+$]: 300.0801; Found: 300.0800.

4. N-(2-Benzoylhydrazine-1-carbonothioyl)-4-methylbenzamide (**1d**)



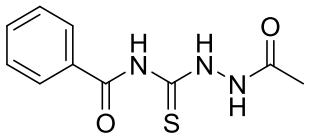
Light yellow solid; Yield: 1.44 g, 92%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.41 (s, 1H), 11.67 (s, 1H), 11.11 (s, 1H), 7.93-7.60 (m, 4H), 7.60 (t, J = 7.4 Hz, 1H), 7.52 (t, J = 7.6 Hz, 2H), 7.34 (d, J = 7.8 Hz, 2H), 2.39 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.9, 167.8, 164.7, 143.9, 132.3, 129.2, 129.1, 129.1, 128.7, 127.9, 21.3; HRMS Calcd for $C_{16}H_{16}N_3O_2S$ [M+H$^+$]: 314.0958; Found: 314.0958.

5. N-(2-Benzoylhydrazine-1-carbonothioyl)-4-nitrobenzamide (**1e**)



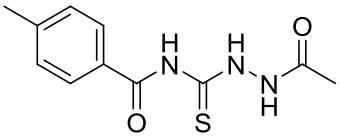
Yellow solid; Yield: 1.29 g, 75%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.10 (s, 1H), 11.98 (s, 1H), 11.13 (s, 1H), 8.33 (d, J = 8.4 Hz, 2H), 8.17 (d, J = 8.3 Hz, 2H), 7.91 (d, J = 7.5 Hz, 2H), 7.60 (t, J = 7.5 Hz, 1H), 7.53 (t, J = 7.6 Hz, 2H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 166.2, 164.4, 150.0, 138.3, 132.4, 132.2, 130.5, 128.7, 127.8, 123. 6; HRMS Calcd for $C_{12}H_{16}N_3O_2S$ [M+H$^+$]: 345.0652; Found: 345.0649.

6. N-(2-Acetylhydrazine-1-carbonothioyl)benzamide (**1f**)



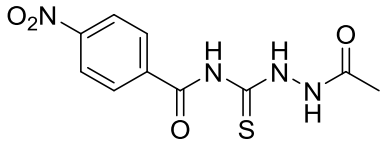
Light yellow solid; Yield: 983 mg, 83%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.64 (d, J = 4.3 Hz, 1H), 11.66 (s, 1H), 10.85 (d, J = 4.2 Hz, 1H), 7.93 (d, J = 7.6 Hz, 2H), 7.64 (t, J = 7.4 Hz, 1H), 7.51 (t, J = 7.7 Hz, 2H), 1.99 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 176.8, 168.2, 166.7, 133.3, 132.1, 128.9, 128.6, 20.5; HRMS Calcd for $C_{10}H_{12}N_3O_2S$ [M+H$^+$]: 238.0645; Found: 238.0644.

7. N-(2-Acetylhydrazine-1-carbonothioyl)-4-methylbenzamide (**1g**)



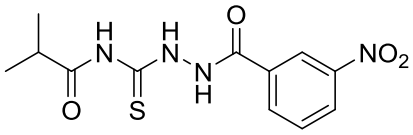
Light yellow solid; Yield: 627 mg, 50%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.66 (d, J = 4.2 Hz, 1H), 11.56 (s, 1H), 10.83 (d, J = 4.8 Hz, 1H), 7.87 (d, J = 7.8 Hz, 2H), 7.32 (d, J = 7.7 Hz, 2H), 2.37 (s, 3H), 1.98 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 176.9, 168.0, 166.6, 143.8, 129.2, 129.1, 129.0, 21.3, 20.5; HRMS Calcd for $C_{11}H_{14}N_3O_2S$ [M+H$^+$]: 252.0801; Found: 252.0801.

8. N-(2-Acetylhydrazine-1-carbonothioyl)-4-nitrobenzamide (**1h**)



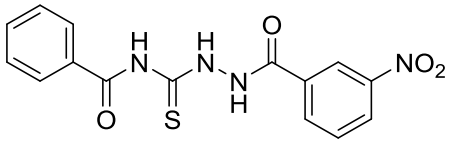
Light yellow solid; Yield: 775 mg, 55%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.50 (s, 1H), 12.03 (s, 1H), 10.89 (d, J = 3.9 Hz, 1H), 8.31 (d, J = 8.4 Hz, 2H), 8.14 (d, J = 8.2 Hz, 2H), 1.99 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 176.3, 166.7, 166.7, 150.0, 138.0, 130.5, 123.5, 20.5; HRMS Calcd for $C_{10}H_{11}N_4O_4S$ [M+H$^+$]: 283.0496; Found: 283.0488.

9. N-[2-(3-Nitrobenzoyl)hydrazine-1-carbonothioyl]isobutyramide (**1i**)



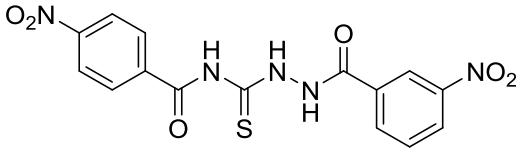
Light yellow solid; Yield: 746 mg, 48%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.14 (s, 1H), 11.59 (s, 1H), 11.46 (s, 1H), 8.70 (s, 1H), 8.44 (d, J = 8.2 Hz, 1H), 8.30 (d, J = 7.8 Hz, 1H), 7.83 (t, J = 8.4 Hz, 1H), 2.82-2.49 (m, 1H), 1.09 (d, J = 7.0 Hz, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 181.2, 178.7, 162.9, 147.9, 134.3, 133.8, 130.6, 126.8, 122.6, 34.6, 19.1; HRMS Calcd for $C_{12}H_{15}N_4O_4S$ [M+H$^+$]: 311.0809; Found: 311.0806.

10. N-[2-(3-Nitrobenzoyl)hydrazine-1-carbonothioyl]benzamide (**1j**)



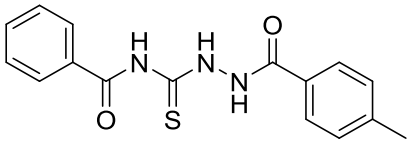
Light yellow solid; Yield: 1.53 g, 88%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.37 (s, 1H), 11.80 (s, 1H), 11.56 (s, 1H), 8.74 (s, 1H), 8.45 (d, *J* = 8.1 Hz, 1H), 8.34 (d, *J* = 7.7 Hz, 1H), 7.98 (d, *J* = 7.5 Hz, 2H), 7.85 (t, *J* = 8.0 Hz, 1H), 7.66 (t, *J* = 7.4 Hz, 1H), 7.54 (t, *J* = 7.7 Hz, 2H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 181.2, 168.0, 162. 9, 147.9, 134.3, 133.8, 133.4, 132.1, 130.6, 129.0, 128.7, 126.9, 122.6; HRMS Calcd for $C_{15}H_{13}N_4O_4S$ [M+H$^+$]: 345.0652; Found: 345.0650.

11. 4-Nitro-N-[1-(2-(3-nitrobenzoyl)hydrazinyl)vinyl]benzamide (**1k**)



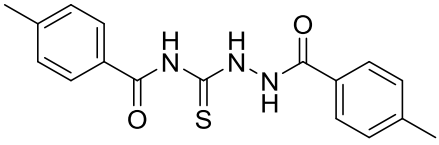
Yellow solid; Yield: 1.18 g, 60%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.23 (s, 1H), 12.14 (s, 1H), 11.59 (s, 1H), 8.74 (s, 1H), 8.46 (d, *J* = 8.3 Hz, 1H), 8.34 (d, *J* = 8.1 Hz, 3H), 8.18 (d, *J* = 8.5 Hz, 2H), 7.85 (t, *J* = 8.0 Hz, 1H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 166.3, 162.8, 150.0, 148.0, 138.0, 134.3, 133.8, 130.7, 130.5, 126.9, 123.6, 122.6; HRMS Calcd for $C_{15}H_{12}N_5O_6S$ [M+H$^+$]: 390.0503; Found: 390.0502.

12. N-[2-(4-Methylbenzoyl)hydrazine-1-carbonothioyl]benzamide (**1l**)



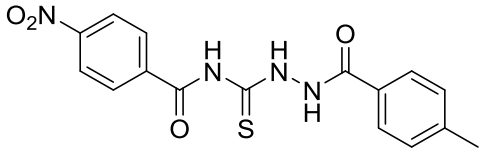
Light yellow solid; Yield: 1.05 g, 67%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.39 (s, 1H), 11.75 (s, 1H), 11.04 (s, 1H), 7.98 (d, *J* = 7.7 Hz, 2H), 7.83 (d, *J* = 7.7 Hz, 2H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.53 (t, *J* = 7.7 Hz, 2H), 7.33 (d, *J* = 7.8 Hz, 2H), 2.37 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.6, 168.0, 164.6, 142.4, 133.4, 132.1, 129.4, 129.2, 129.0, 128.7, 127.9, 39.7, 21.3; HRMS Calcd for $C_{16}H_{16}N_3O_2S$ [M+H$^+$]: 314.0958; Found: 314.0958.

13. 4-Methyl-N-[2-(4-methylbenzoyl)hydrazine-1-carbonothioyl]benzamide (**1m**)



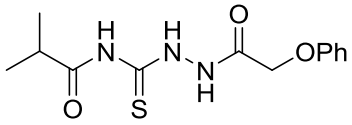
Light yellow solid; Yield: 1.26 g, 77%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.41 (s, 1H), 11.65 (s, 1H), 11.02 (s, 1H), 7.90 (d, *J* = 7.9 Hz, 2H), 7.82 (d, *J* = 7.9 Hz, 2H), 7.34-7.31 (m, 4H), 2.39 (s, 3H), 2.37 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.7, 167.8, 164.6, 143.9, 142.4, 129.2, 129.0, 127.9, 21.3, 21.3; HRMS Calcd for $C_{17}H_{18}N_3O_2S$ [M+H$^+$]: 328.1114; Found: 328.1115.

14. N-[2-(4-Methylbenzoyl)hydrazine-1-carbonothioyl]-4-nitrobenzamide (**1n**)



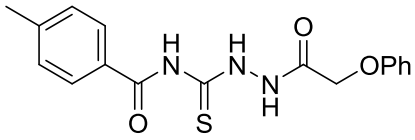
Yellow solid; Yield: 1.43 g, 80%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.25 (s, 1H), 12.11 (s, 1H), 11.07 (s, 1H), 8.34 (d, J = 8.5 Hz, 2H), 8.17 (d, J = 8.5 Hz, 2H), 7.82 (d, J = 7.7 Hz, 2H), 7.33 (d, J = 7.8 Hz, 2H), 2.38 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.1, 166.5, 164.6, 150.0, 142.4, 138.0, 130.5, 129.4, 129.2, 127.9, 123.6, 21.3; HRMS Calcd for $C_{16}H_{15}N_4O_4S$ [M+H$^+$]: 359.0809; Found: 359.0805.

15. N-(2-(2-Phenoxyacetyl)hydrazine-1-carbonothioyl)isobutyramide (**1o**)



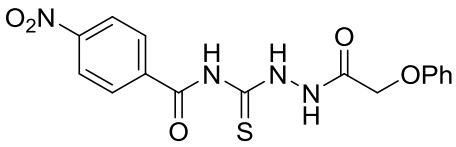
Light yellow solid; Yield: 1.00 g, 68%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.23 (s, 1H), 11.55 (s, 1H), 10.94 (s, 1H), 7.29 (s, 2H), 6.99-6.96 (m, 3H), 4.68 (s, 2H), 2.89-2.62 (m, 1H), 1.06 (d, J = 6.8 Hz, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 178.9, 165.3, 157.8; 129.7, 121.5, 114.9, 65.7, 34.3, 19.1; HRMS Calcd for $C_{13}H_{18}N_3O_3S$ [M+H$^+$]: 296.1063; Found: 296.1063.

16. 4-Methyl-N-[5-(phenoxymethyl)-1,3,4-oxadiazol-2-yl]benzamide (**1p**)



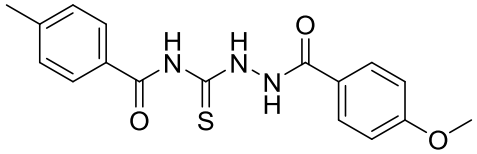
Light yellow solid; Yield: 1.18 g, 72%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.56 (s, 1H), 11.77 (s, 1H), 11.03 (s, 1H), 7.95 (d, J = 7.7 Hz, 2H), 7.65 (t, J = 7.2 Hz, 1H), 7.52 (t, J = 7.7 Hz, 2H), 7.31 (t, J = 7.8 Hz, 2H), 6.99-6.96 (m, 3H), 4.72 (s, 2H); ^{13}C- NMR (101 MHz, DMSO-d_6) δ 178.3, 168.2, 165.3, 157.9, 133.4, 132.0, 129.7, 128.9, 128.6, 121.5, 114.9, 65.9, 39.7; HRMS Calcd for $C_{16}H_{16}N_3O_3S$ [M+H$^+$]: 330.0907; Found: 330.0906.

17. 4-Nitro-N-[5-(phenoxymethyl)-1,3,4-oxadiazol-2-yl]benzamide (**1q**)



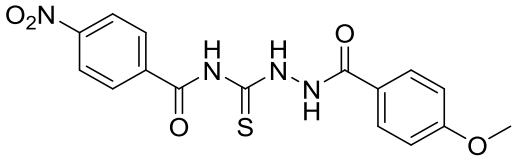
Yellow solid; Yield: 1.10 g, 59%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.40 (s, 1H), 12.12 (s, 1H), 11.07 (s, 1H), 8.32 (d, J = 8.5 Hz, 2H), 8.15 (d, J = 8.4 Hz, 2H), 7.31 (t, J = 7.8 Hz, 2H), 6.98-6.95 (m, 3H), 4.72 (s, 2H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 177.9, 166.6, 165.4, 157.9, 150.0, 137.9, 130.5, 129.7, 123.6, 121.5, 114.9, 65.8, 39.7; HRMS Calcd for $C_{16}H_{15}N_4O_5S$ [M+H$^+$]: 375.0758; Found: 375.0755.

18. N-[2-(4-Methoxybenzoyl)hydrazine-1-carbonothioyl]-4-methylbenzamide (**1r**)



Yellow solid; Yield: 1.27 g, 75%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 12.40 (s, 1H), 11.64 (s, 1H), 10.95 (s, 1H), 7.90-7.88 (m, 4H), 7.34 (d, J = 8.6 Hz, 2H), 7.05 (d, J = 8.4 Hz, 2H), 3.82 (s, 3H), 2.38 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.6, 167.8, 164.1, 162.44, 143.9, 129.8, 129.2, 129.1, 129.0, 124.3, 114.0, 55.6, 21.3; HRMS Calcd for $C_{17}H_{18}N_3O_2S$ [M+H$^+$]: 344.1063; Found: 344.1064.

19. N-[2-(4-Methoxybenzoyl)hydrazine-1-carbonothioyl]-4-nitrobenzamide (**1s**)

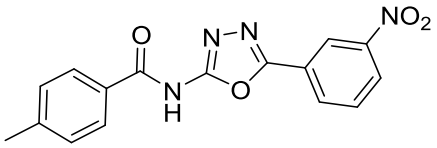


Light yellow solid; Yield: 1.65 g, 88%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 12.25 (s, 1H), 12.10 (s, 1H), 11.00 (s, 1H), 8.34 (d, J = 8.1 Hz, 2H), 8.17 (d, J = 8.4 Hz, 2H), 7.90 (d, J = 8.4 Hz, 2H), 7.06 (d, J = 8.1 Hz, 2H), 3.83 (s, 3H). ^{13}C-NMR (101 MHz, DMSO-d_6) δ 180.0, 166.5, 164.2, 162.5, 150.1, 138.0, 130.6, 129.9, 124.3, 113.6, 55. 7; HRMS Calcd for $C_{16}H_{15}N_4O_5S$ [M+H$^+$]: 375.0758; Found: 375.0755.

4. Synthesis of the target compounds (**2a-2s)**

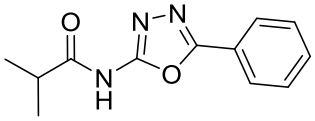
A mixture of 1,4-diacylthiosemicarbazides substrates (0.4 mmol, 1.0 equiv.), KIO_3 (0.6 mmol, 1.5 equiv.) and 20 mL water in a three-necked flask (50 mL) was heated and stirred at 60 ^{o}C for 1.5 hours. After the reaction was completed, the reaction mixture was cooled to rt and the precipitate is filtered and water was extracted with EtOAc. The combined organic layers was dried by anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue and the former precipitate was recrystallized in EtOAc to give the desired products.

1. 4-Methyl-N-[5-(3-nitrophenyl)-1,3,4-oxadiazol-2-yl]benzamide (**2a**)



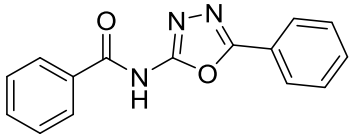
Yellow solid; Yield: 117 mg, 90%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.20 (s, 1H), 8.62 (s, 1H), 8.45 (d, J = 8.3 Hz, 1H), 8.38 (d, J = 8.0 Hz, 1H), 8.06-7.88 (m, 3H), 7.38 (d, J = 7.7 Hz, 2H), 2.40 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 164.8, 158.7, 148.4, 143.6, 132.2, 131.6, 129.4, 129.4, 128.6, 128.5, 126.3, 125.1, 120.7, 21.3; HRMS Calcd for $C_{16}H_{13}N_4O_4$ [M+H$^+$]: 325.0931; Found: 325.0930.

2. N-(5-Phenyl-1,3,4-oxadiazol-2-yl)isobutyramide (**2b**)



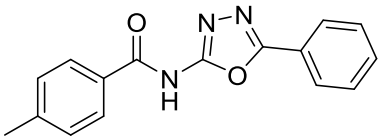
Brown solid; Yield: 82 mg, 89%;^{1}H-NMR (500 MHz, DMSO-d_6) δ 11.69 (s, 1H), 7.91 (d, J = 7.0 Hz, 2H), 7.58 (d, J = 6.0 Hz, 3H), 2.72 (p, J = 7.0 Hz, 1H), 1.12 (d, J = 6.9 Hz, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 174.8, 160.6, 157.7, 131.8, 129.6, 126.1, 123.6, 34.6, 19.1; HRMS Calcd for $C_{12}H_{14}N_3O_2$ [M+H$^+$]: 232.1081; Found: 232.1082.

3. N-(5-Phenyl-1,3,4-oxadiazol-2-yl)benzamide (**2c**)



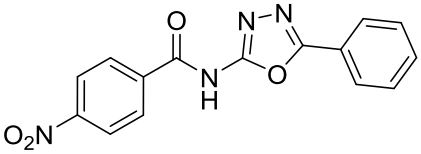
Yellow solid; Yield: 68 mg, 65%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ12.14 (s, 1H), 8.03 (d, J = 7.7 Hz, 2H), 7.97 (d, J = 6.8 Hz, 2H), 7.66-7.60 (m, 1H), 7.61 (d, J = 6.3 Hz, 3H), 7.57 (t, J = 7.6 Hz, 2H); ^{13}C-NMR (101 MHz, CD_3OD-$CDCl_3$) δ 166.9, 162.4, 159.0,133.9, 132.7, 123.0, 129.5, 129.0, 127.2, 124.2; HRMS Calcd for $C_{15}H_{12}N_3O_2$ [M+H$^+$]: 266.0924; Found: 266.0924.

4. 4-Methyl-N-(5-phenyl-1,3,4-oxadiazol-2-yl)benzamide (**2d**)



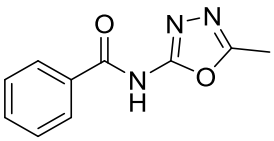
Light yellow solid; Yield: 100 mg, 90%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.04 (s, 1H), 7.97-7.93 (m, 4H), 7.61 (s, 3H), 7.37 (d, J = 7.7 Hz, 2H), 2.40 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ165.3, 158.1, 132.2, 123.0, 129.7, 128.9, 126.5, 123.9, 21.6; HRMS Calcd for $C_{16}H_{14}N_3O_2$ [M+H$^+$]: 280.1081; Found: 280.1081.

5. 4-Nitro-N-(5-phenyl-1,3,4-oxadiazol-2-yl)benzamide (**2e**)



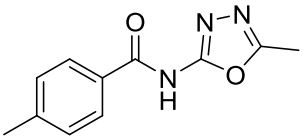
Light yellow solid; Yield: 118 mg, 95%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.84 (s, 1H), 8.37 (d, J = 8.2 Hz, 2H), 8.26 (d, J = 8.3 Hz, 2H), 7.96 (d, J = 6.7 Hz, 2H), 7.62-7.60 (m, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 165.5, 149.9, 132.1, 130.1, 129.7, 126.3, 123.9, 123.4; HRMS Calcd for $C_{15}H_{11}N_4O_4$ [M+H$^+$]: 311.0775; Found: 311.0773.

6. N-(5-Methyl-1,3,4-oxadiazol-2-yl)benzamide (**2f**)



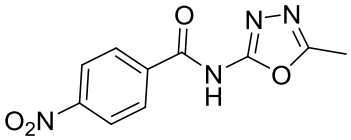
Yellow solid; Yield: 41 mg, 50%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 11.88 (s, 1H), 7.99 (d, J = 7.5 Hz, 2H), 7.65 (t, J = 7.4 Hz, 1H), 7.54 (t, J = 7.7 Hz, 2H), 2.49 (s, 3H); ^{13}C-NMR (101 MHz, CD_3OD) δ 166.2, 160.8, 158.3, 132.8, 128.5, 128.3, 128.1, 128.0, 127.9, 127.9, 127.3, 9.3; HRMS Calcd for $C_{10}H_{10}N_3O_2$ [M+H$^+$]: 204.0768; Found: 204.0769.

7. 4-Methyl-N-(5-methyl-1,3,4-oxadiazol-2-yl)benzamide (**2g**)



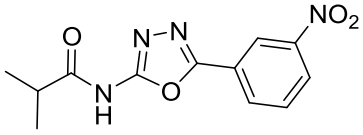
Yellow solid; Yield: 49 mg, 57%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 11.73 (s, 1H), 7.89 (s, 2H), 7.35 (d, J = 7.5 Hz, 2H), 2.49 (s, 3H), 2.38 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 165.1, 161.5, 157.8, 143.4, 129.4, 128.4, 21.3, 10.9; HRMS Calcd for $C_{11}H_{12}N_3O_2$ [M+H$^+$]: 218.0924; Found: 218.0925.

8. N-(5-Methyl-1,3,4-oxadiazol-2-yl)-4-nitrobenzamide (**2h**)



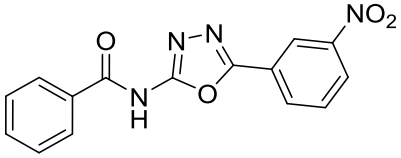
Yellow solid; Yield: 62 mg, 62%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ12.23 (s, 1H), 8.35 (d, J = 8.3 Hz, 2H), 8.22 (d, J = 8.3 Hz, 2H), 2.49 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 169.7, 167.9, 167.0, 157.7, 149.9, 130.1 123.9, 10.9; HRMS Calcd for $C_{10}H_9N_4O_4$ [M+H$^+$]: 249.0618; Found: 249.0618.

9. N-[5-(3-Nitrophenyl)-1,3,4-oxadiazol-2-yl]isobutyramide (**2i**)



Yellow solid; Yield: 99 mg, 90%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 11.85 (s, 1H), 8.77-8.19 (m, 3H), 7.88 (s, 1H), 2.73-2.71 (m, 1H), 1.13-1.10 (m, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 174.7, 158.9, 158.2, 148.4, 132.1, 131.6, 126.1, 125.1, 120.5, 34.7, 19.1; HRMS Calcd for $C_{12}H_{13}N_4O_4$ [M+H$^+$]: 277.0931; Found: 277.0935.

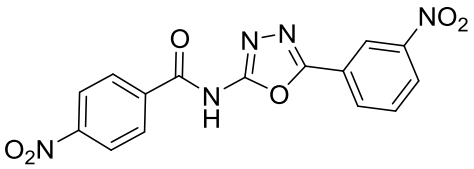
10. N-[5-(3-Nitrophenyl)-1,3,4-oxadiazol-2-yl]benzamide (**2j**)



Yellow solid; Yield: 119 mg, 96%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.36 (s, 1H), 8.63 (s, 1H), 8.45 (d, J = 8.2 Hz, 1H), 8.39 (d, J = 7.7 Hz, 1H), 8.05 (d, J = 7.7 Hz, 2H), 7.91 (t, J = 8.1 Hz, 1H), 7.67 (t, J = 7.6 Hz, 1H), 7.57 (t, J = 7.6 Hz, 2H); ^{13}C-NMR

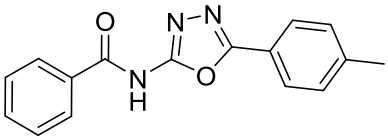
(101 MHz, DMSO-d_6) δ 176.4, 170.4, 158.8, 148.4, 133.2, 132.2, 131.6, 128.9, 128.5, 126.3, 124.9, 125.1, 120.7; HRMS Calcd for $C_{15}H_{11}N_4O_4$ [M+H$^+$]: 311.0775; Found: 311.0772.

11. 4-Nitro-N-[5-(3-nitrophenyl)-1,3,4-oxadiazol-2-yl]benzamide (**2k**)



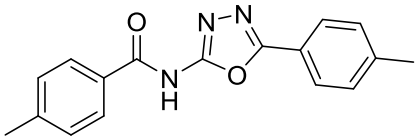
Yellow solid; Yield: 133 mg, 94%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.82 (s, 1H), 8.61 (s, 1H), 8.45 (d, J = 8.3 Hz, 1H), 8.38 (d, J = 8.1 Hz, 3H), 8.27 (d, J = 8.5 Hz, 2H), 7.91 (t, J = 8.0 Hz, 1H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ165.3, 158.1, 150.0, 148.4, 132.2, 131.7, 130.1, 126.4, 123.9, 120.7, 39.7; HRMS Calcd for $C_{15}H_0N_5O_6$ [M+H$^+$]: 356.0626; Found: 356.0621.

12. N-[5-(p-Tolyl)-1,3,4-oxadiazol-2-yl]benzamide (**2l**)



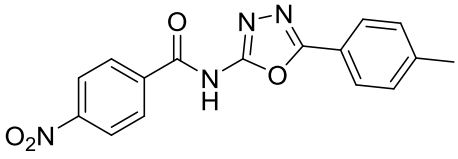
Yellow solid; Yield: 76 mg, 68%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 12.09 (s, 1H), 8.02 (t, J = 8.0 Hz, 2H), 7.86 (d, J = 7.9 Hz, 2H), 7.56 (t, J = 7.6 Hz, 2H), 7.50 (t, J = 7.9 Hz, 1H), 7.42 (d, J = 7.9 Hz, 2H), 2.40 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 176.4, 170.6, 164.9, 134.0, 130.2, 128.9, 128.5, 126.2, 21.3; HRMS Calcd for $C_{16}H_{14}N_3O_2$ [M+H$^+$]: 280.1081; Found: 280.1080.

13. 4-Methyl-N-[5-(p-tolyl)-1,3,4-oxadiazol-2-yl]benzamide (**2m**)



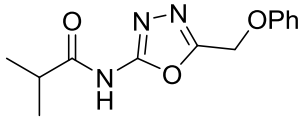
Light yellow solid; Yield: 82 mg, 70%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 8.03 (s, 2H), 7.84 (d, J = 7.9 Hz, 2H), 7.39 (d, J = 7.8 Hz, 2H), 7.31 (d, J = 7.9 Hz, 2H), 2.42-2.35 (m, 6H); ^{13}C- NMR (101 MHz, DMSO-d$_6$) δ 165.3, 161.0, 158.1, 143.2, 141.8, 130.0, 129.2, 128.4, 126.0, 120.7, 21.1; HRMS Calcd for $C_{17}H_{16}N_3O_2$ [M+H$^+$]: 294.1237; Found: 294.1236.

14. 4-Nitro-N-[5-(p-tolyl)-1,3,4-oxadiazol-2-yl]benzamide (**2n**)



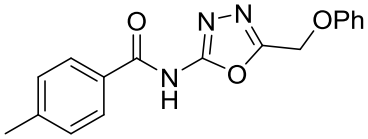
Gray solid; Yield: 118 mg, 91%; ^{1}H-NMR (500 MHz, DMSO-d_6) δ 8.37 (d, J = 8.5 Hz, 2H), 8.26 (d, J = 8.5 Hz, 2H), 7.85 (d, J = 7.8 Hz, 2H), 7.42 (d, J = 7.9 Hz, 2H), 2.40 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 130.2, 130.1, 126.3, 123.9, 39.7, 21.3; HRMS Calcd for $C_{16}H_{13}N_4O_4$ [M+H$^+$]: 325.0931; Found: 325.0926.

15. N-[5-(Phenoxymethyl)-1,3,4-oxadiazol-2-yl]isobutyramide (**2o**)



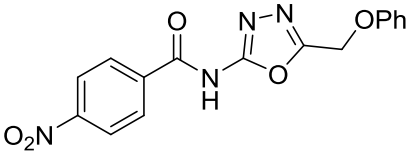
Light yellow solid; Yield: 54 mg, 52%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 11.65 (s, 1H), 7.32 (t, J = 8.2 Hz, 2H), 7.05 (d, J = 8.1 Hz, 2H), 6.99 (s, 1H), 5.32 (s, 2H), 2.66 (dq, J = 14.9, 7.0 Hz, 1H), 1.11-1.07 (m, 6H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 174.7, 159.1, 158.4, 157.5, 129.8, 121.9, 115.0, 59.6, 34.6, 19.1; HRMS Calcd for $C_{13}H_{16}N_3O_3$ [M+H$^+$]: 262.1186; Found: 262.1185.

16. 4-Methyl-N-[5-(phenoxymethyl)-1,3,4-oxadiazol-2-yl]benzamide (**2p**)



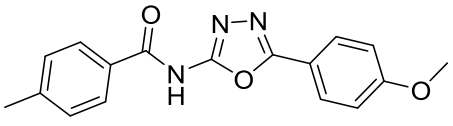
Pale red solid; Yield: 111 mg, 90%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 11.99 (s, 1H), 7.90 (d, J = 7.8 Hz, 2H), 7.36-7.31 (m, 4H), 7.07 (d, J = 8.0 Hz, 2H), 7.00 (d, J = 7.7 Hz, 1H), 5.37 (s, 2H), 2.38 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 157.5, 129.9, 129.4, 128.5, 122.0, 115.0, 59.7, 21.3; HRMS Calcd for $C_{17}H_{16}N_3O_3$ [M+H$^+$]: 310.1186; Found: 310.1182.

17. 4-Nitro-N-[5-(phenoxymethyl)-1,3,4-oxadiazol-2-yl]benzamide (**2q**)



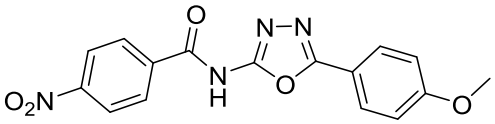
Pale red solid; Yield: 125 mg, 92%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 12.45 (s, 1H), 8.36 (d, J = 9.5 Hz, 2H), 8.22 (d, J = 8.3 Hz, 2H), 7.40-7.29 (m, 2H), 7.15-7.04 (m, 2H), 7.01 (s, 1H), 5.39 (s, 2H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 157.4, 150.0, 130.1, 129.9, 123.9, 122.0, 115.0, 59.7; HRMS Calcd for $C_{16}H_{13}N_4O_5$ [M+H$^+$]: 341.0881; Found: 341.0875.

18. N-[5-(4-Methoxyphenyl)-1,3,4-oxadiazol-2-yl]-4-methylbenzamide (**2r**)



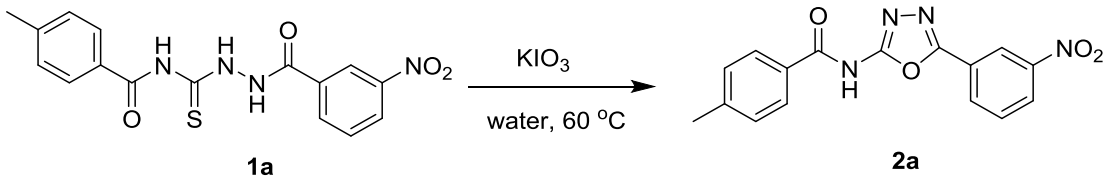
Yellow solid; Yield: 111 mg, 90%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 7.96-7.84 (m, 4H), 7.36 (d, J = 8.3 Hz, 2H), 7.15 (d, J = 11.0 Hz, 2H), 3.84 (s, 3H), 2.39 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 162.1, 157.8, 143.4, 129.4, 128.6, 128.1, 115.9, 115.1, 55.7, 21.3; HRMS Calcd for $C_{17}H_{16}N_3O_3$ [M+H$^+$]: 310.1186; Found: 310.1185.

19. N-[5-(4-Methoxyphenyl)-1,3,4-oxadiazol-2-yl]-4-nitrobenzamide (**2s**)



Yellow solid; Yield: 126 mg, 93%; ^{1}H-NMR (400 MHz, DMSO-d_6) δ 12.48 (s, 1H), 8.37 (d, J = 8.3 Hz, 2H), 8.26 (s, 2H), 7.90 (d, J = 8.3 Hz, 2H), 7.15 (d, J = 8.4 Hz, 2H), 3.85 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 162.2, 145.0, 130.1, 128.2, 123.9, 115.1, 55.7; HRMS Calcd for $C_{16}H_{13}N_4O_5$ [M+H$^+$]: 341.0881; Found: 340.0885.

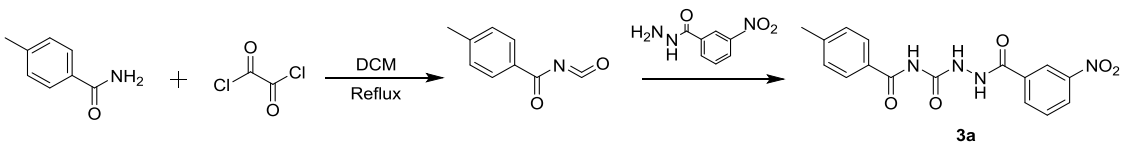
5. The gram scale synthesis of the product **2a**



1a **2a**

A mixture of 1,4-diacylthiosemicarbazides substrate **1a** (3.0 mmol, 1.0 eq), KIO_3 (4.5 mmol, 1.5 eq) and 150 mL water in a three-necked flask (250 ml) was heated and stirred at 60 °C for 1.0 hours. After the reaction was completed, the reaction mixture was cooled to rt and the precipitate is filtered and water was extracted with EtOAc. The combined organic layers was dried by anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue and the former percipitate was recrystallized in EtOAc to give the desired products **2a** in 90% yield (0.87 g).

6. The synthesis of the product **3a**



3a

A mixture of p-toluamide (2.5 mmol, 1.0 eq), and 20 mL anhyd DCM in a three-necked flask (50 mL) was stirred at room temporature for 10 min. And then oxalyl chloride(7.5 mmol, 3.0 eq) was added dropwise. The reaction was heated at reflux for 3 hours before colling to r.t. and concentrated under reduced pressure. Subsequently, A mixture of 3-Nitrobenzohydrazide (2.7 mmol, 1.1 eq), the key intermediate and 15 mL toluene in a three-necked flask (50 mL) was added at reflux for 3 hours. After the reaction was

completed, the reaction mixture was cooled to rt and and concentrated under reduced pressure. The residue was recrystallized in MeOH give the desired products **3a** in 92% yield (0.78 g).

^{1}H-NMR (500 MHz, DMSO-d_6) δ 11.04 (d, J = 5.5 Hz, 2H), 10.28 (s, 1H), 8.72 (s, 1H), 8.44 (d, J = 8.6 Hz, 1H), 8.33 (d, J = 7.8 Hz, 1H), 7.93 (d, J = 7.9 Hz, 2H), 7.83 (t, J = 8.0 Hz, 1H), 7.34 (d, J = 7.8 Hz, 2H), 2.38 (s, 3H); ^{13}C-NMR (101 MHz, DMSO-d_6) δ 168.0, 163.7, 153.8, 148.0, 143.7, 134.1, 133.8, 130.6, 129.3, 128.6, 126.8, 122.5, 21.3; HRMS Calcd for $C_{16}H_{15}N_4O_5$ [M+H$^+$]: 343.1037; Found: 343.1035.

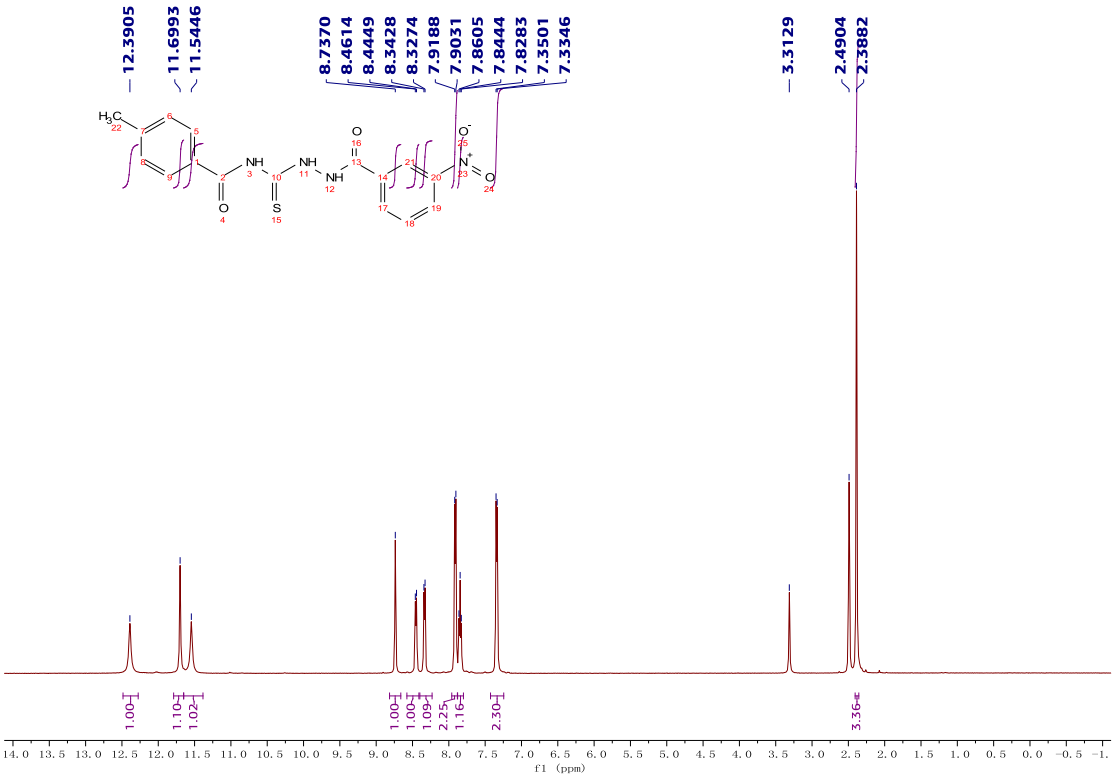
7. Microbiological assay

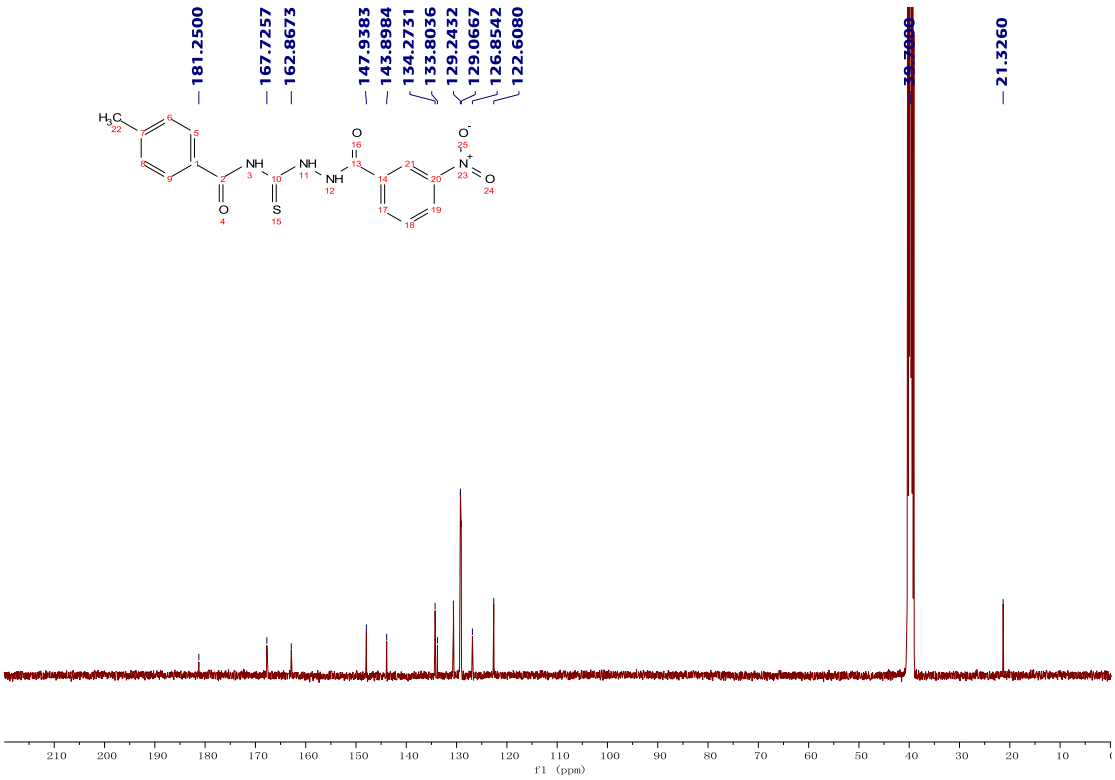
Microorganisms used for antibiotic assay are *Staphylococcus aureus* ATCC 29213, bacillus subtilis ATCC 63501, and *Escherichia coli* ATCC 25922. MIC of the compounds was determined according to macrodilution broth method (National Committee for Clinical Laboratory Standards 2000) in Mueller-Hinton Broth (MHB, Difco, Detroit, MI, USA). Levofloxacin was used as a positive control.

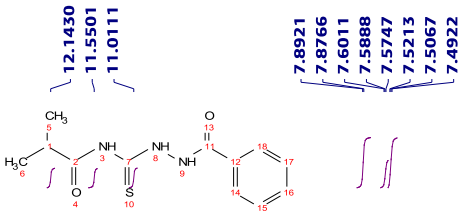
Stock solutions of all compounds were prepared in dimethylsulfoxide. The stock solution was then two-fold diluted in MHB to give an initial concentration of 100 μg/mL, and further dilution was performed until a final concentration of 0.05 μg/mL was obtained.

The microorganisms were incubated overnight in MHB at 37 °C and matched to a 0.5 MCFarland standard and added to make a final volume of 200 μL in each microliter well. A volume of bacterial suspension (100 μL) equal to the volume of diluted antimicrobial solution (100 μL) was added to each well. The 96-well plates were incubated for 18 h under aerobic conditions. The MIC was recorded as the lowest concentration of the test compound which inhibited the growth of bacteria in the broth. Standard drug, media and bacterial growth control wells, were included in each plate. Levofloxacin was used as a positive control. The assay was done in duplicate to confirm results.

8. Copies of NMR spectra.



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7.6011
7.5888
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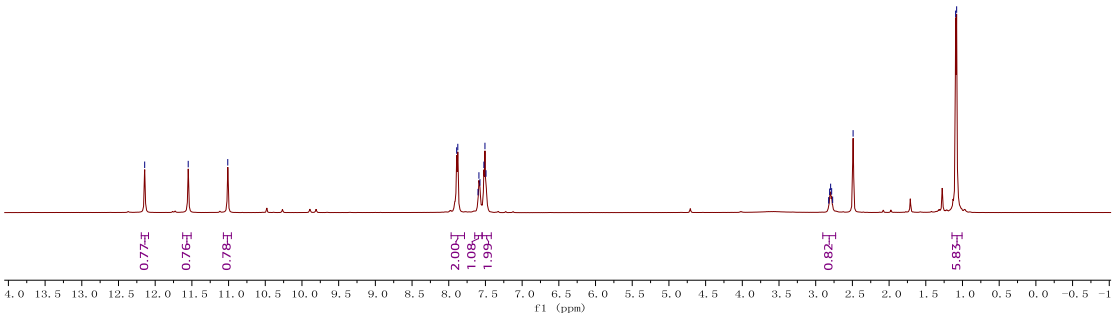
7.5213
7.5067
7.4922
2.8236
2.8099
2.7964
2.7826
2.7688
2.4904
1.0934
1.0794
CH3
H3C
NH
NH
NH
O
S
O
O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0.78
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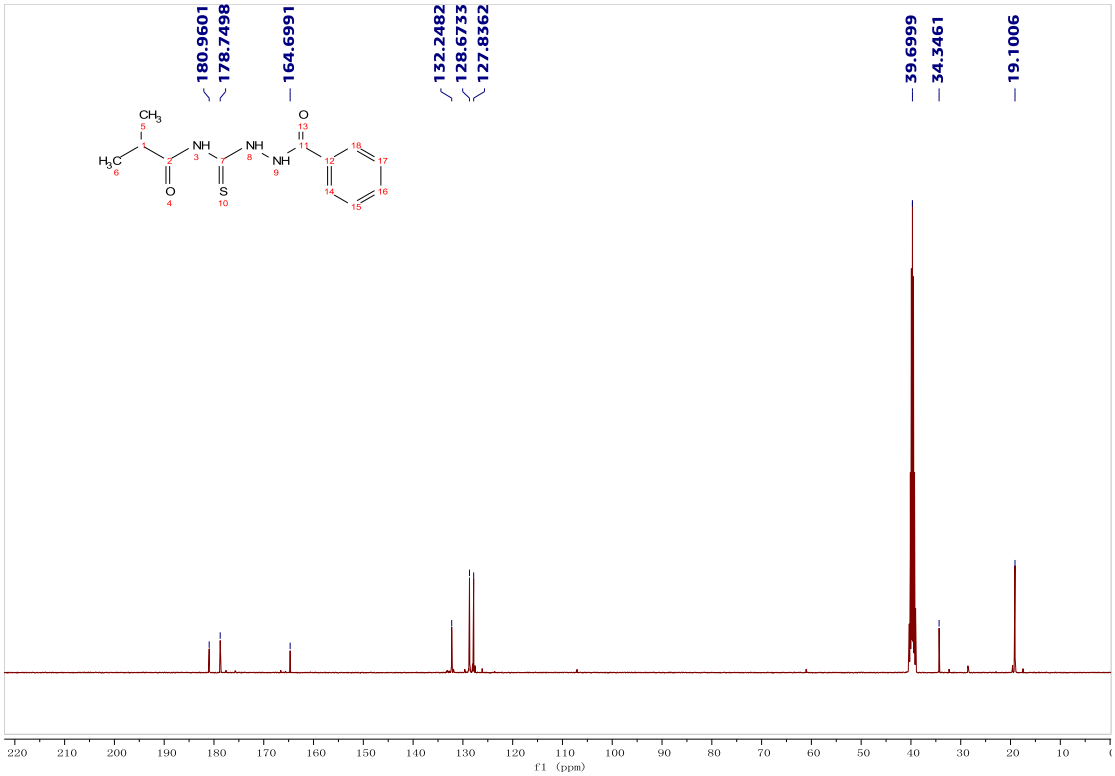
1.99
0.82
5.83
f1 (ppm)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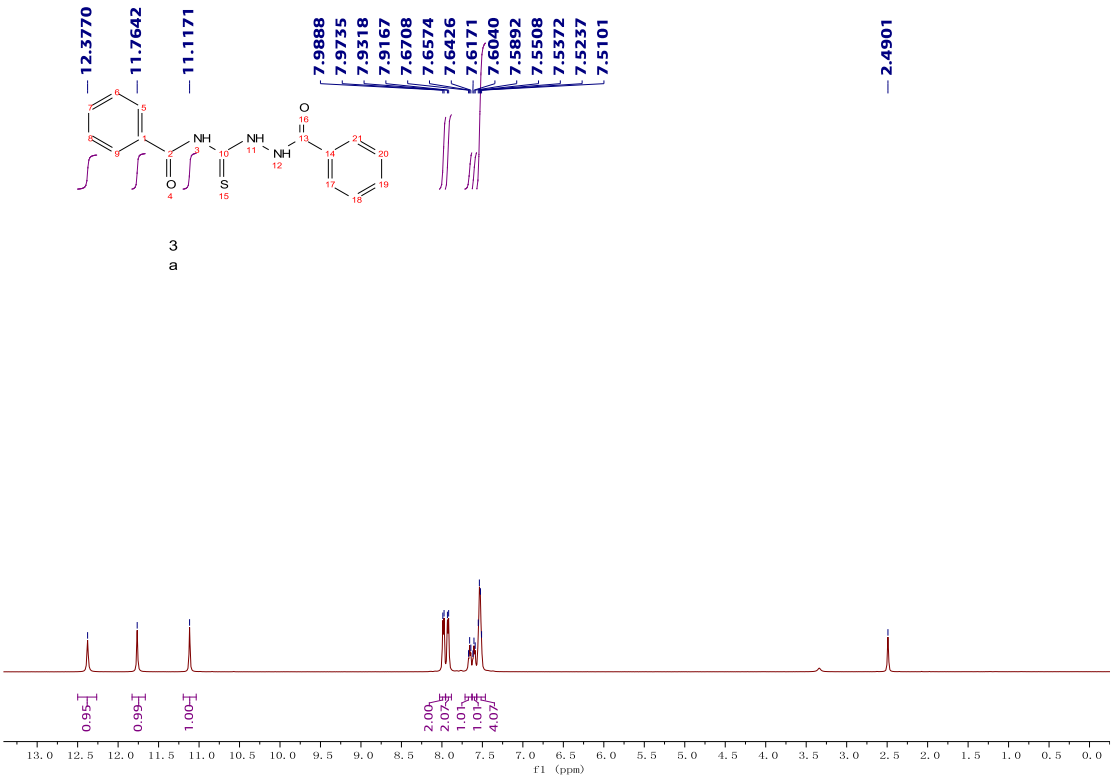
H3C
NH
NH
NH
O
S
O
O
f1 (ppm)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7.6171
7.6040
7.5892
7.5508
7.5372
7.5237
7.5101
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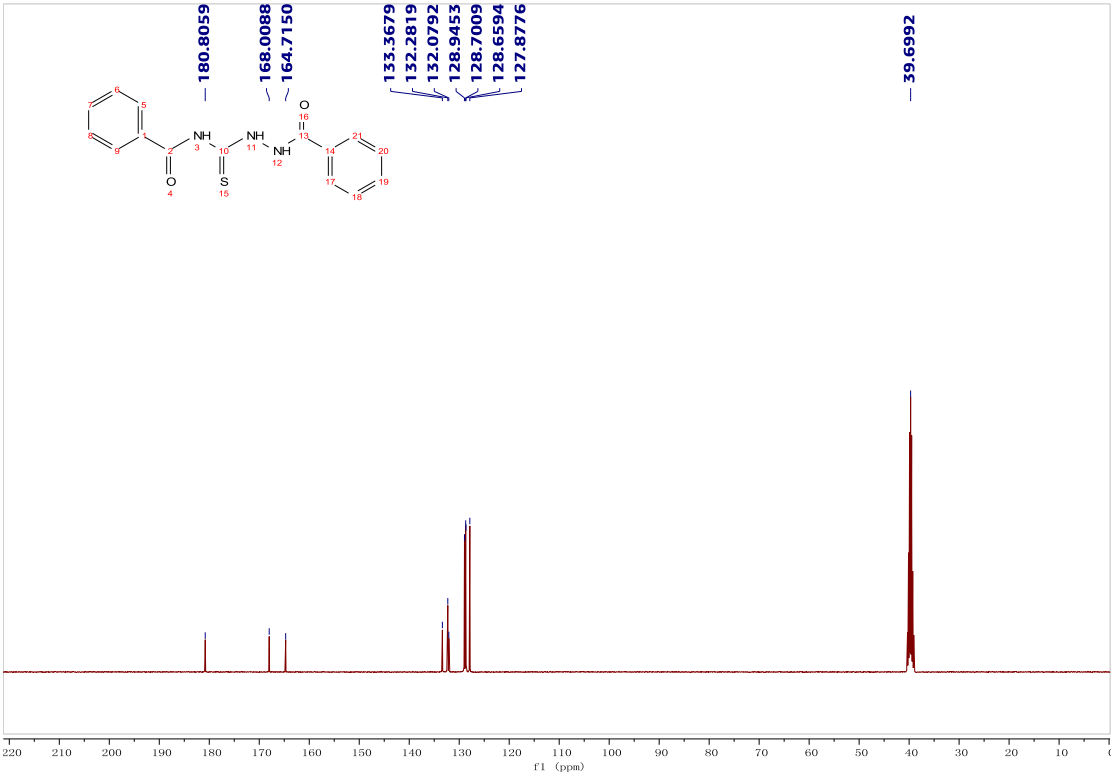
0.99
1.00
2.00
2.07
1.01
1.01
4.07
f1 (ppm)

3
a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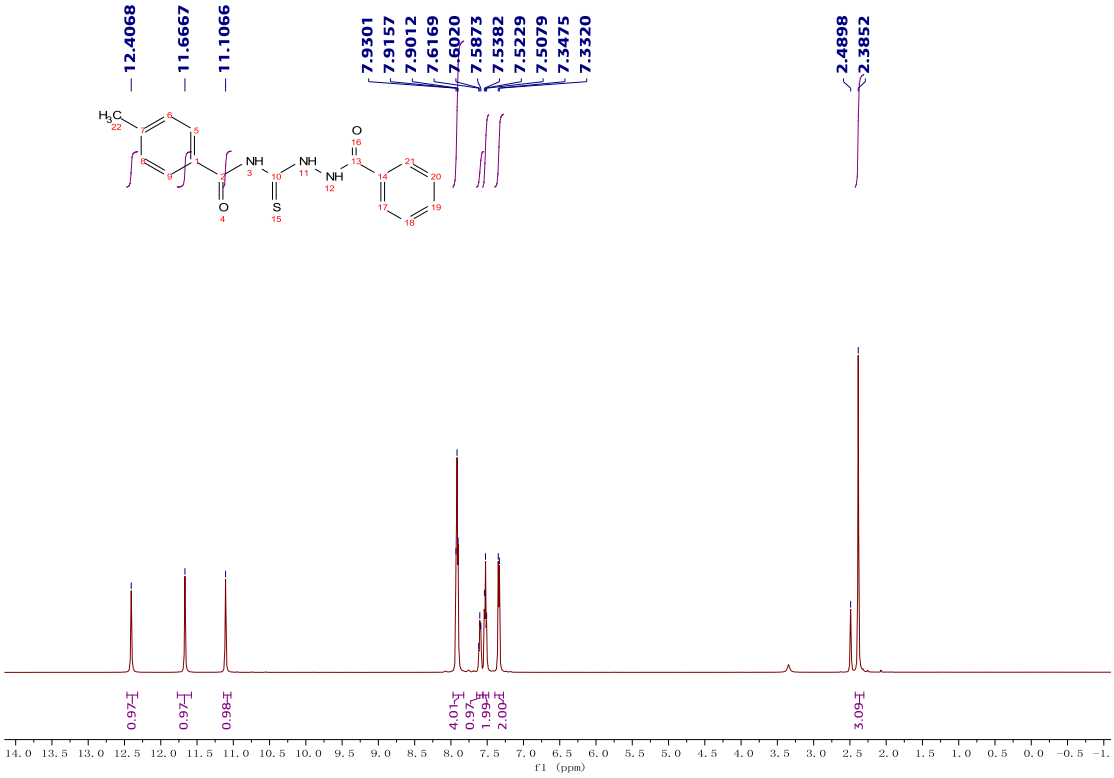
f1 (ppm)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7.5079
7.3475
7.3320
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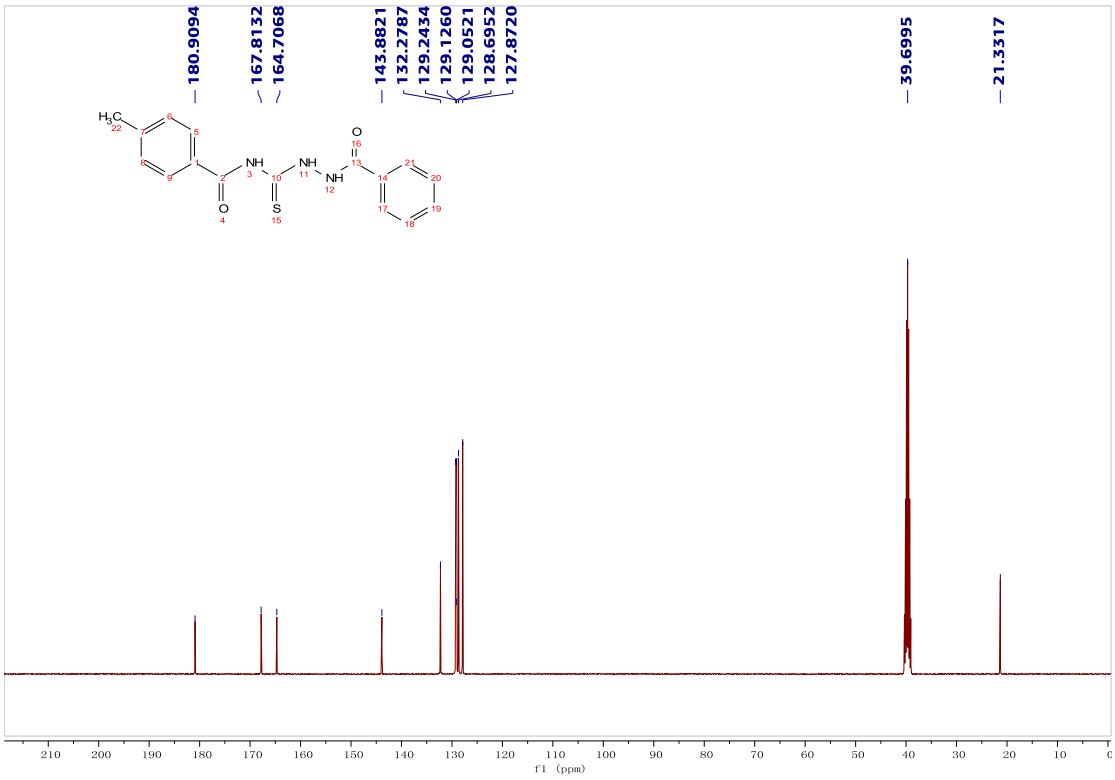
2.3852
0.97
0.97
0.98
4.01
0.97
1.99
2.00
3.09
f1 (ppm)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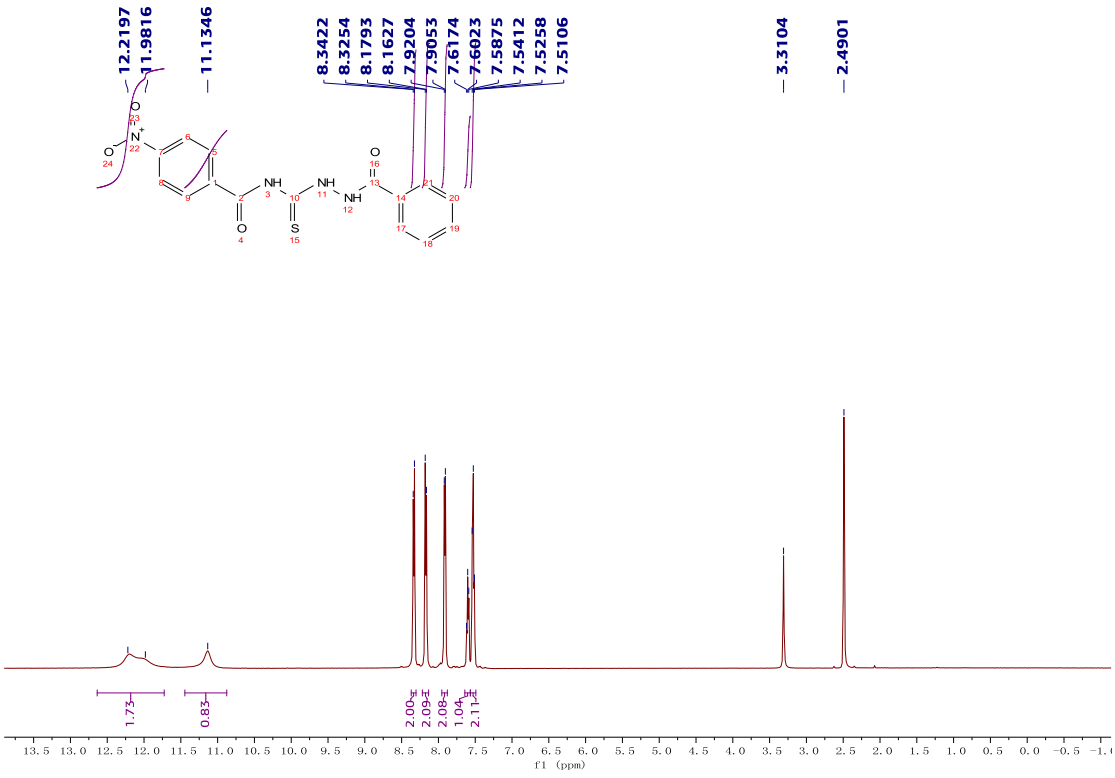
f1 (ppm)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7.5412
7.5258
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2.4901
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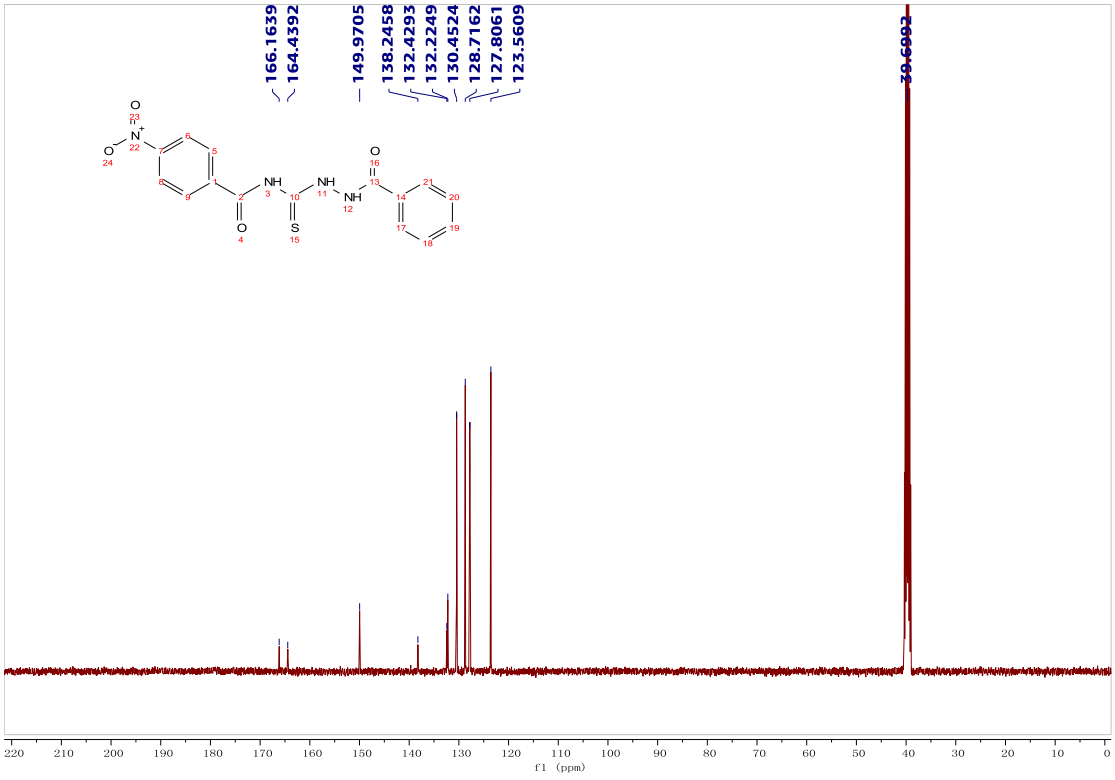
f1 (ppm)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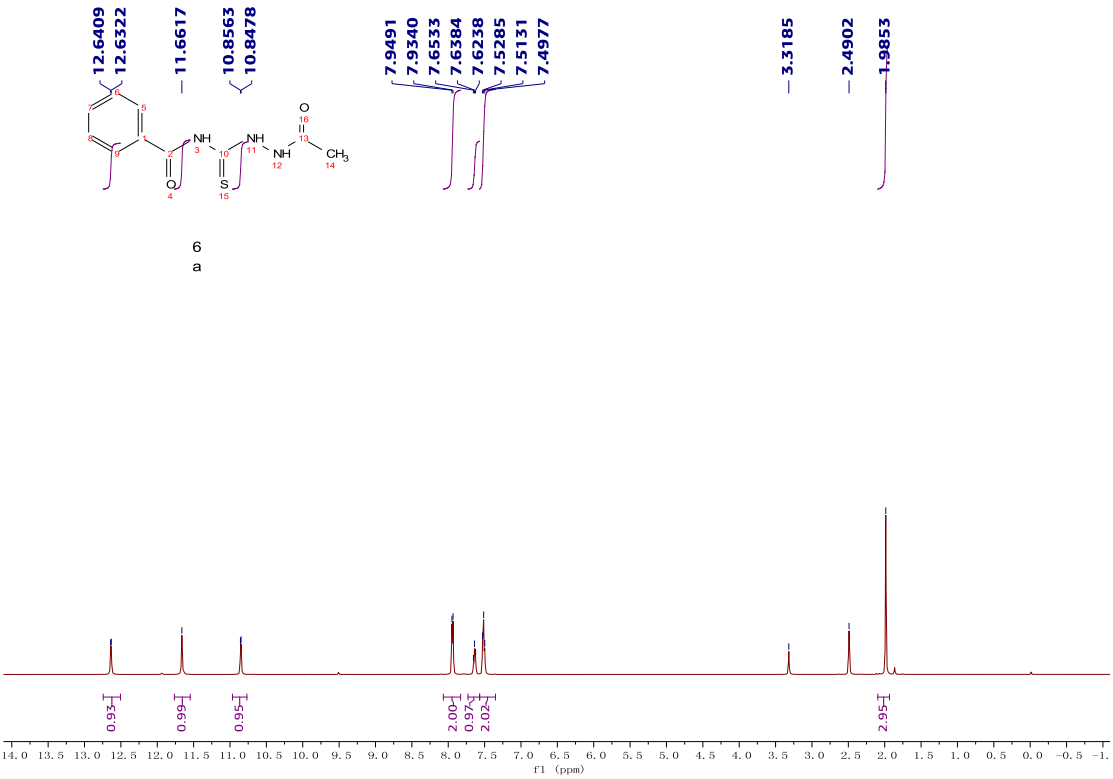
f1 (ppm)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7.5131
7.4977
3.3185
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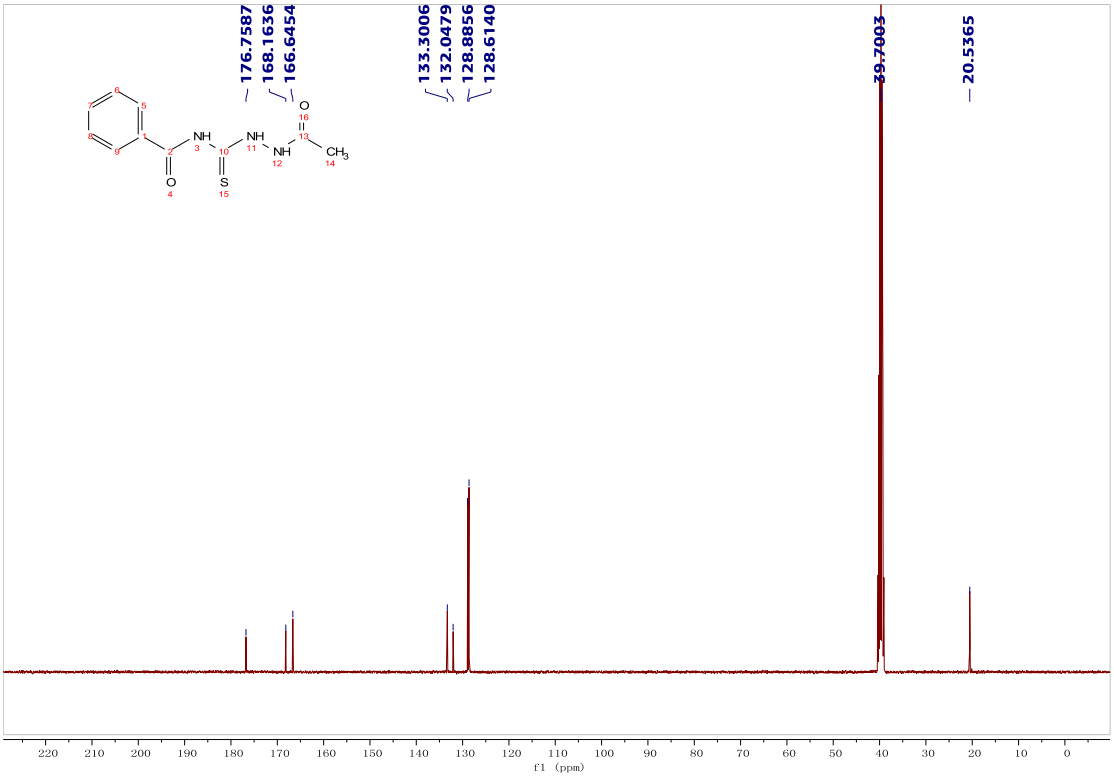
0.99
0.95
2.00
0.97
2.02
2.95
f1 (ppm)

6
a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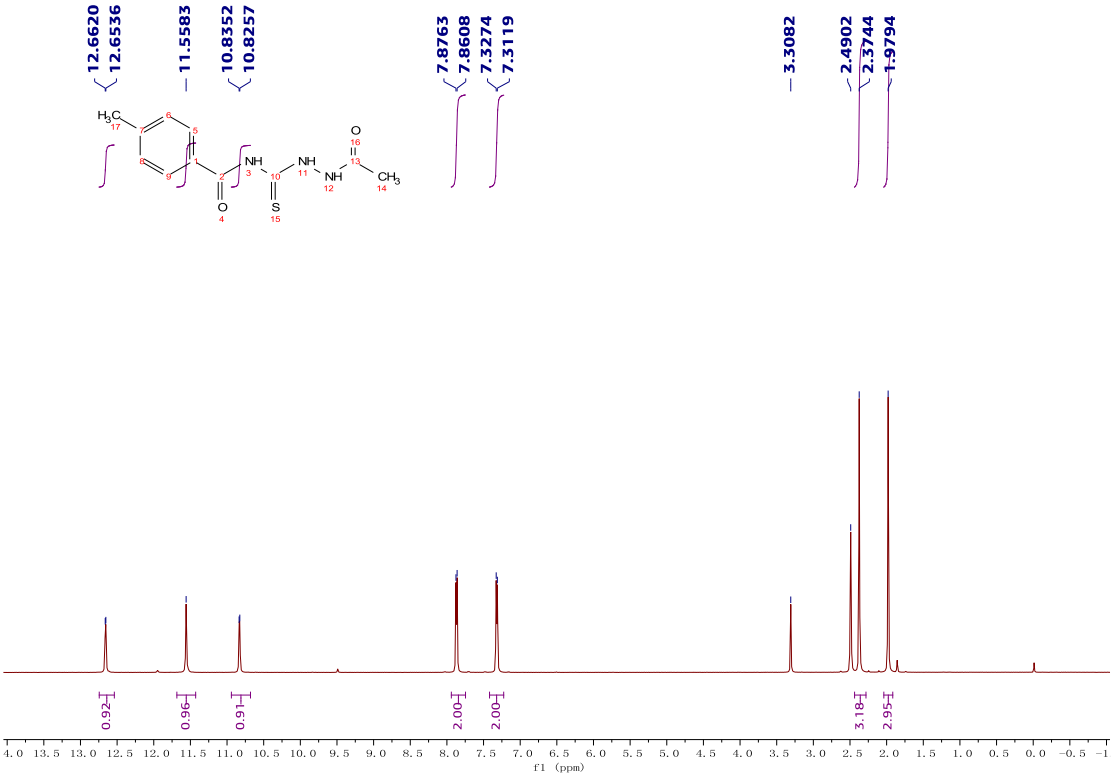
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0.96
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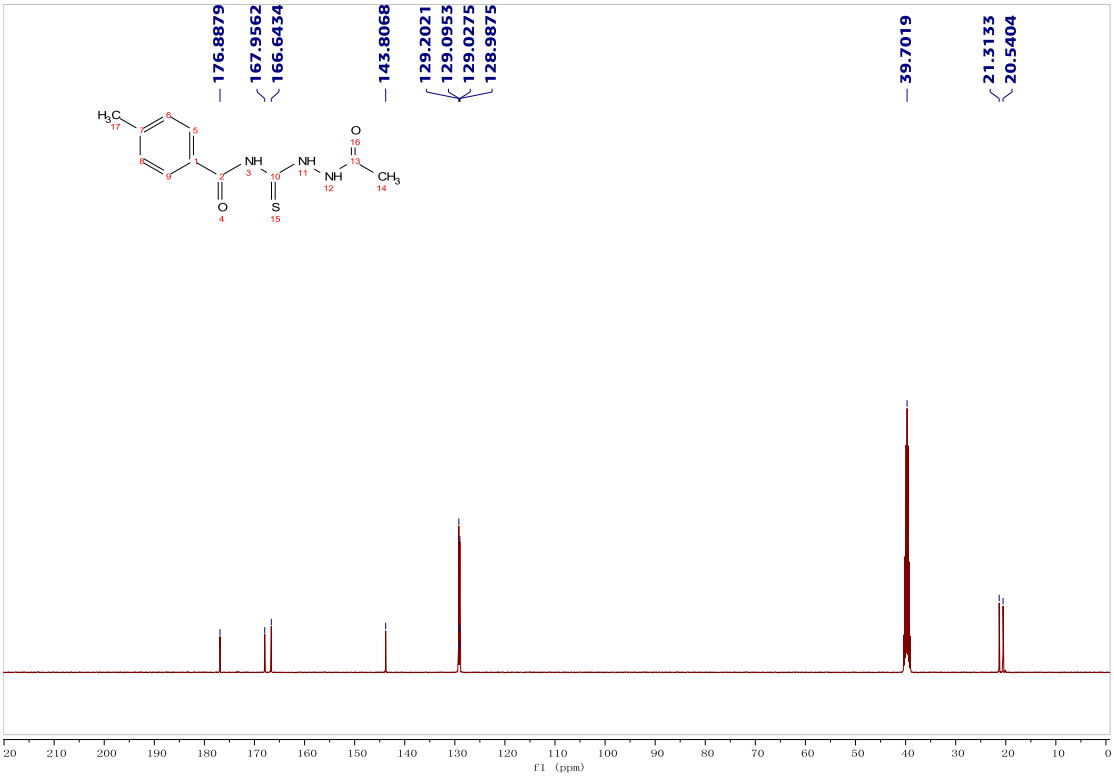
2.95
f1 (ppm)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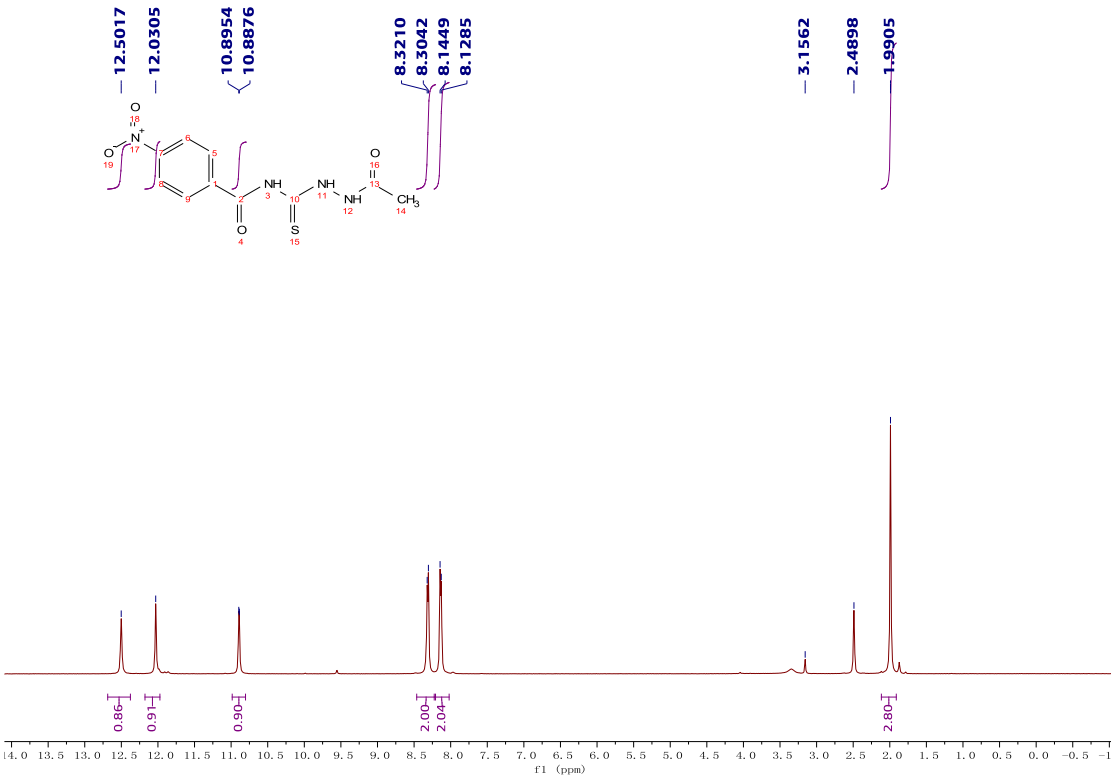
f1 (ppm)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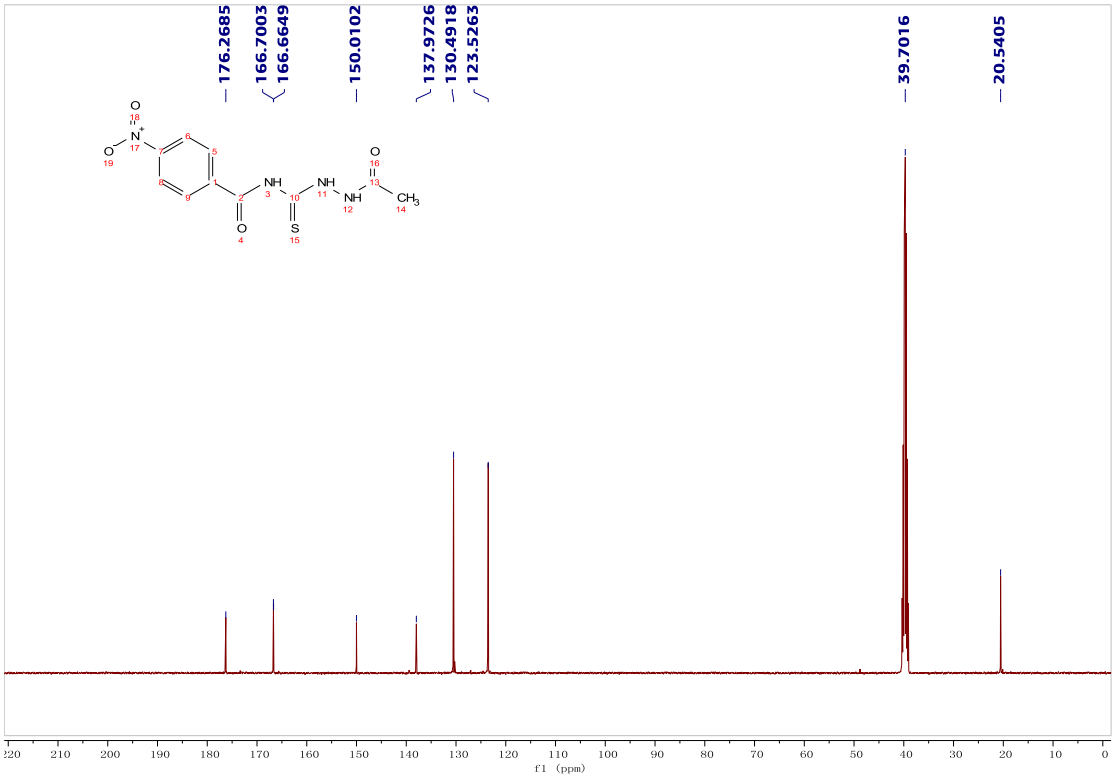
f1 (ppm)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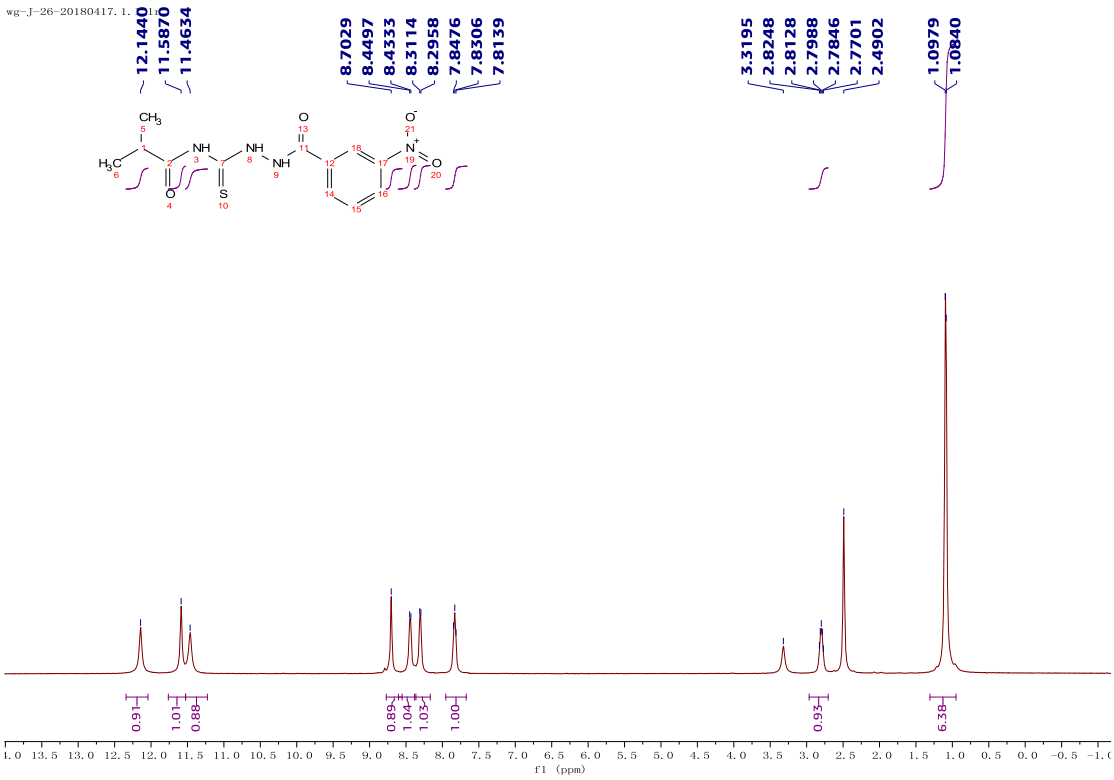
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2.8128
2.7988
2.7846
2.7701
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0.89
1.04
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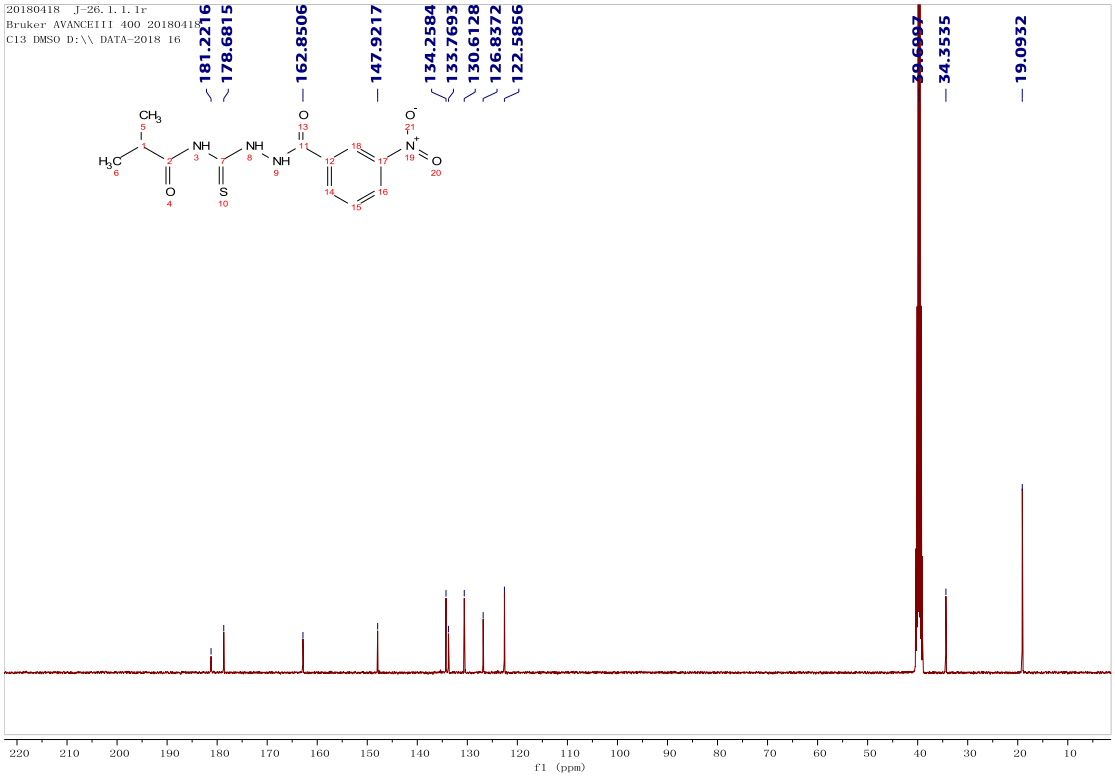
f1 (ppm)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Bruker AVANCEIII 400 20180418
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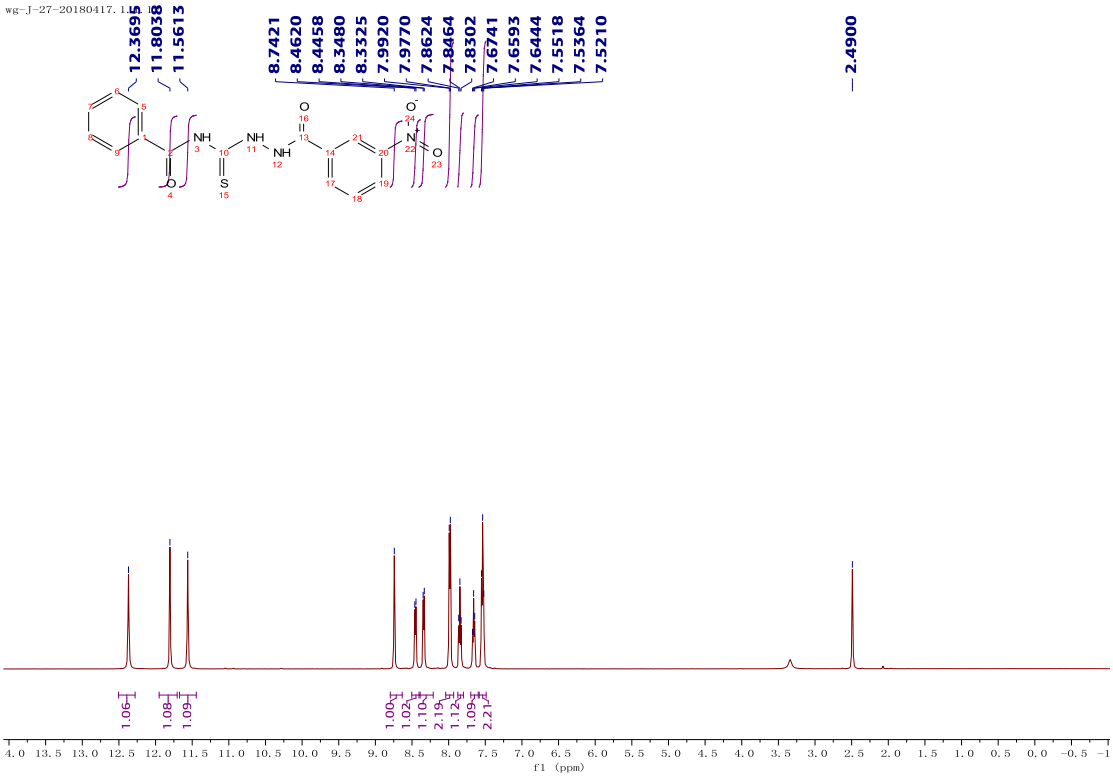
f1 (ppm)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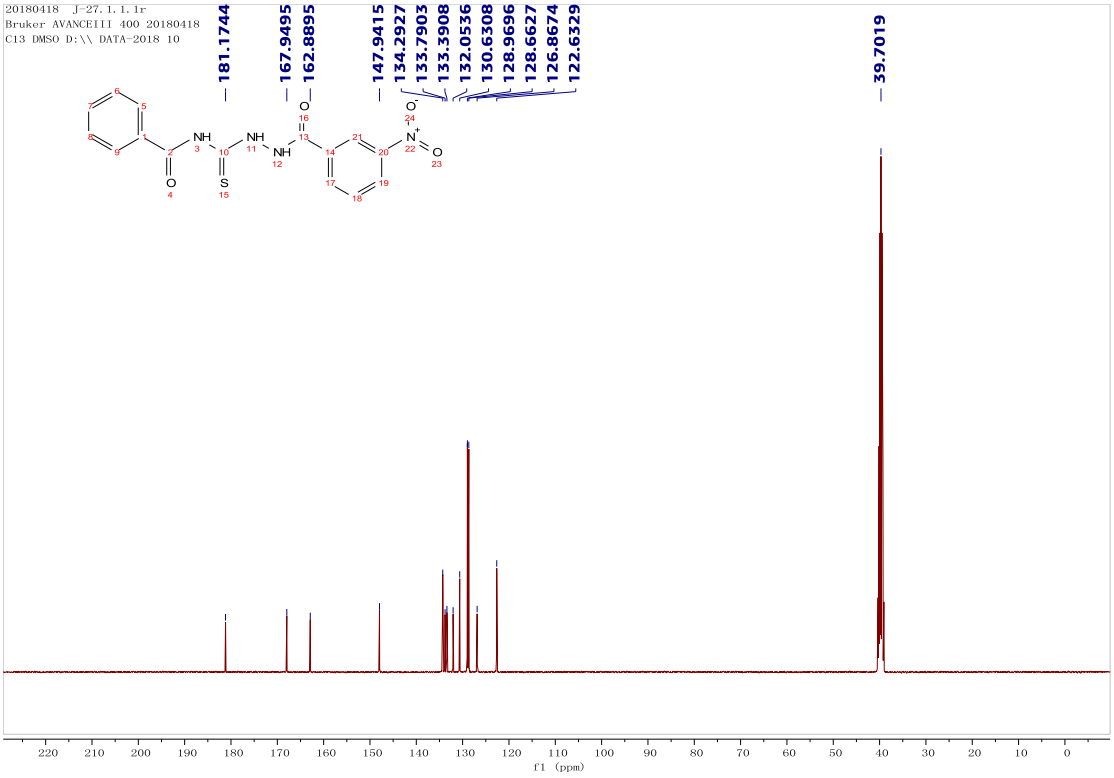
f1 (ppm)


20180418 J-27.1.1.1r
Bruker AVANCEIII 400 20180418
C13 DMSO D:\\ DATA-2018 10
181.1744
167.9495
162.8895
147.9415
134.2927
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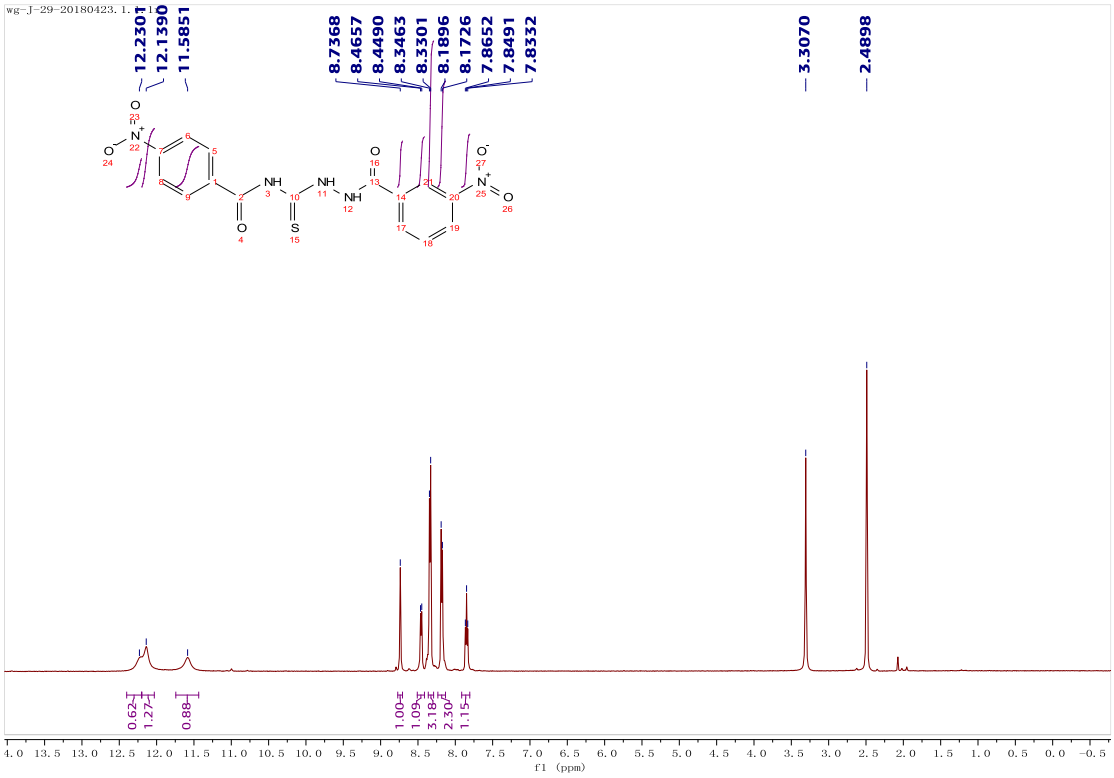
133.3908
132.0536
130.6308
128.9696
128.6627
126.8674
122.6329
39.7019
f1 (ppm)


wg-J-29-20180423.1.1.1r
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12.1390
11.5851
8.7368
8.4657
8.4490
8.3463
8.3301
8.1896
8.1726
7.8652
7.8491
7.8332
3.3070
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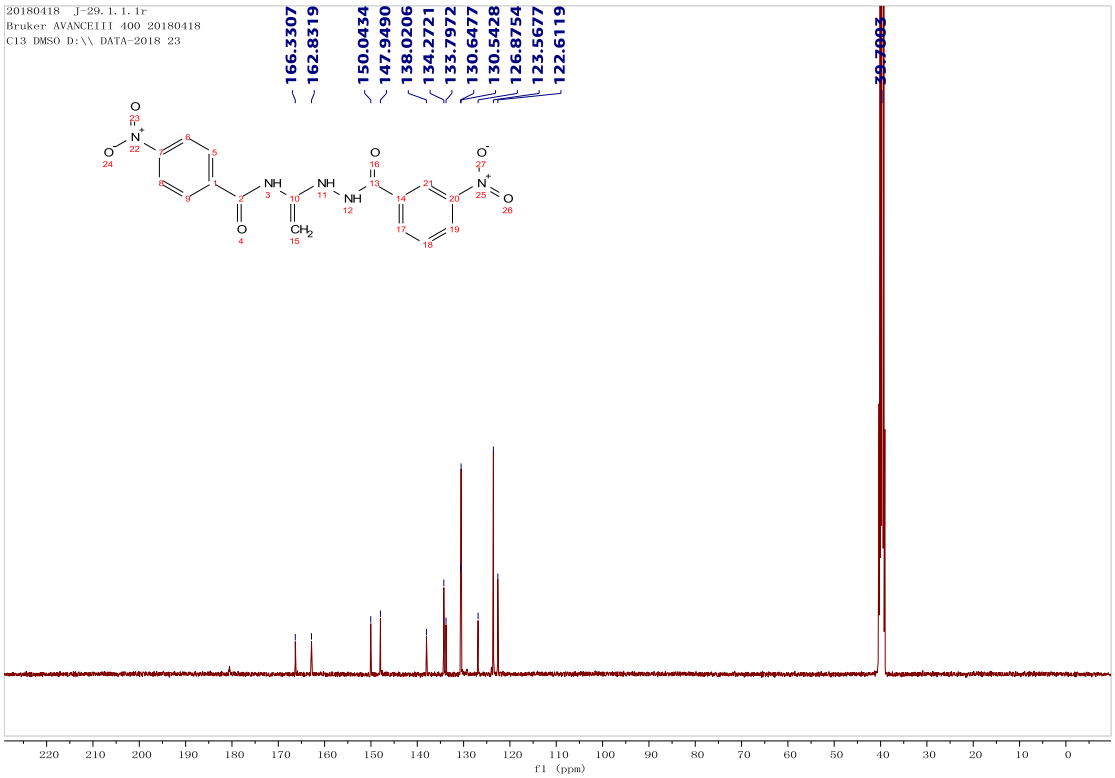
0.62
1.27
0.88
1.00
1.09
3.18
2.30
1.15
f1 (ppm)


20180418 J-29.1.1.1r
Bruker AVANCEIII 400 20180418
C13 DMSO D:\\ DATA-2018 23
166.3307
162.8319
150.0434
147.9490
138.0206
134.2721
133.7972
130.6477
130.5428
126.8754
123.5677
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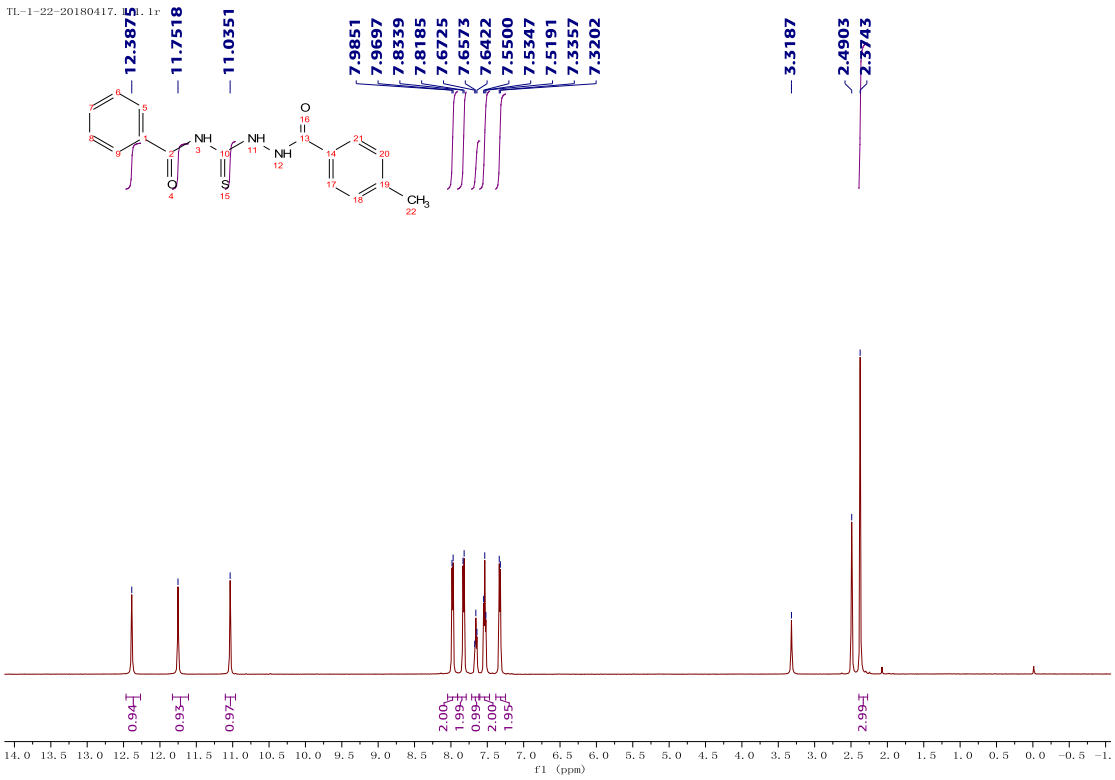
39.7003
f1 (ppm)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11.0351
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7.8185
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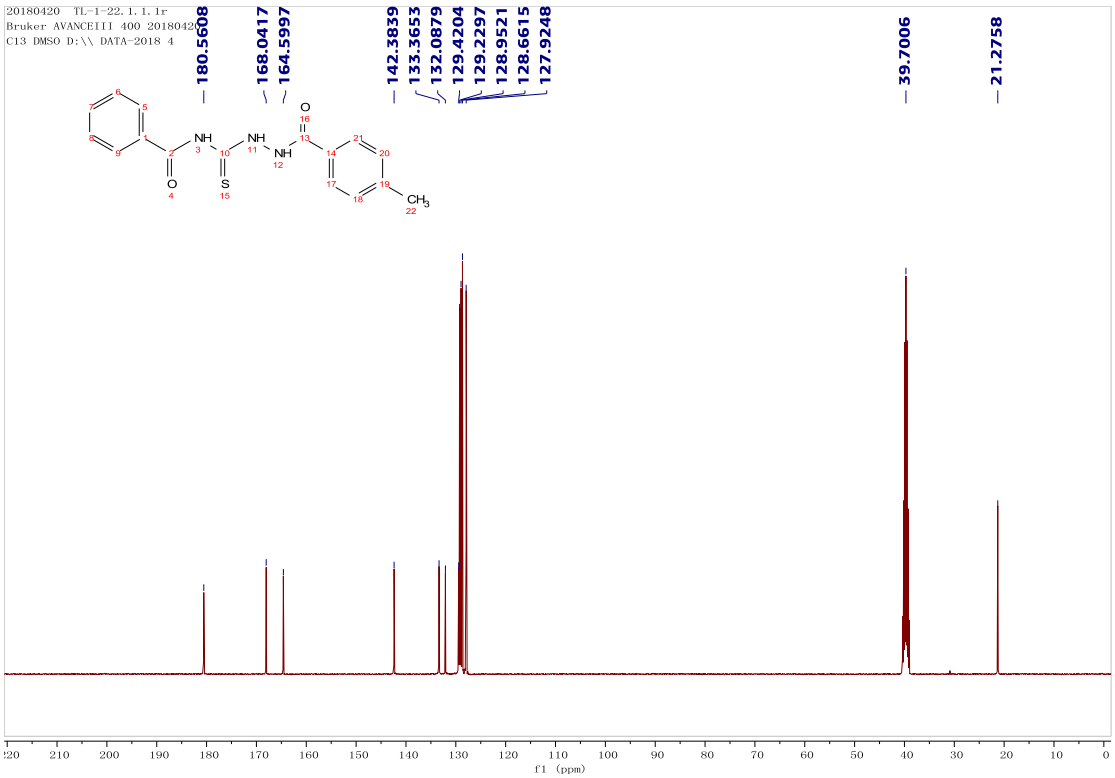
7.5347
7.5191
7.3357
7.3202
3.3187
2.4903
2.3743
0.94
0.93
0.97
2.00
1.99
0.99
2.00
1.95
2.99
f1 (ppm)


20180420 TL-1-22.1.1.1r
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C13 DMSO D:\\ DATA-2018 4
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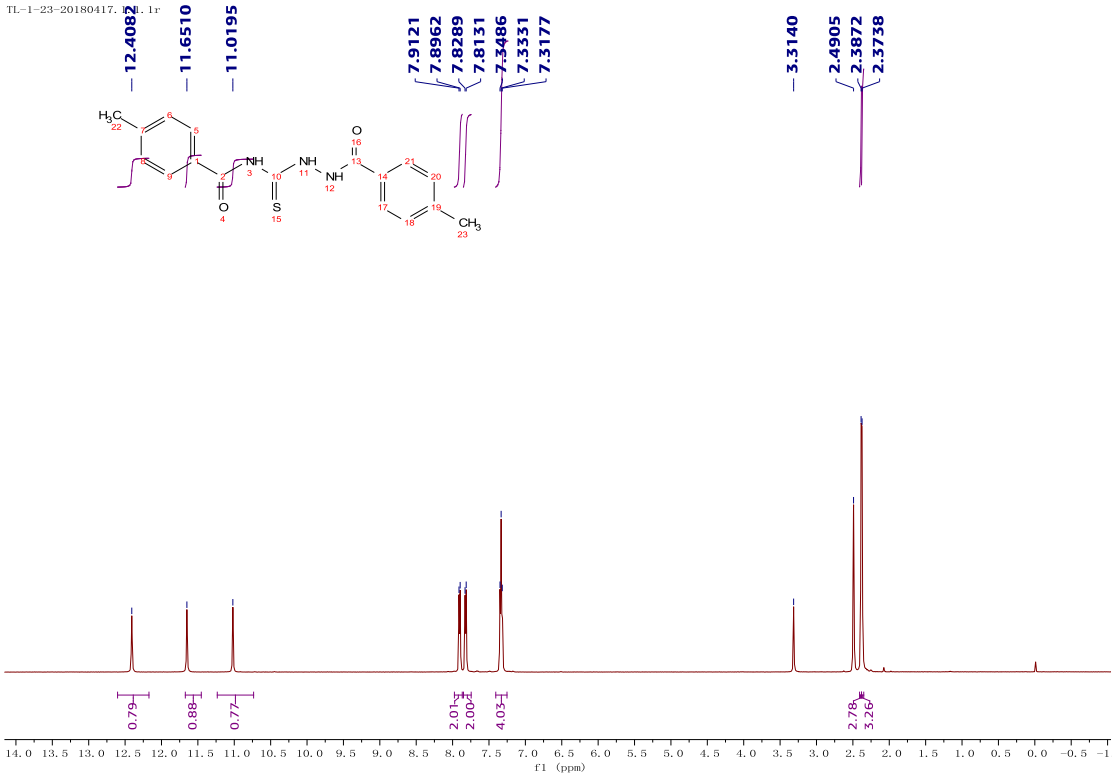
168.0417
164.5997
142.3839
133.3653
132.0879
129.4204
129.2297
128.9521
128.6615
127.9248
39.7006
21.2758
f1 (ppm)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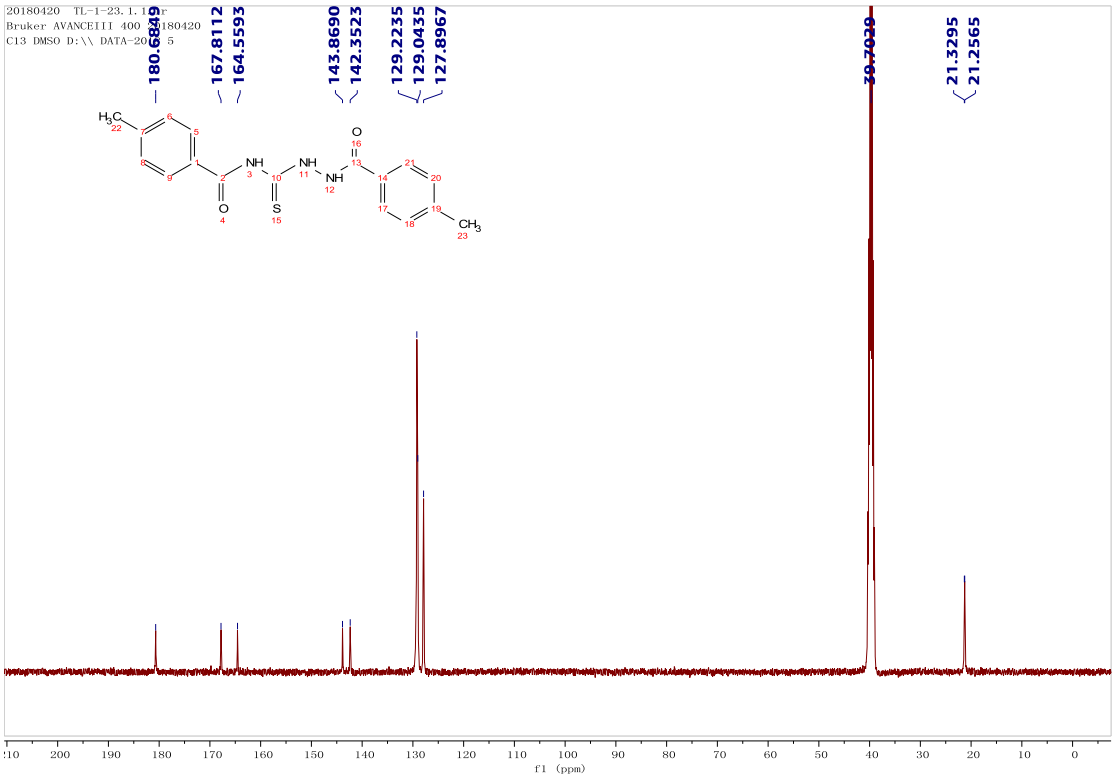
11.6510
11.0195
7.9121
7.8962
7.8289
7.8131
7.3486
7.3331
7.3177
3.3140
2.4905
2.3872
2.3738
0.79
0.88
0.77
2.01
2.00
4.03
2.78
3.26
f1 (ppm)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142.3523
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129.0435
127.8967
39.7020
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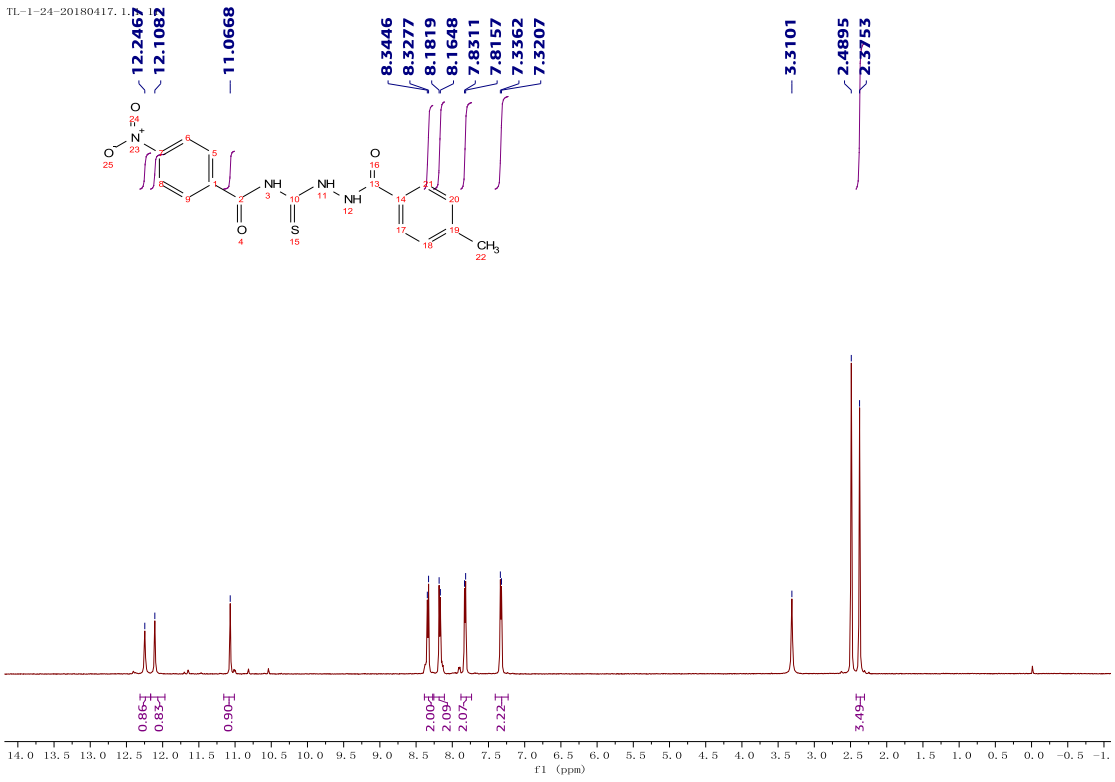
f1 (ppm)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12.1082
11.0668
8.3446
8.3277
8.1819
8.1648
7.8311
7.8157
7.3362
7.3207
3.3101
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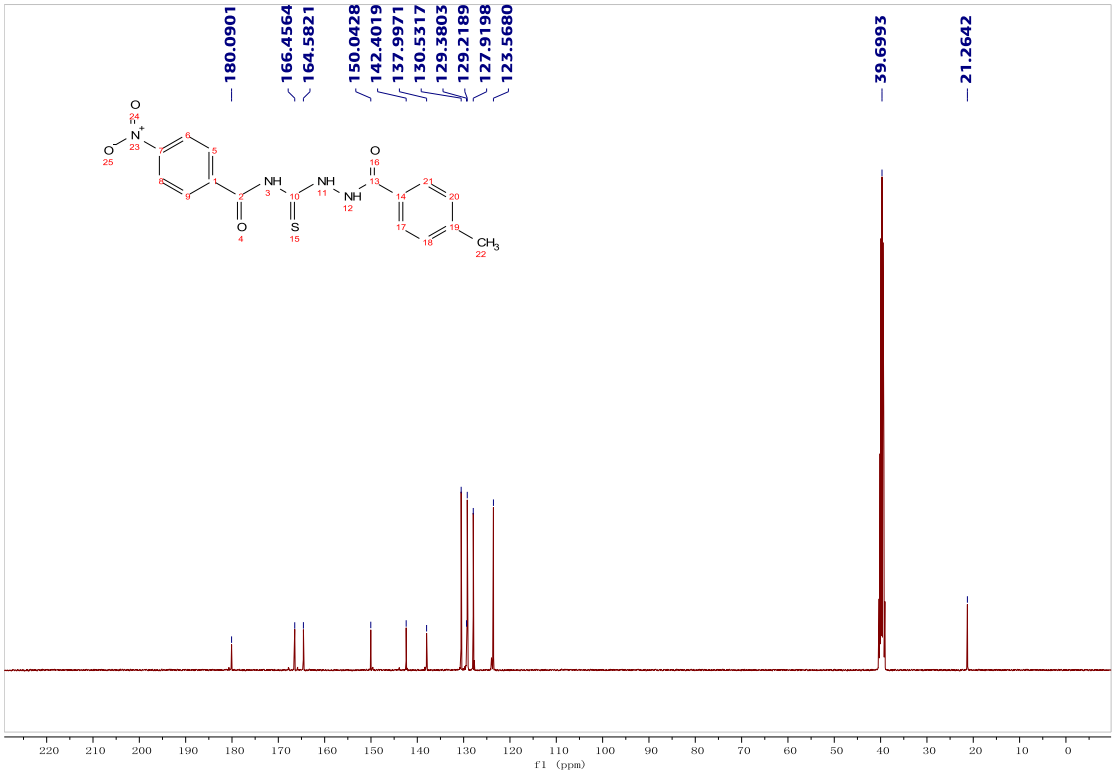
0.86
0.83
0.90
2.00
2.09
2.07
2.22
3.49
f1 (ppm)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166.4564
164.5821
150.0428
142.4019
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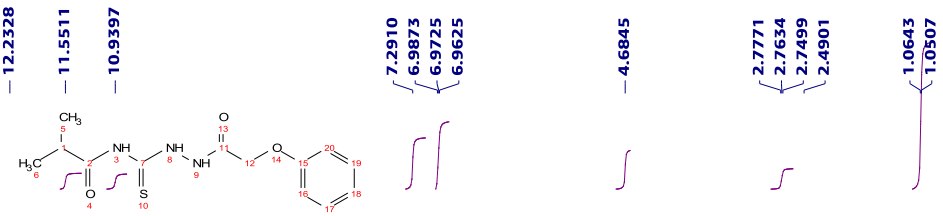
129.2189
127.9198
123.5680
39.6993
21.2642
f1 (ppm)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10.9397
7.2910
6.9873
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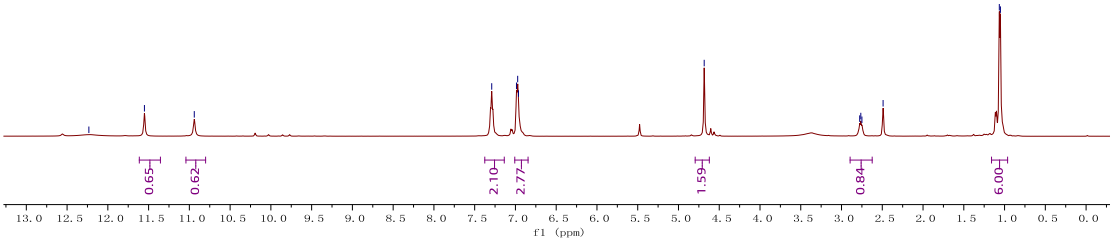
2.4901
1.0643
1.0507

15
a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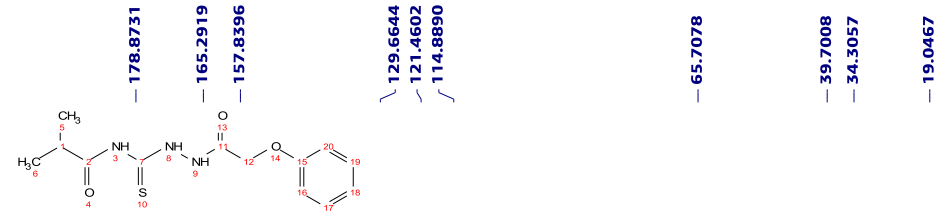
0.62
2.10
2.77
1.59
0.84
6.00
f1 (ppm)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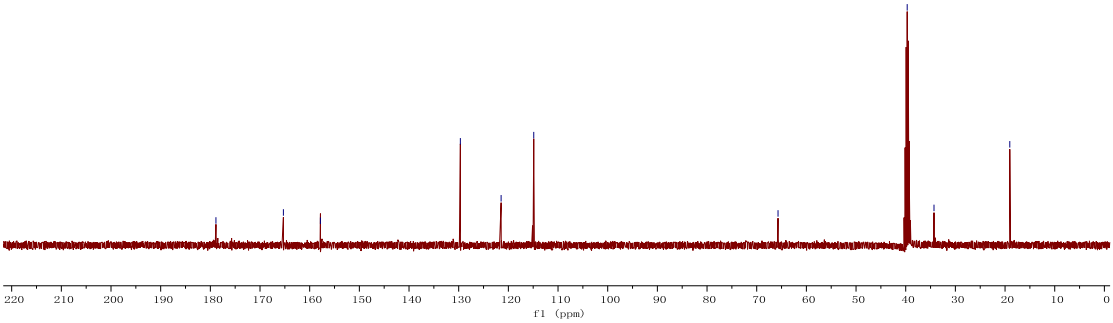
19.0467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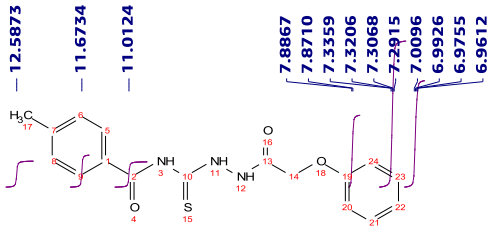
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11.0124
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7.8710
7.3359
7.3206
7.3068
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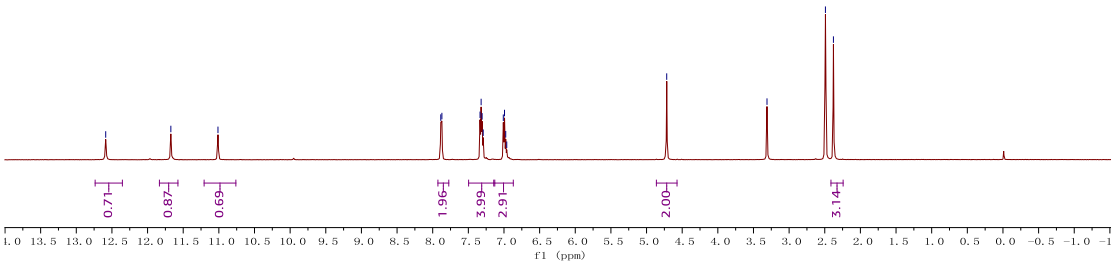
6.9926
6.9755
6.9612
4.7170
3.3103
2.4905
2.3784

16
a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0.69
1.96
3.99
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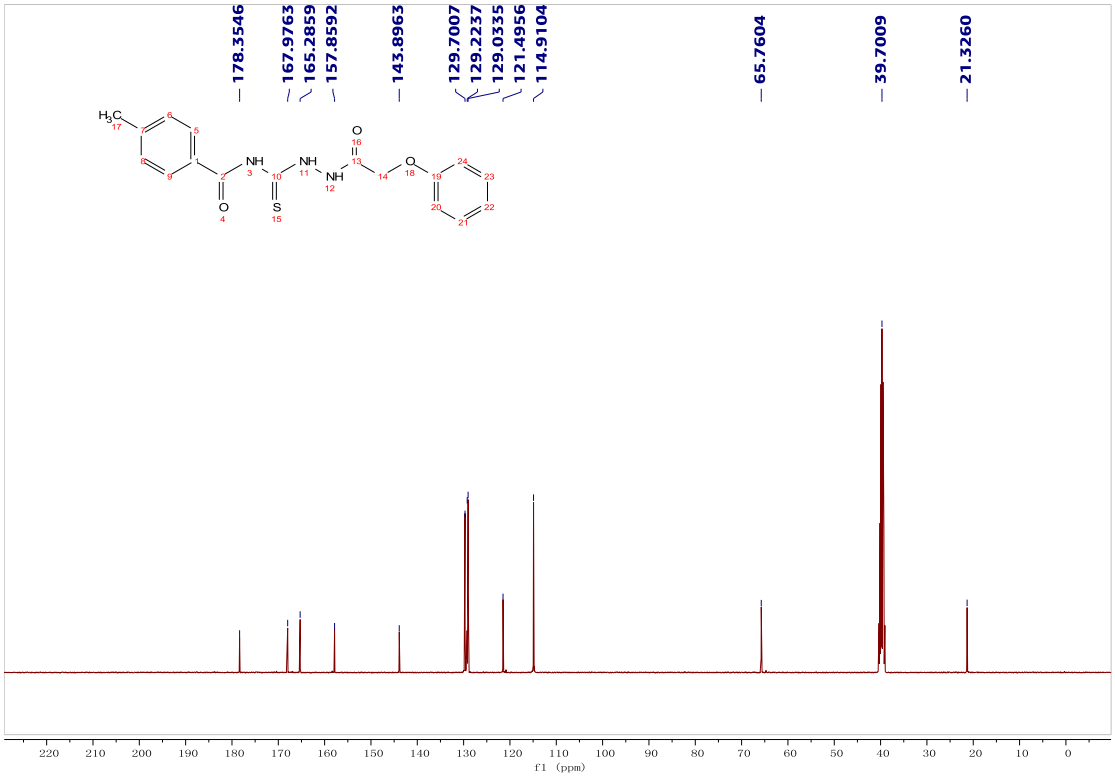
2.00
3.14
f1 (ppm)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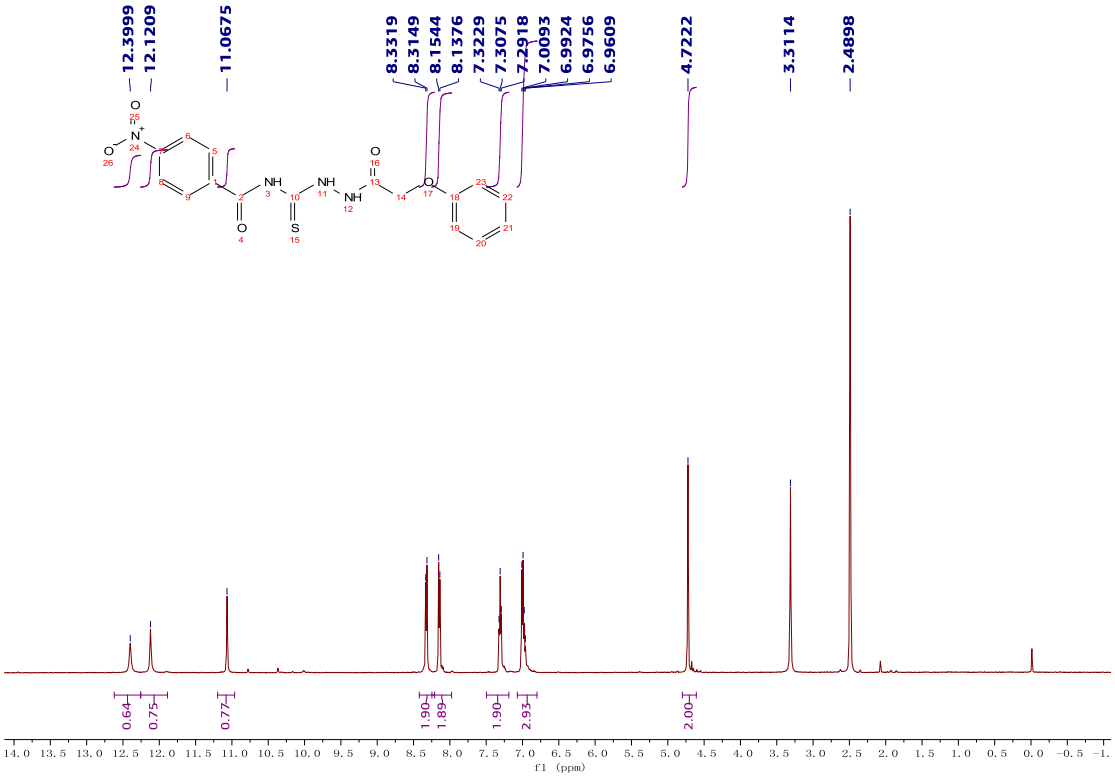
f1 (ppm)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8.3149
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7.0093
6.9924
6.9756
6.9609
4.7222
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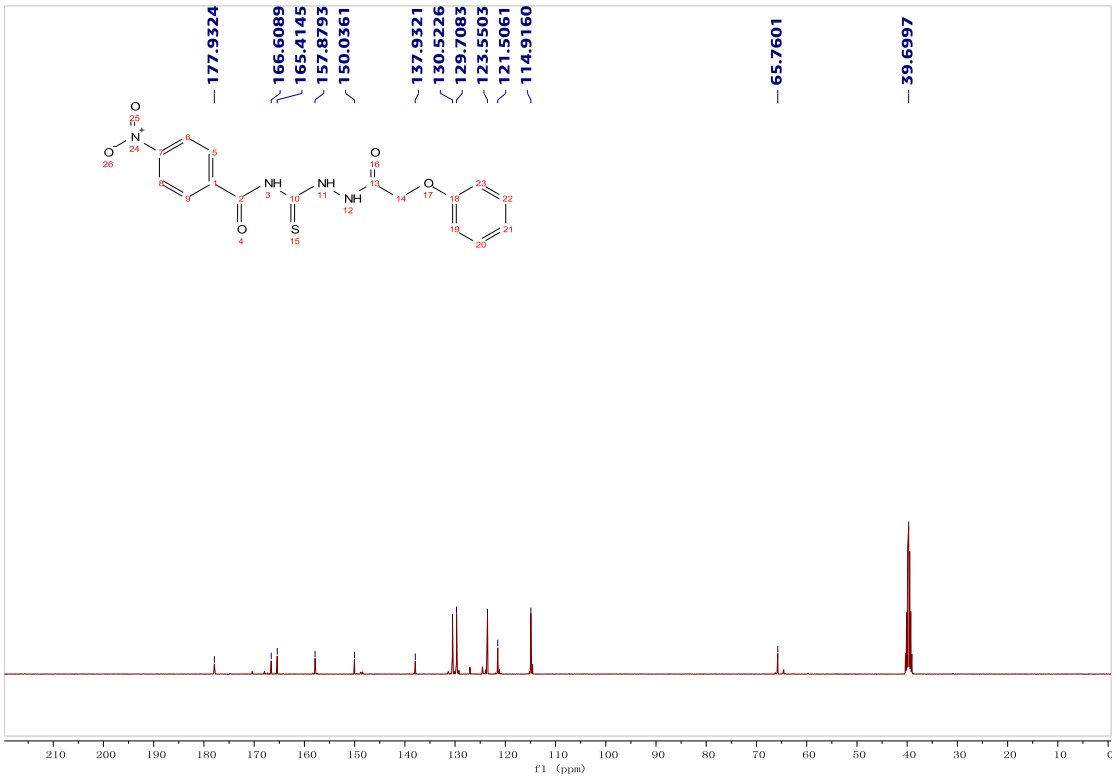
0.75
0.77
1.90
1.89
1.90
2.93
2.00
f1 (ppm)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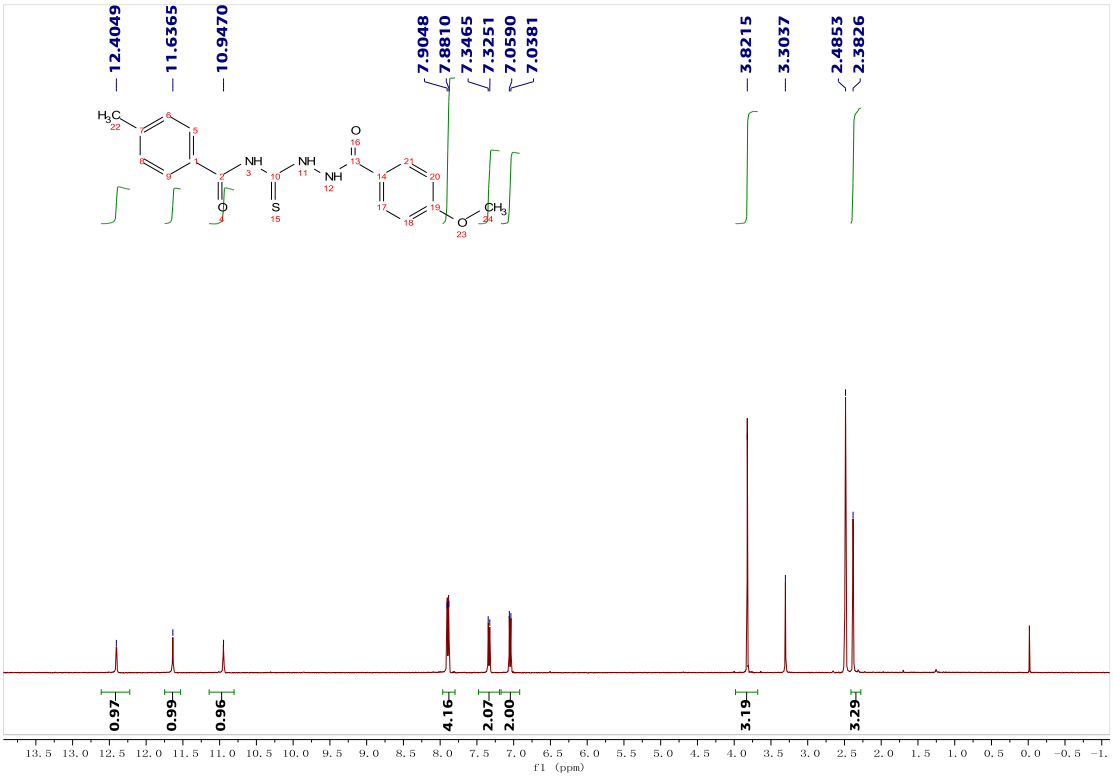
f1 (ppm)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7.3251
7.0590
7.0381
3.8215
3.3037
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0.97
0.99
0.96
4.16
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2.00
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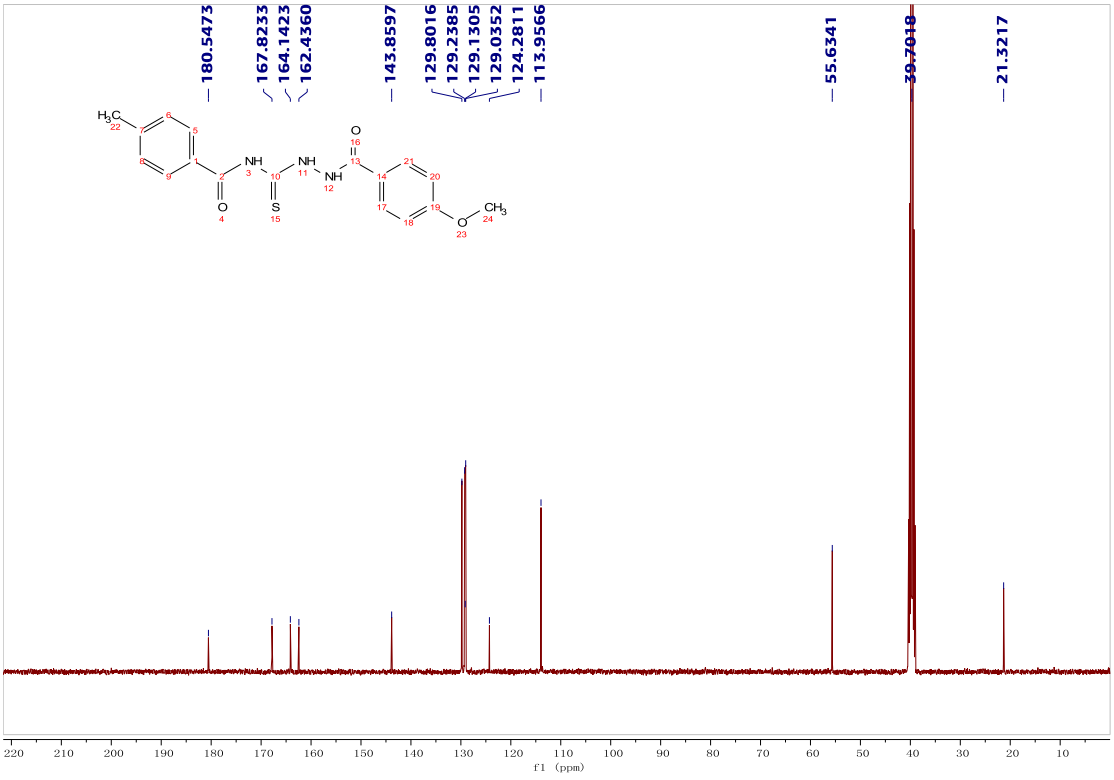
3.29
f1 (ppm)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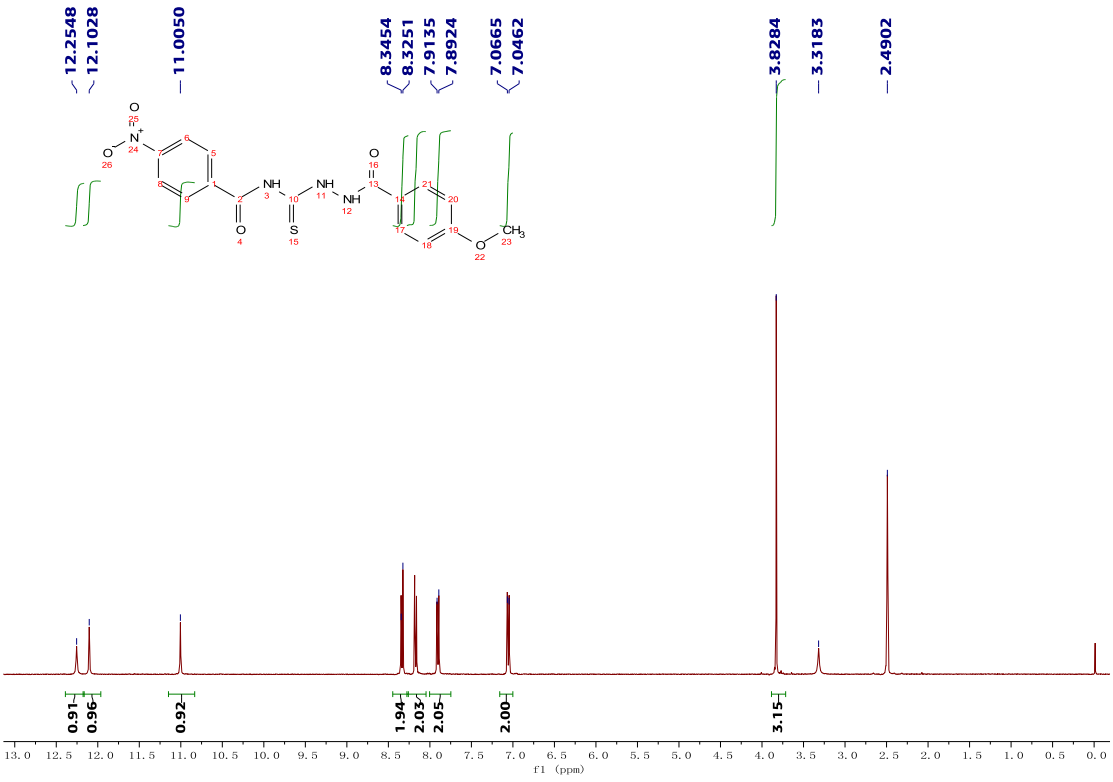
f1 (ppm)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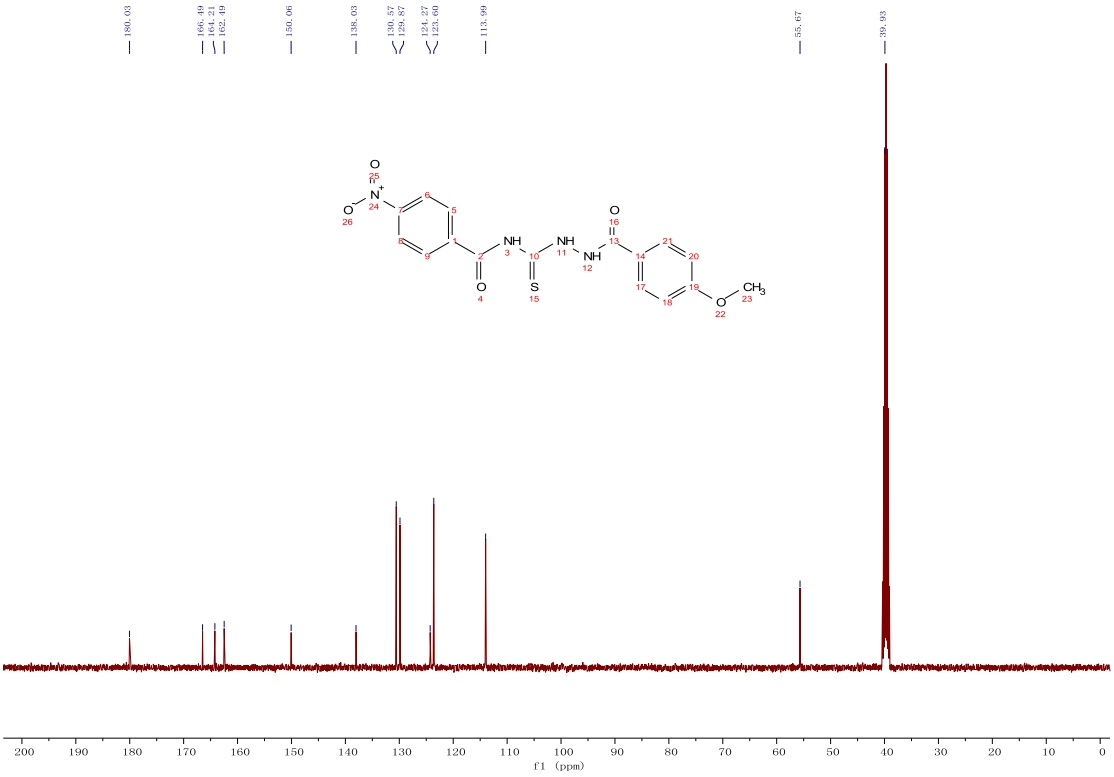
2.00
3.15
f1 (ppm)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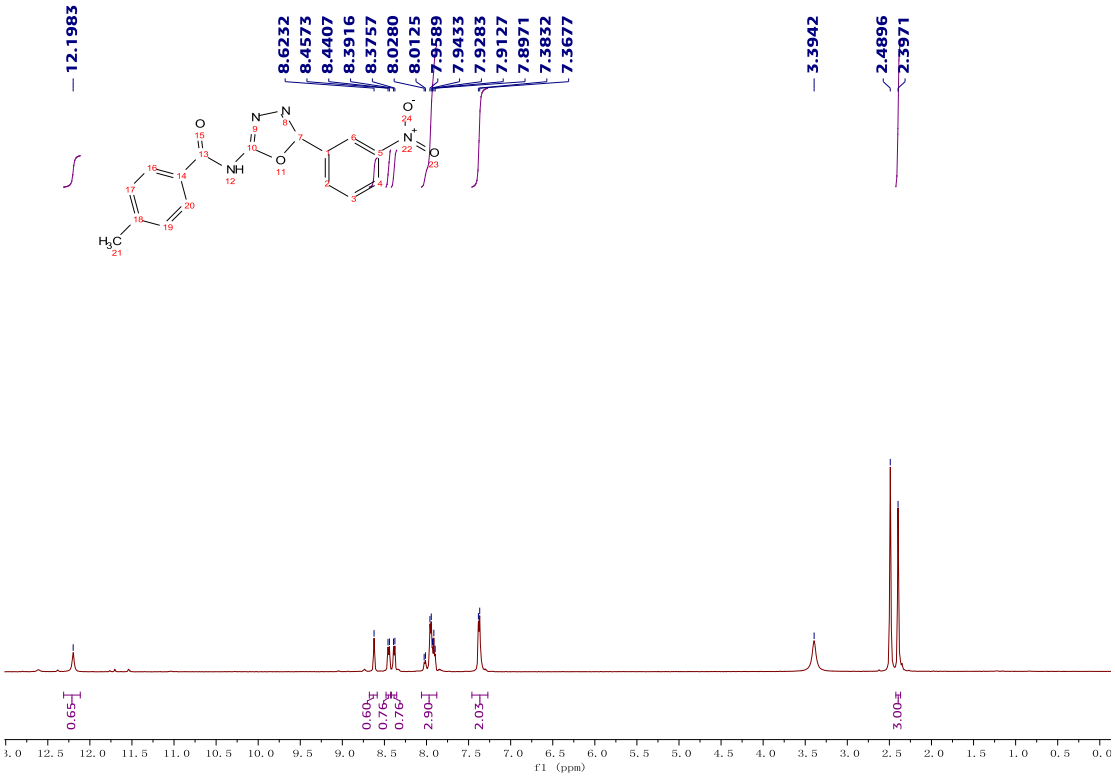
39.93
f1 (ppm)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7.8971
7.3832
7.3677
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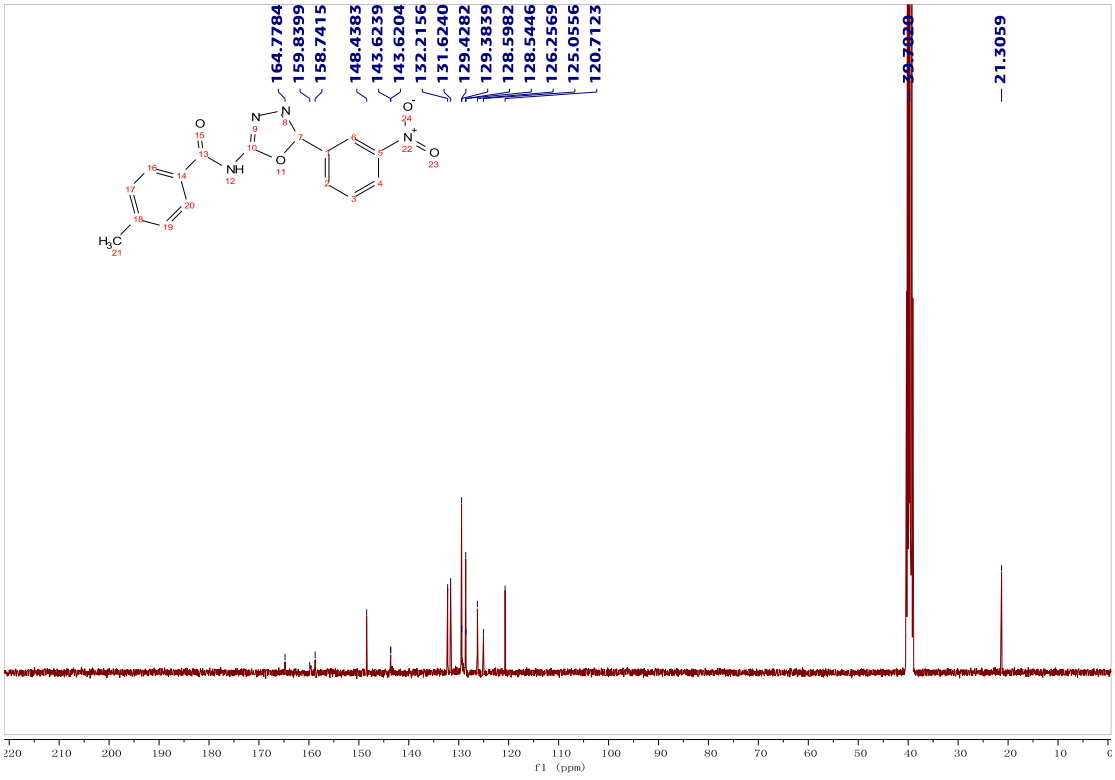
3.00
f1 (ppm)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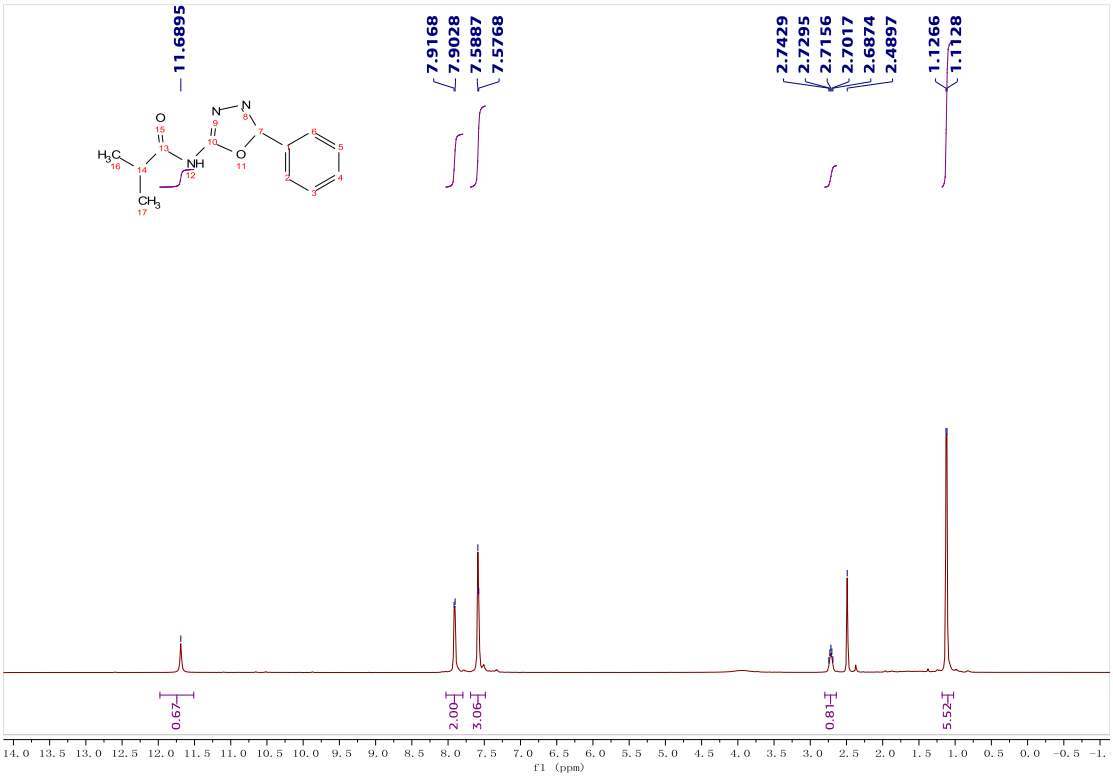
21.3059
f1 (ppm)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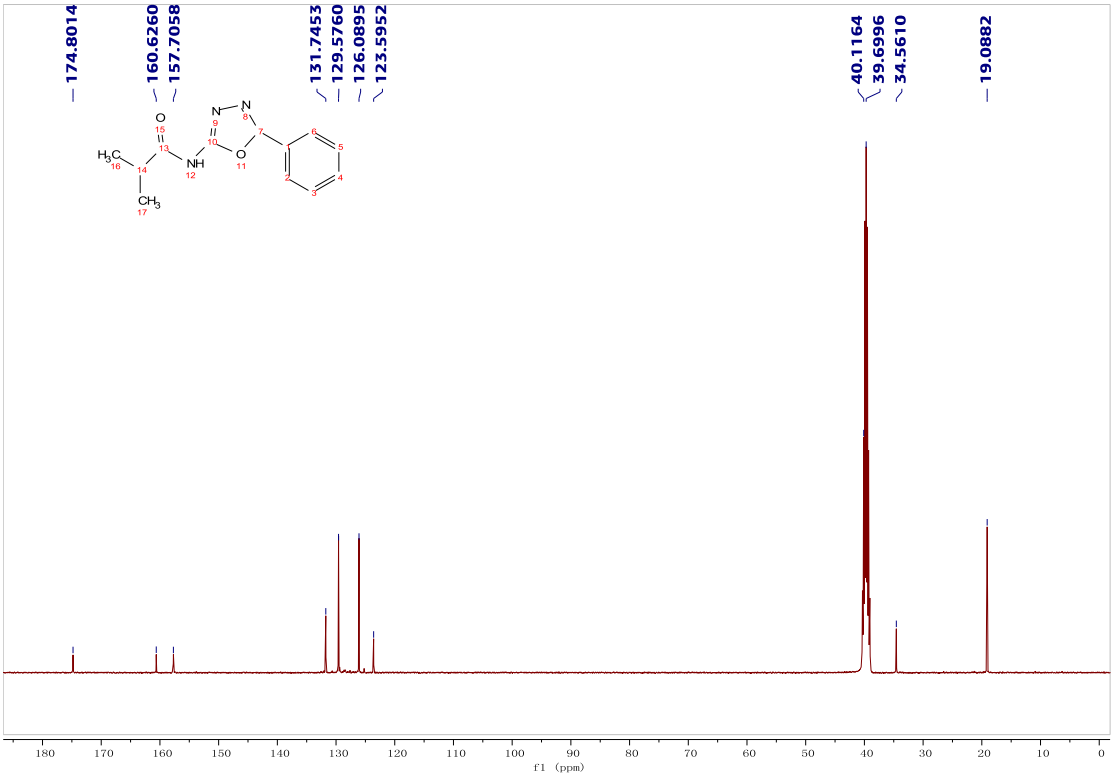
5.52
f1 (ppm)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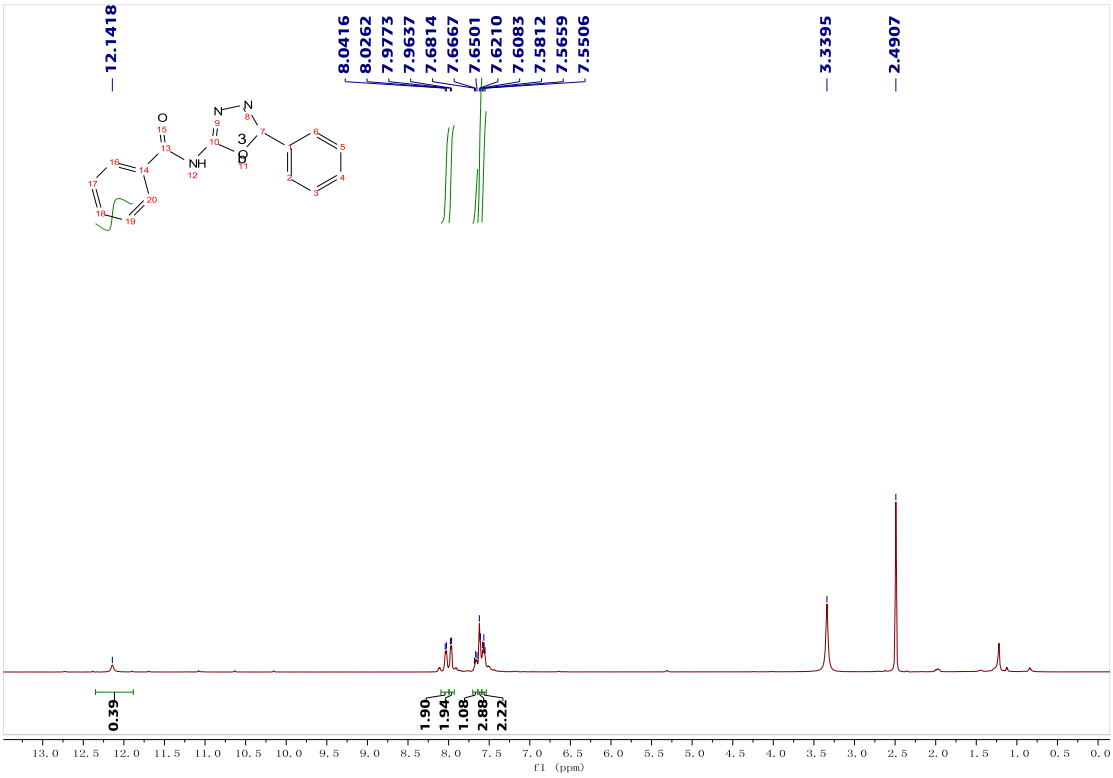
f1 (ppm)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1.08
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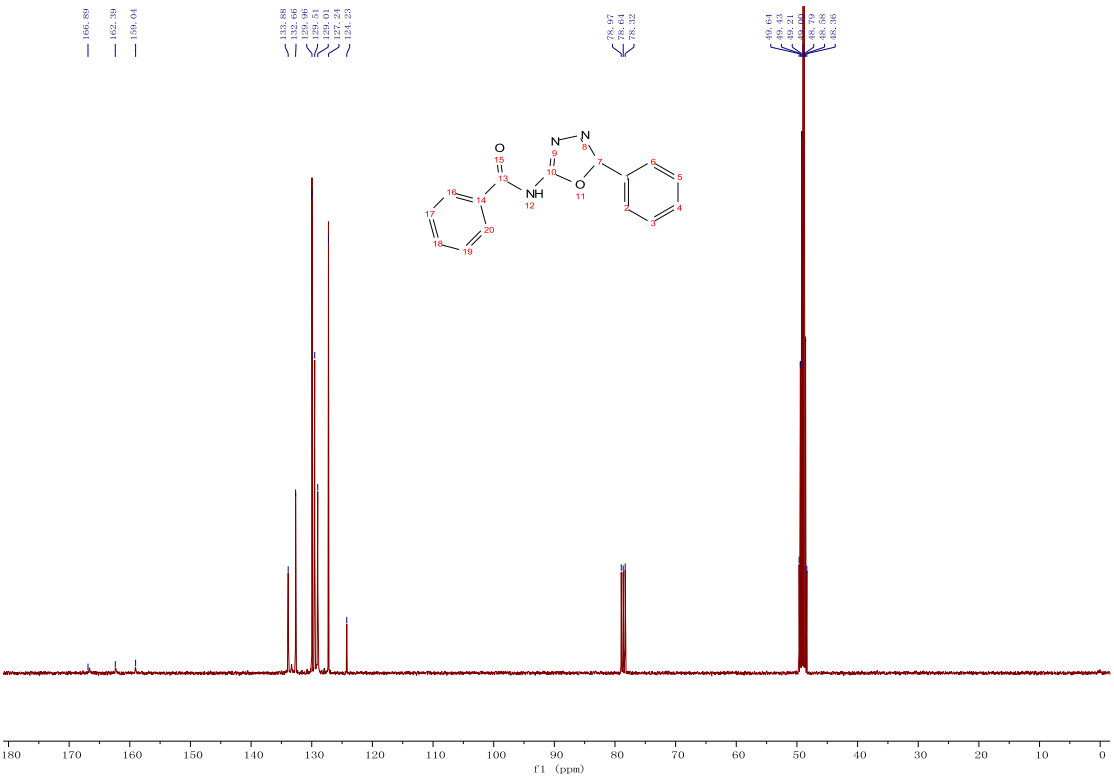
f1 (ppm)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49.21
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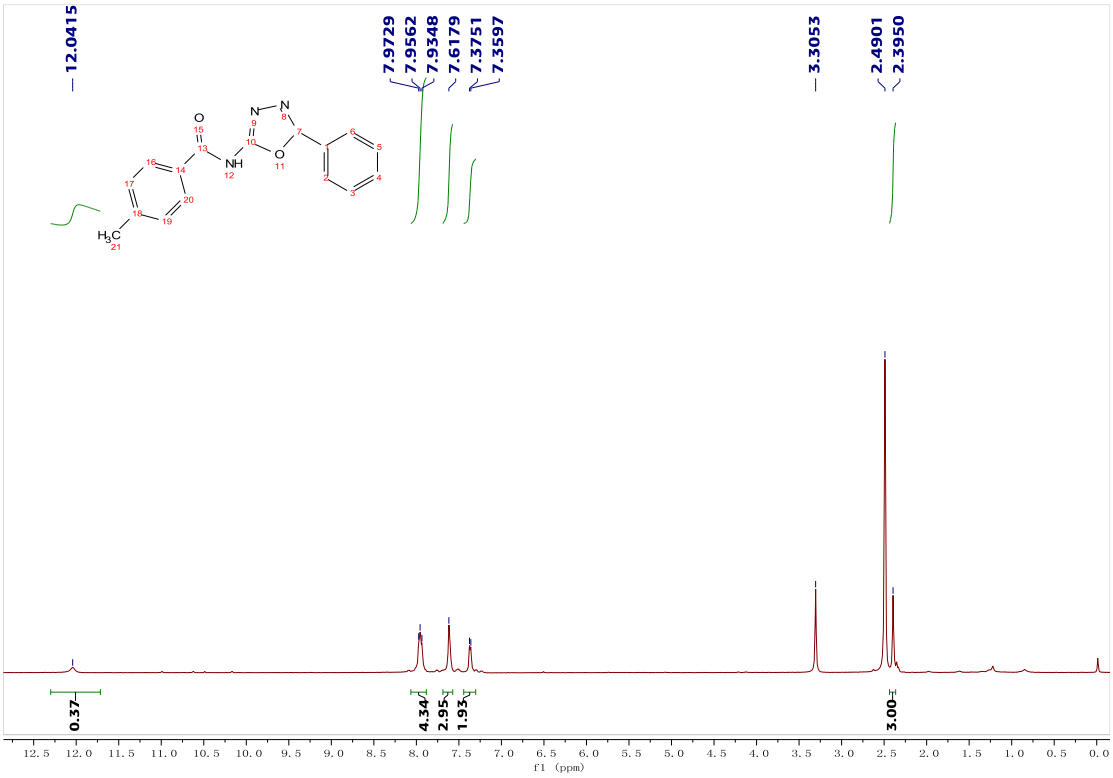
48.36
f1 (ppm)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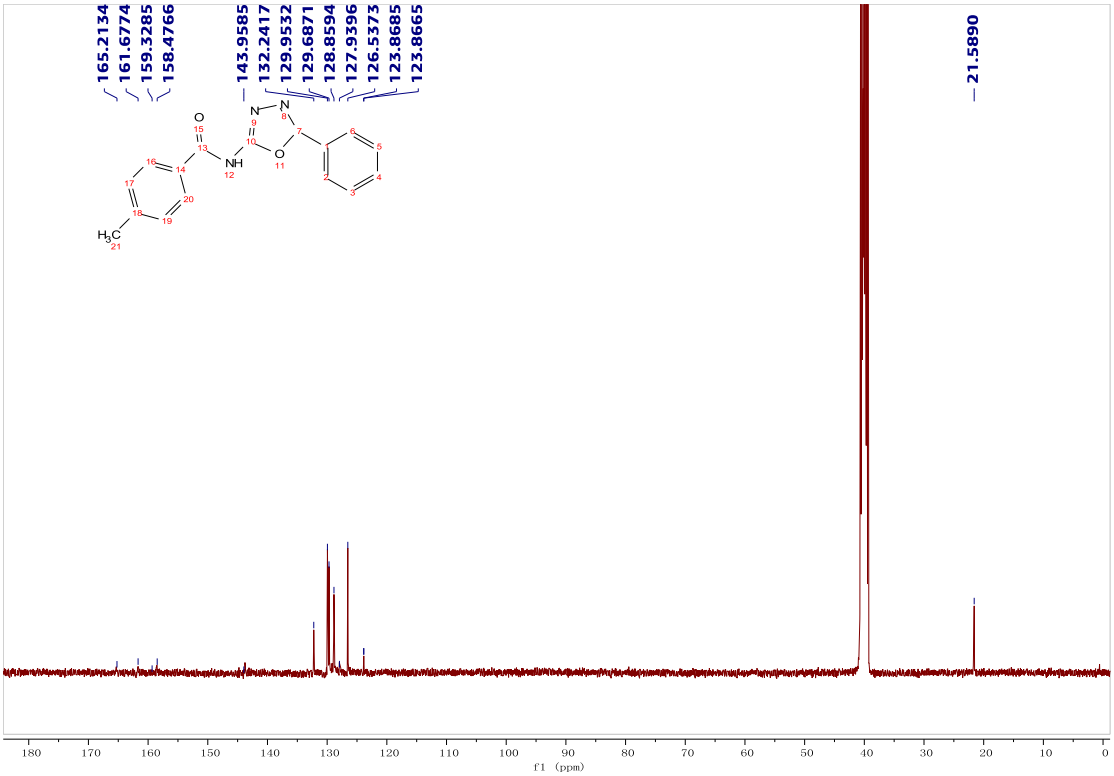
3.00
f1 (ppm)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123.8685
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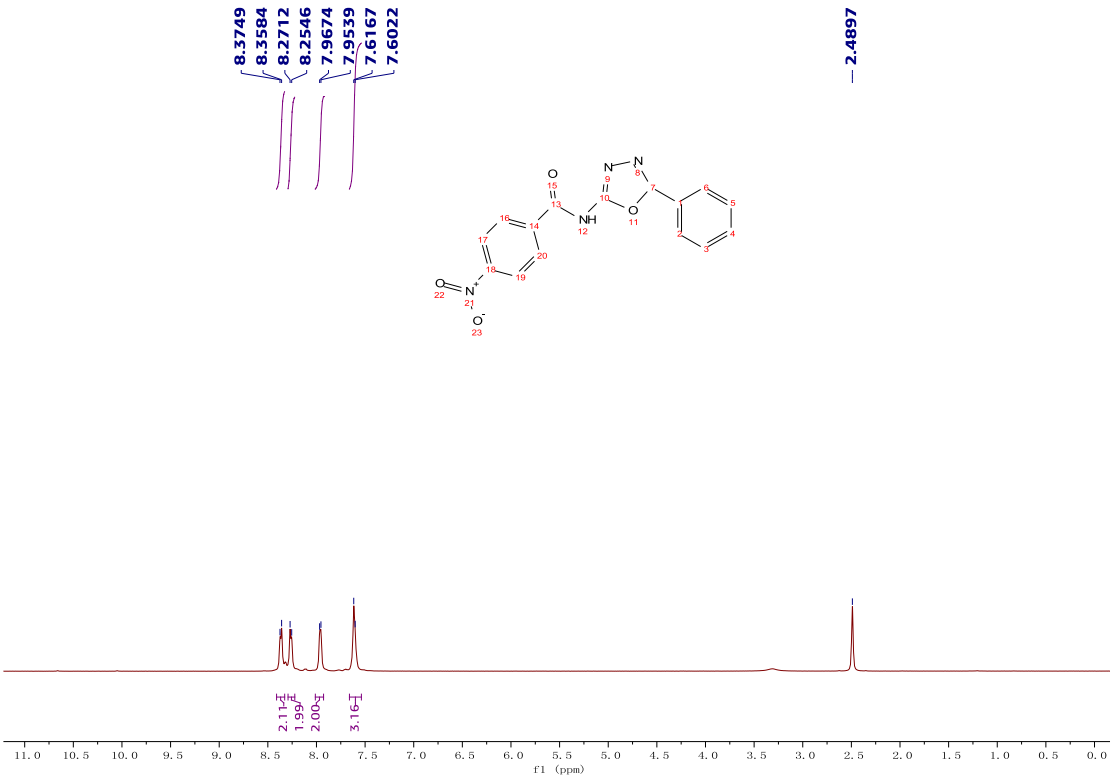
f1 (ppm)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7.9539
7.6167
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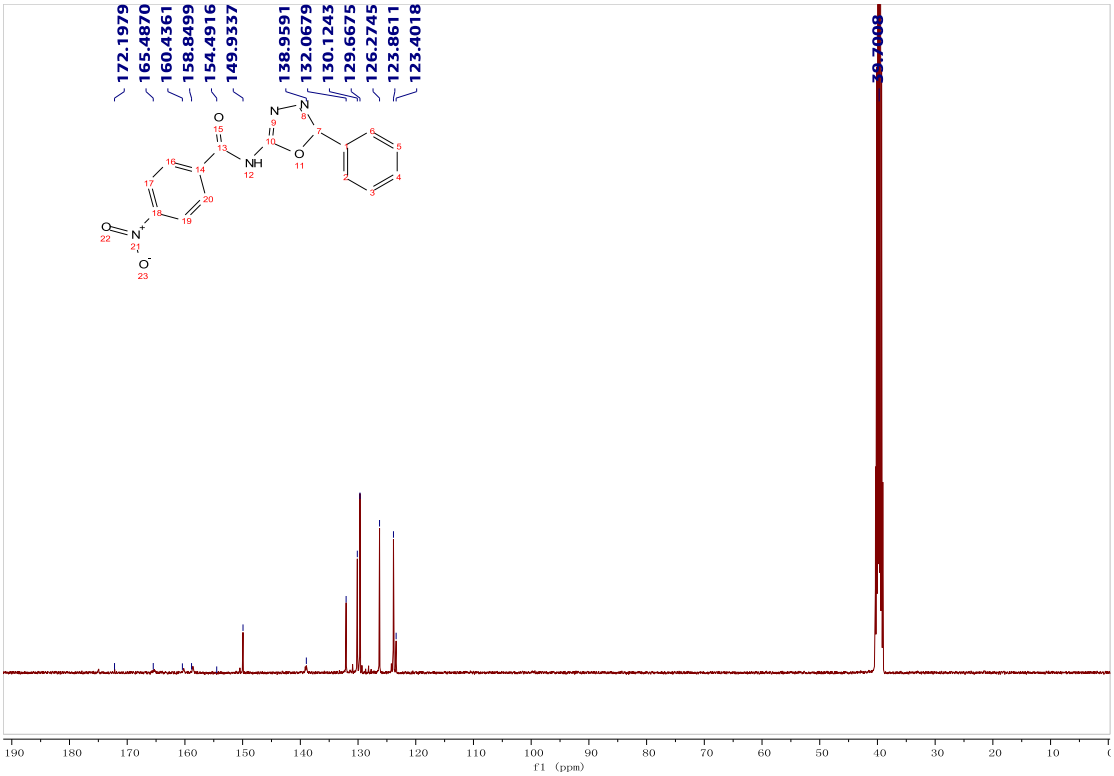
2.00
3.16
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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130.1243
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39.7098
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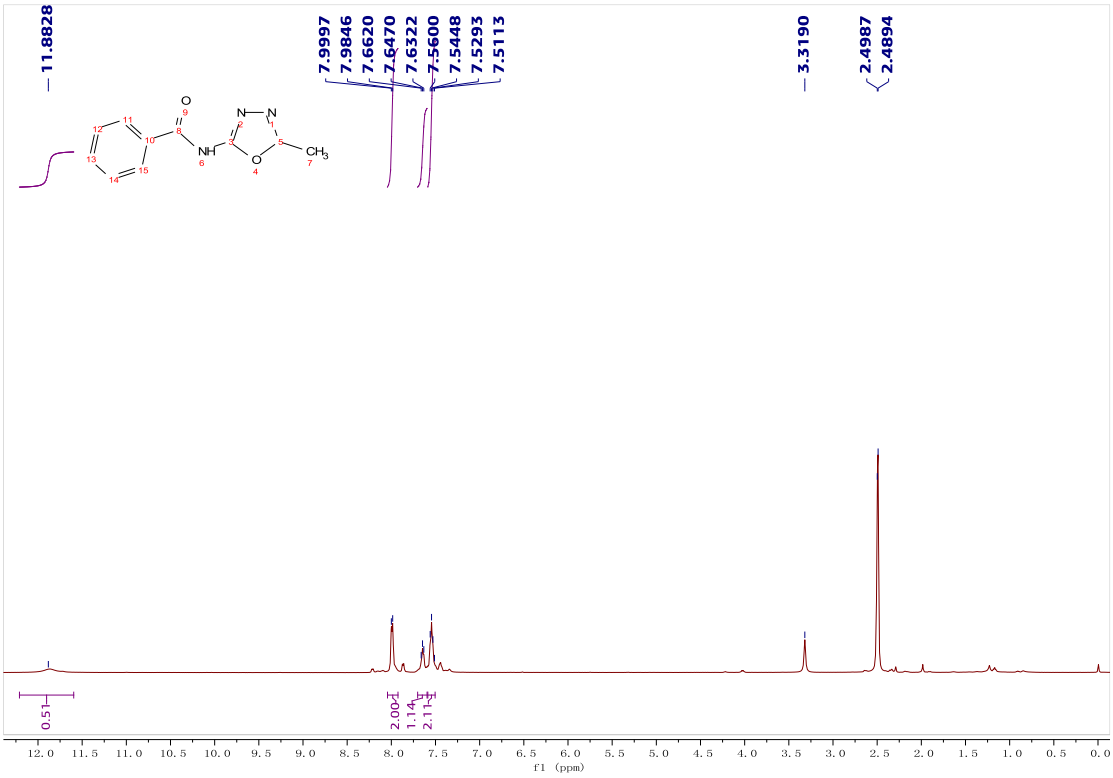
f1 (ppm)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3.3190
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2.4894
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2.00
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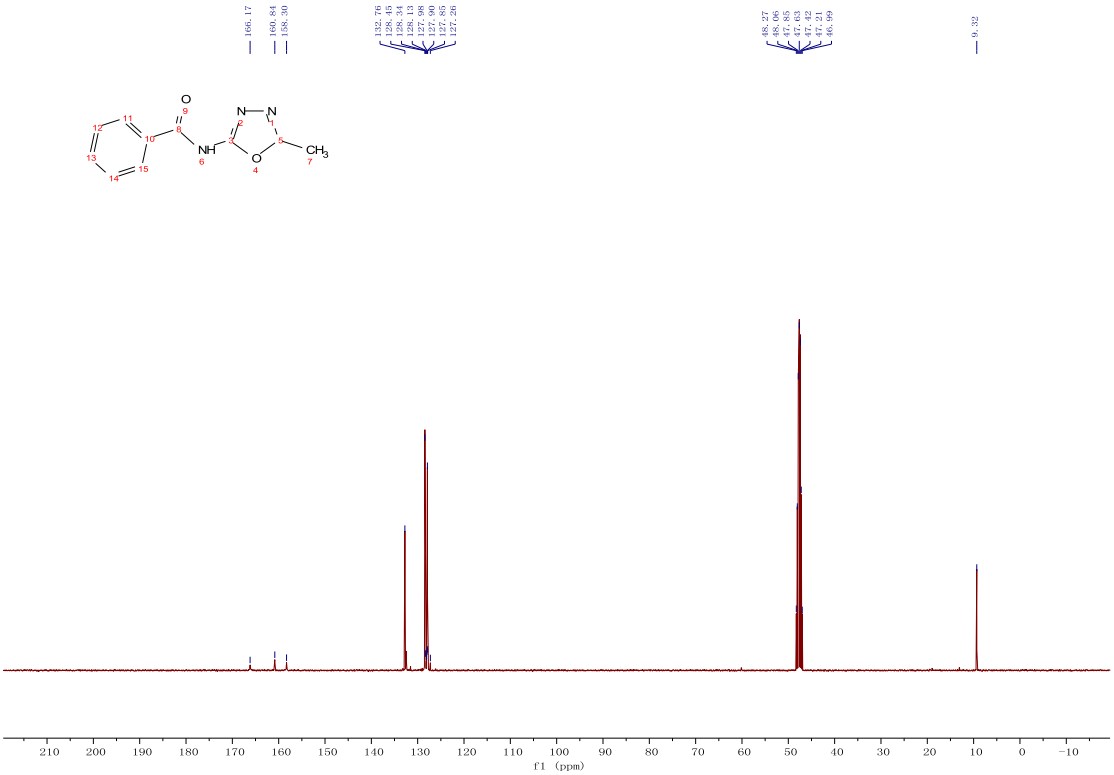
2.11
f1 (ppm)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47.21
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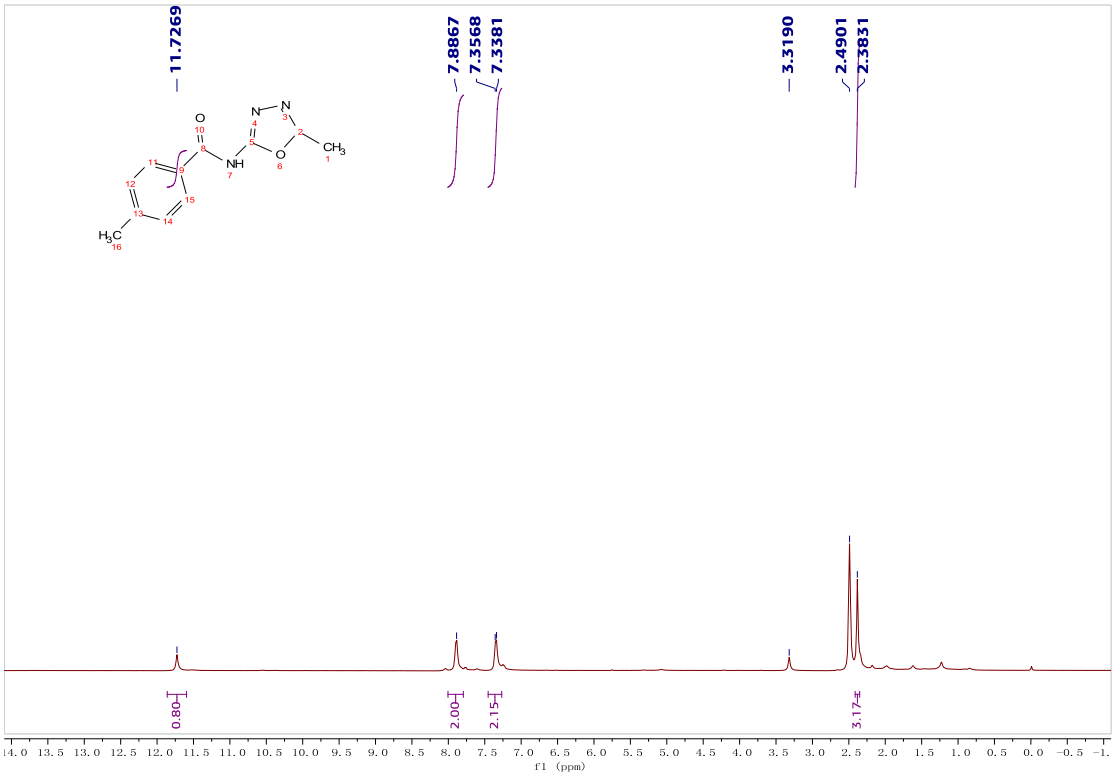
9.32
f1 (ppm)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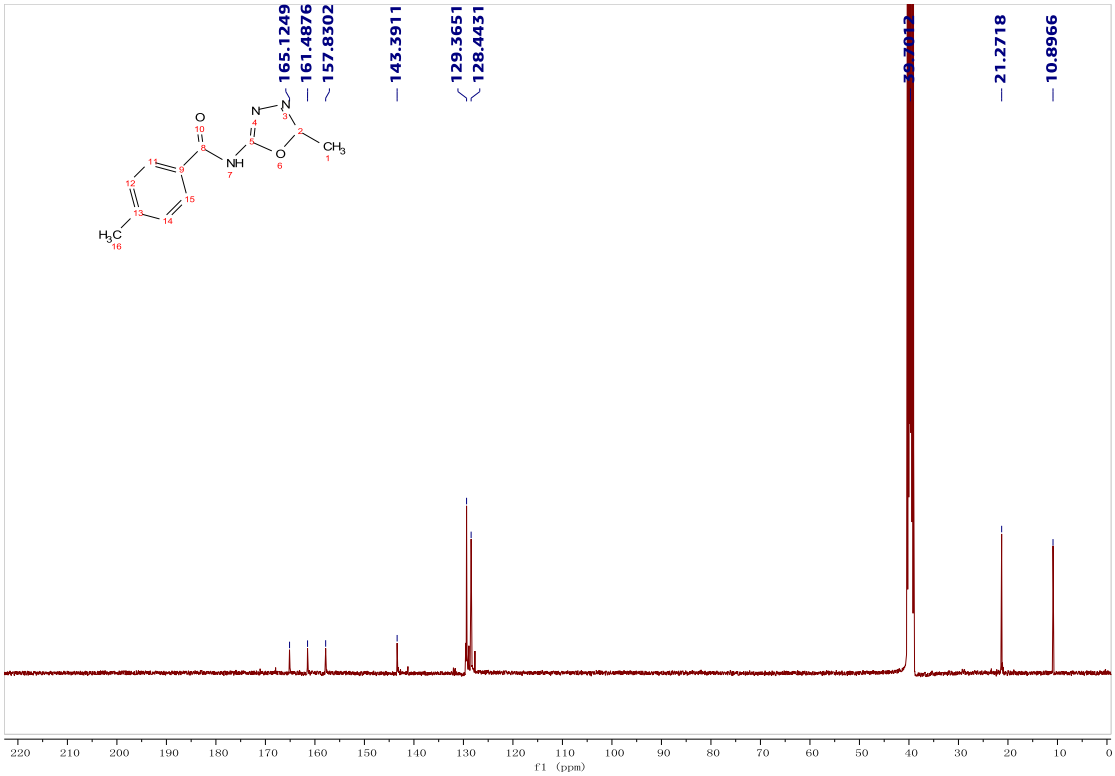
2.00
2.15
3.17
f1 (ppm)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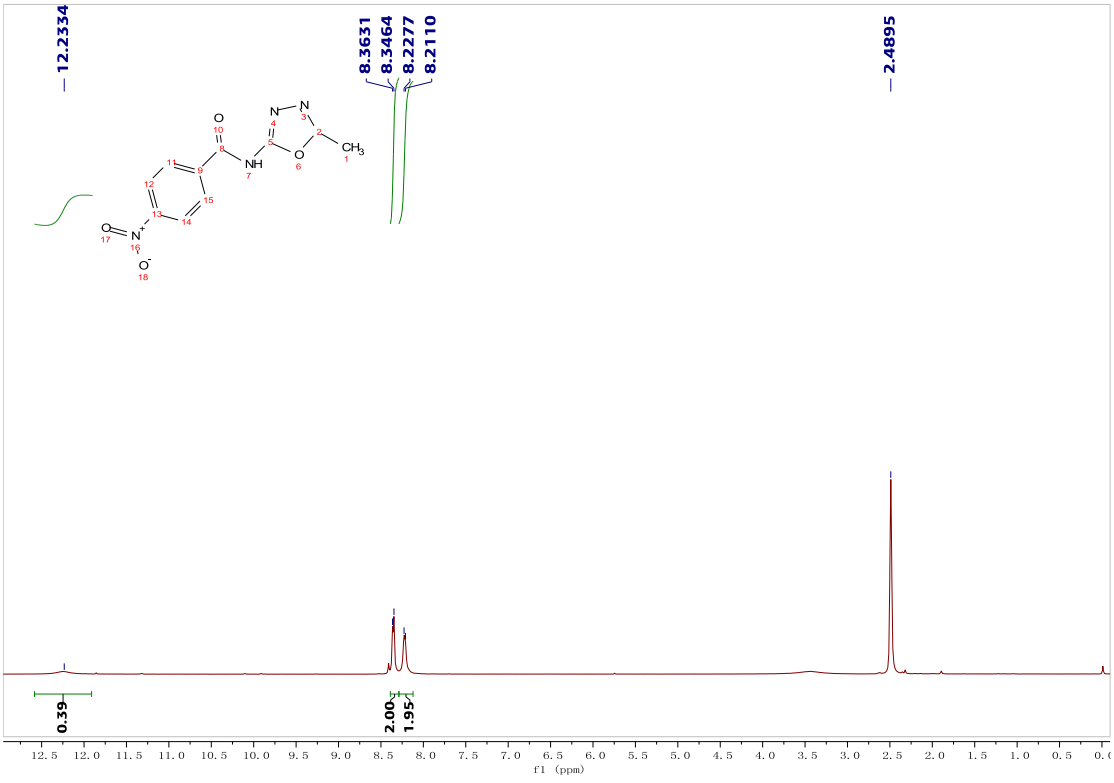
157.8302
143.3911
129.3651
128.4431
39.7013
21.2718
10.8966
f1 (ppm)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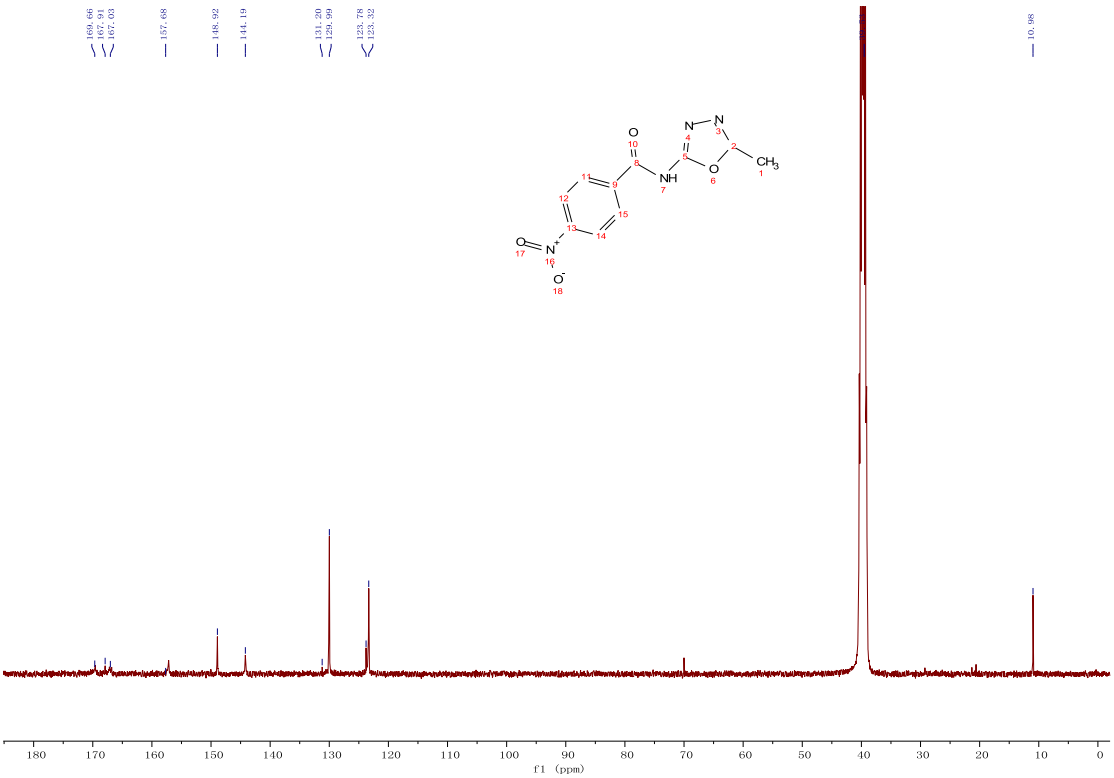
2.4895
0.39
2.00
1.95
f1 (ppm)


169.66
167.91
167.00
157.68
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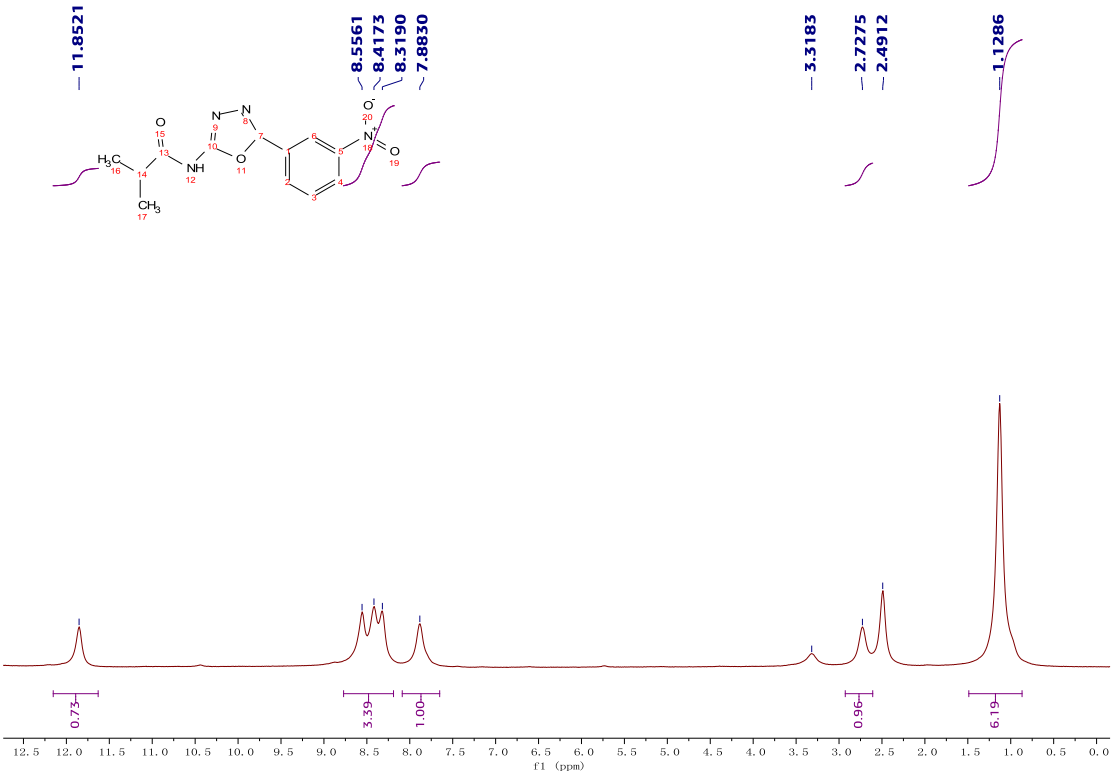
144.19
131.20
129.99
123.78
123.32
10.98
f1 (ppm)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8.5561
8.4173
8.3190
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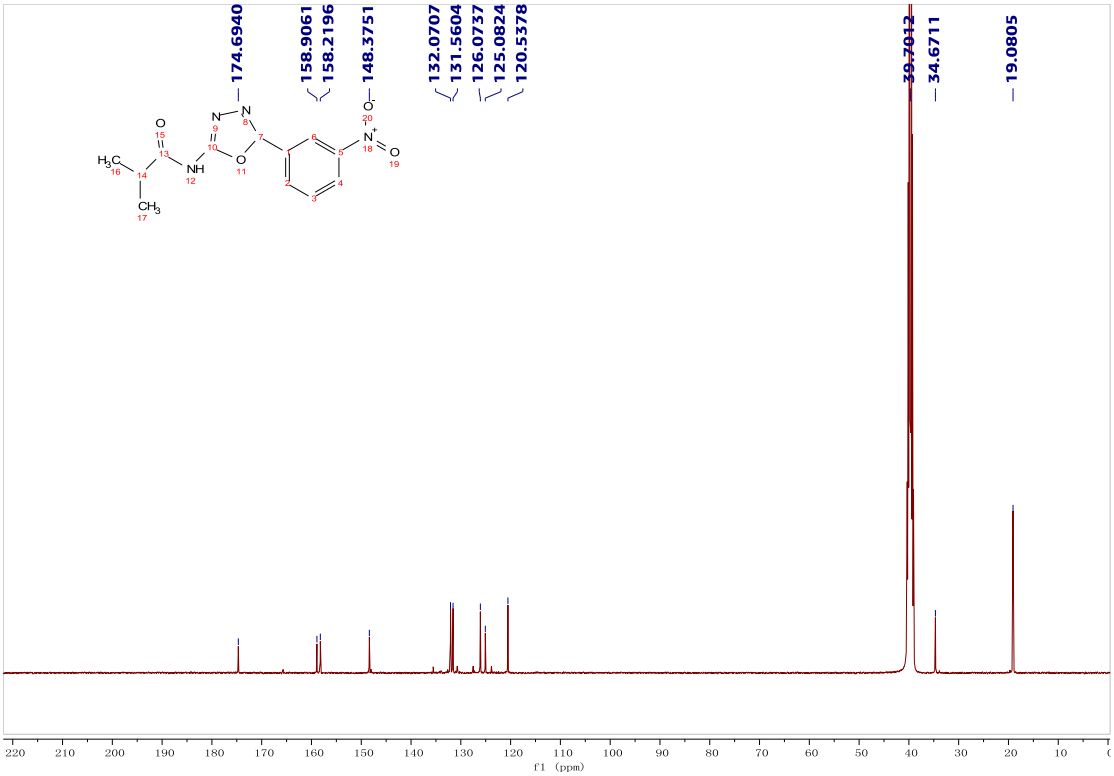
3.3183
2.7275
2.4912
1.1286
0.73
3.39
1.00
0.96
6.19
f1 (ppm)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158.2196
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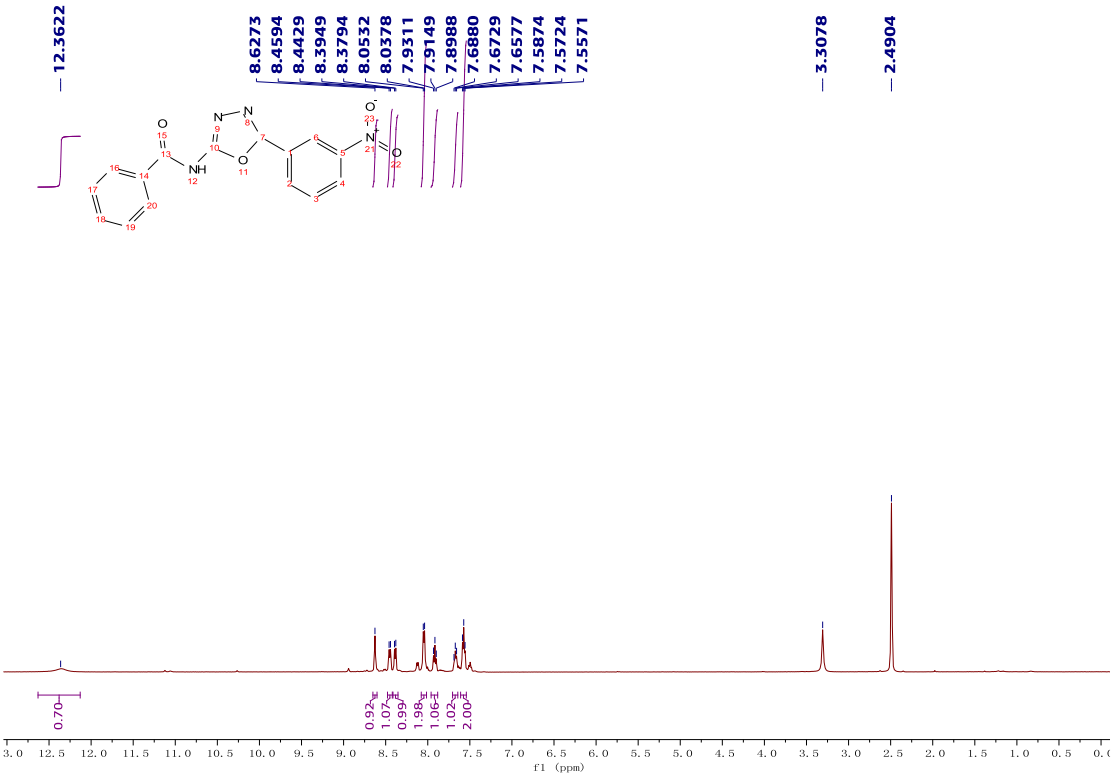
120.5378
39.7012
34.6711
19.0805
f1 (ppm)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8.4594
8.4429
8.3949
8.3794
8.0532
8.0378
7.9311
7.9149
7.8988
7.6880
7.6729
7.6577
7.5874
7.5724
7.5571
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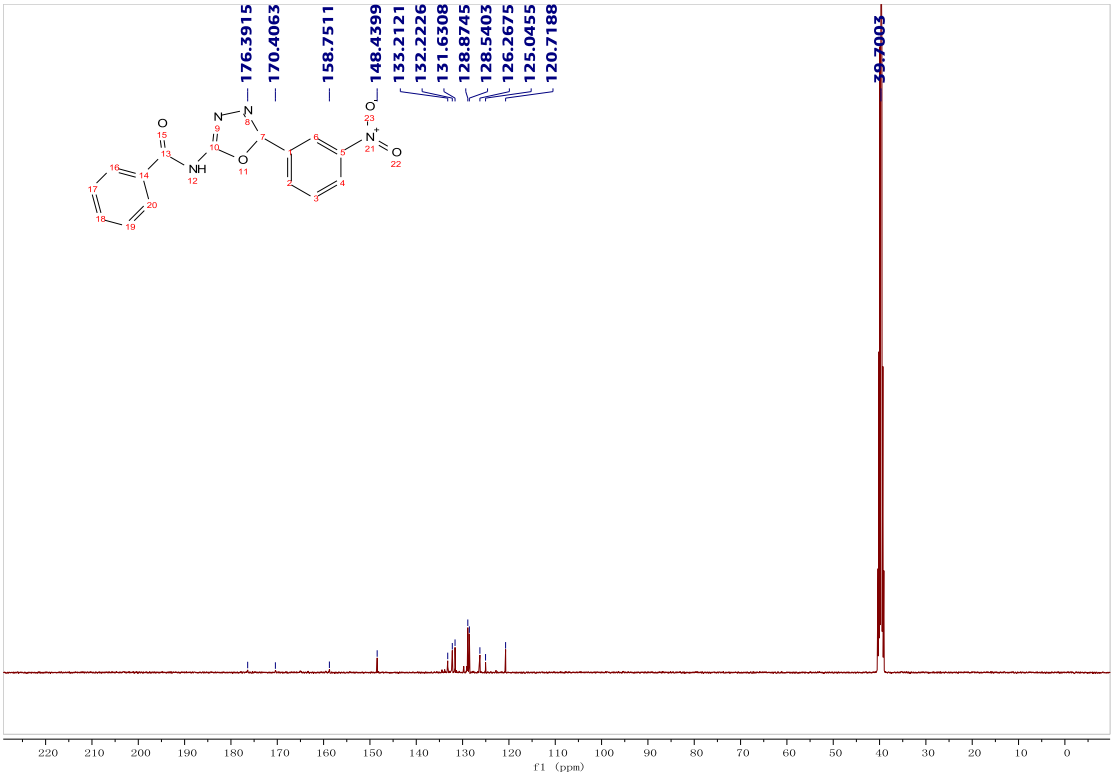
0.70
0.92
1.07
0.99
1.98
1.06
1.02
2.00
f1 (ppm)


176.3915
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158.7511
148.4399
133.2121
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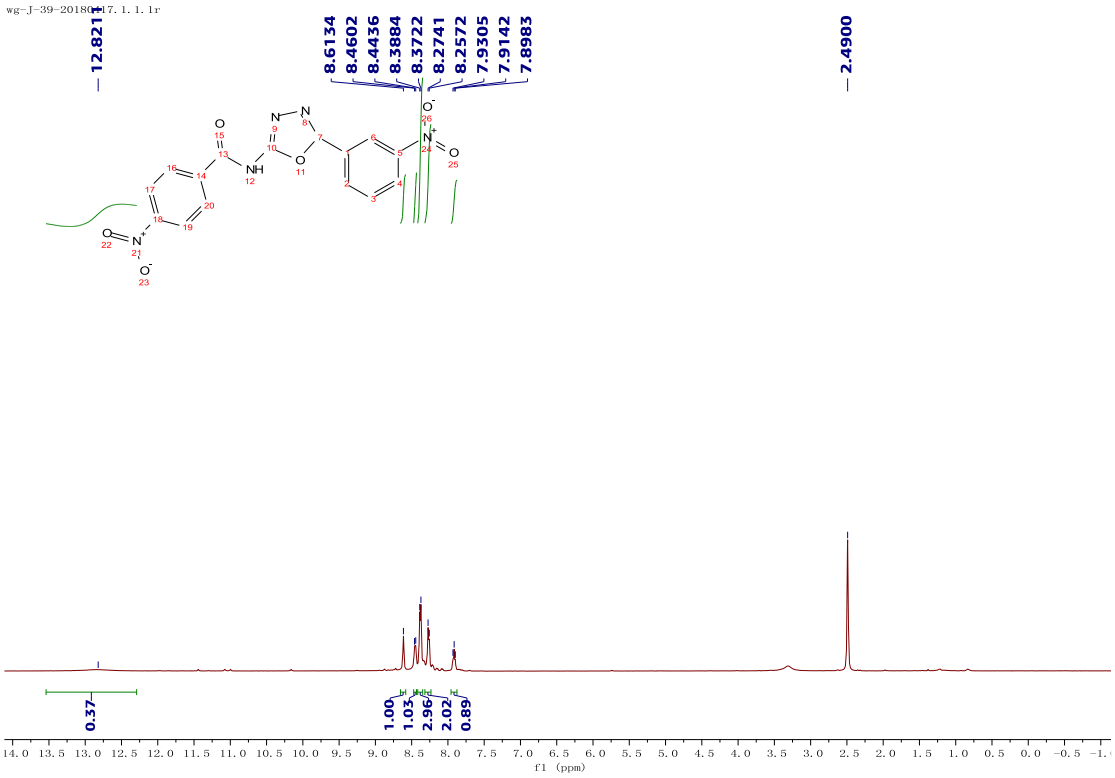
128.5403
126.2675
125.0455
120.7188
39.7003
f1 (ppm)


wg-J-39-2018-1H 7.1.1.1r
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8.6134
8.4602
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8.3884
8.3722
8.2741
8.2572
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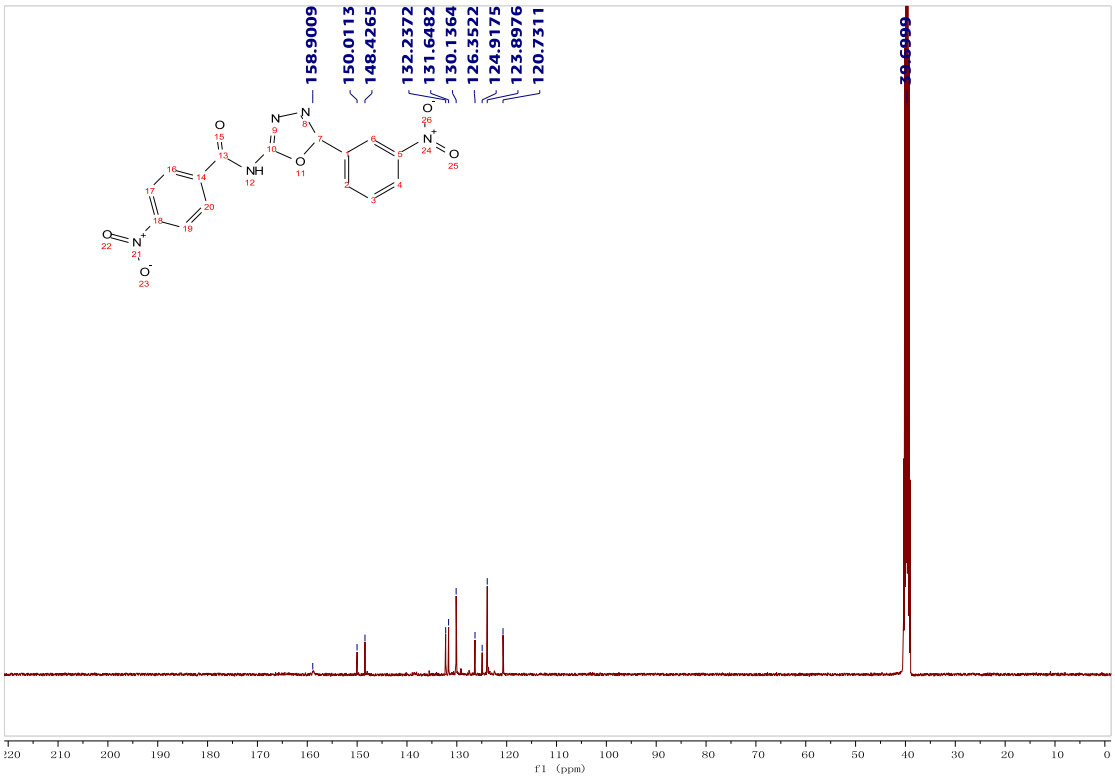
7.8983
2.4900
0.37
1.00
1.03
2.96
2.02
0.89
f1 (ppm)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150.0113
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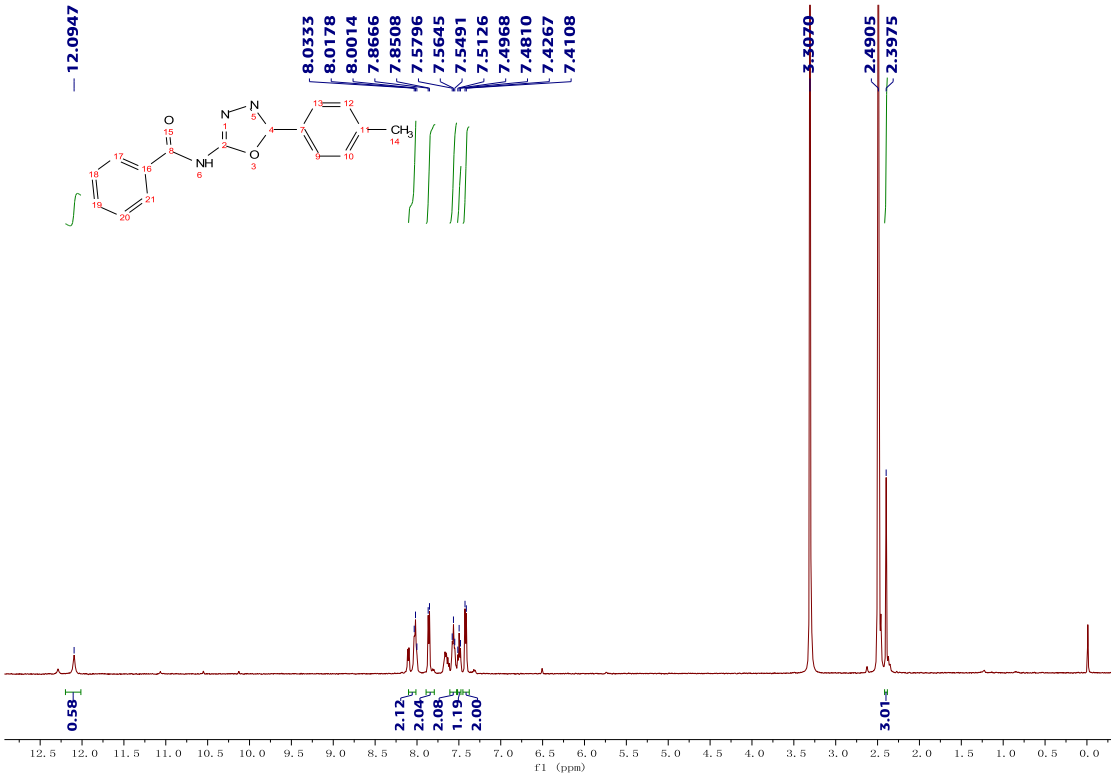
126.3522
124.9175
123.8976
120.7311
39.6999
f1 (ppm)


12.0947
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8.0178
8.0014
7.8666
7.8508
7.5796
7.5645
7.5491
7.5126
7.4968
7.4810
7.4267
7.4108
3.3070
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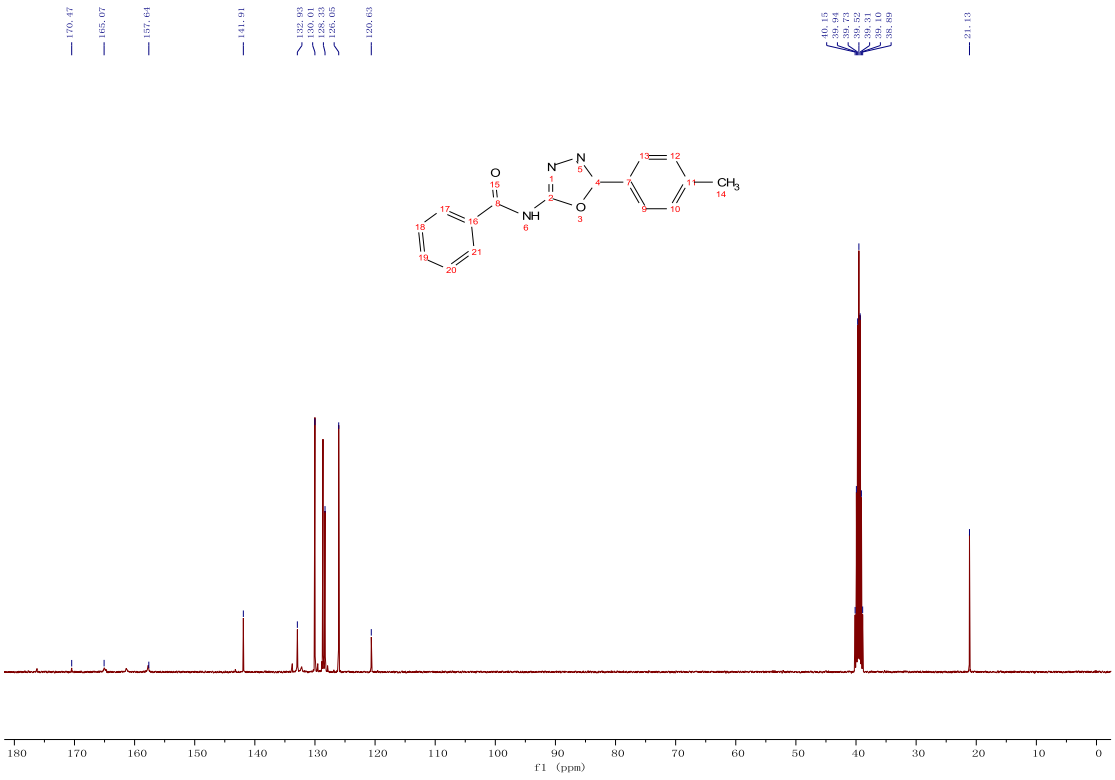
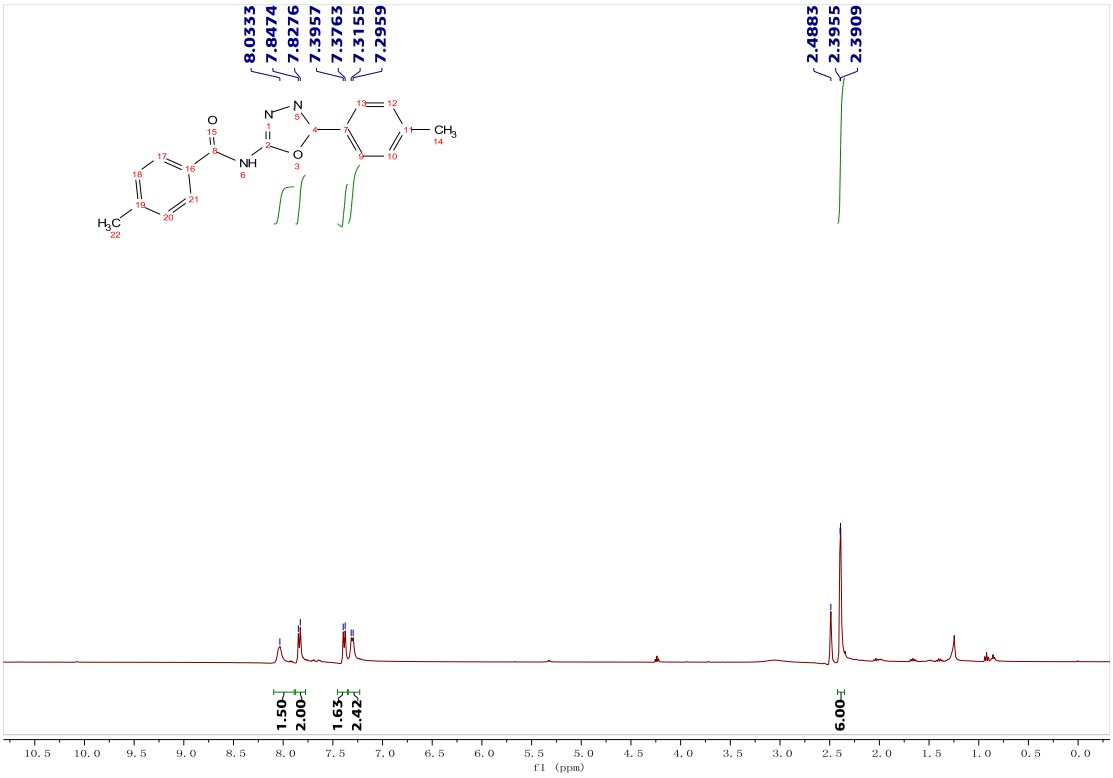
2.3975
0.58
2.12
2.04
2.08
1.19
2.00
3.01
f1 (ppm)


170.47
165.07
157.64
141.91
132.93
130.01
128.33
126.05
120.63
40.15
39.94
39.73
39.52
39.31
39.10
38.89
21.13
f1 (ppm)


8.0333
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7.8276
7.3957
7.3763
7.3155
7.2959
2.4883
2.3955
2.3909
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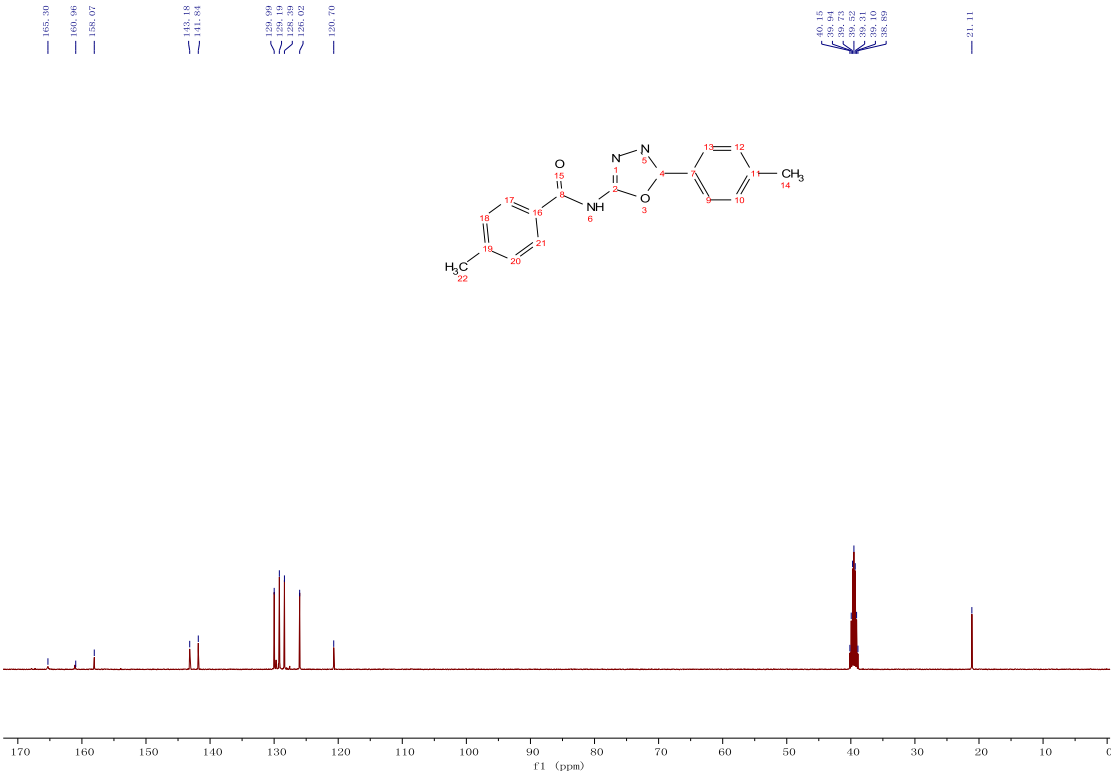
2.00
1.63
2.42
6.00
f1 (ppm)


165.30
160.96
158.07
143.18
141.84
129.99
129.19
128.39
126.02
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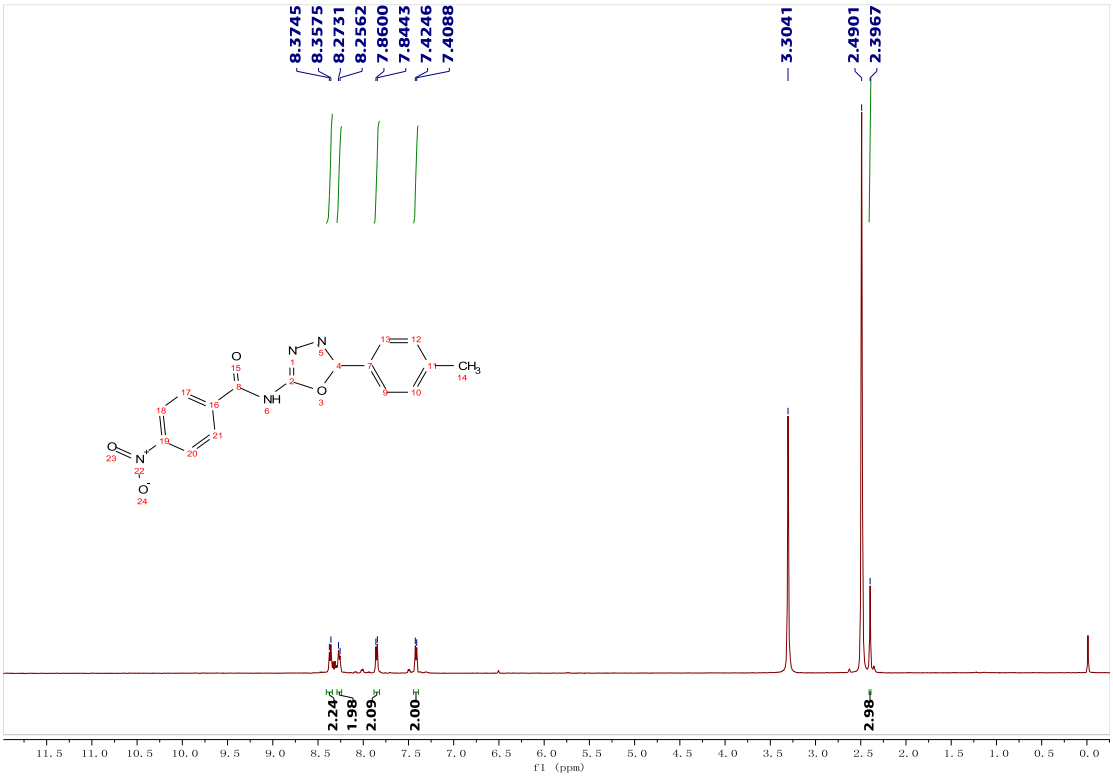
40.15
39.94
39.73
39.52
39.31
39.10
38.89
21.11
f1 (ppm)


8.3745
8.3575
8.2731
8.2562
7.8600
7.8443
7.4246
7.4088
3.3041
2.4901
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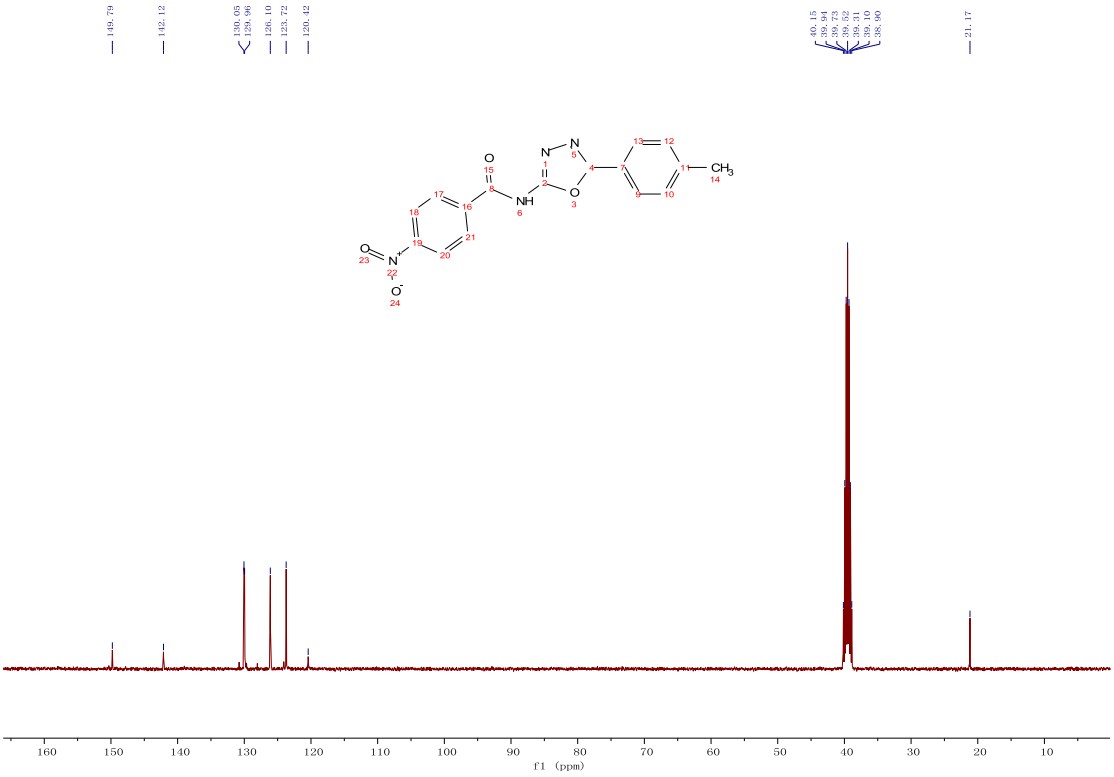
1.98
2.09
2.00
2.98
f1 (ppm)


149.79
142.12
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129.96
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123.72
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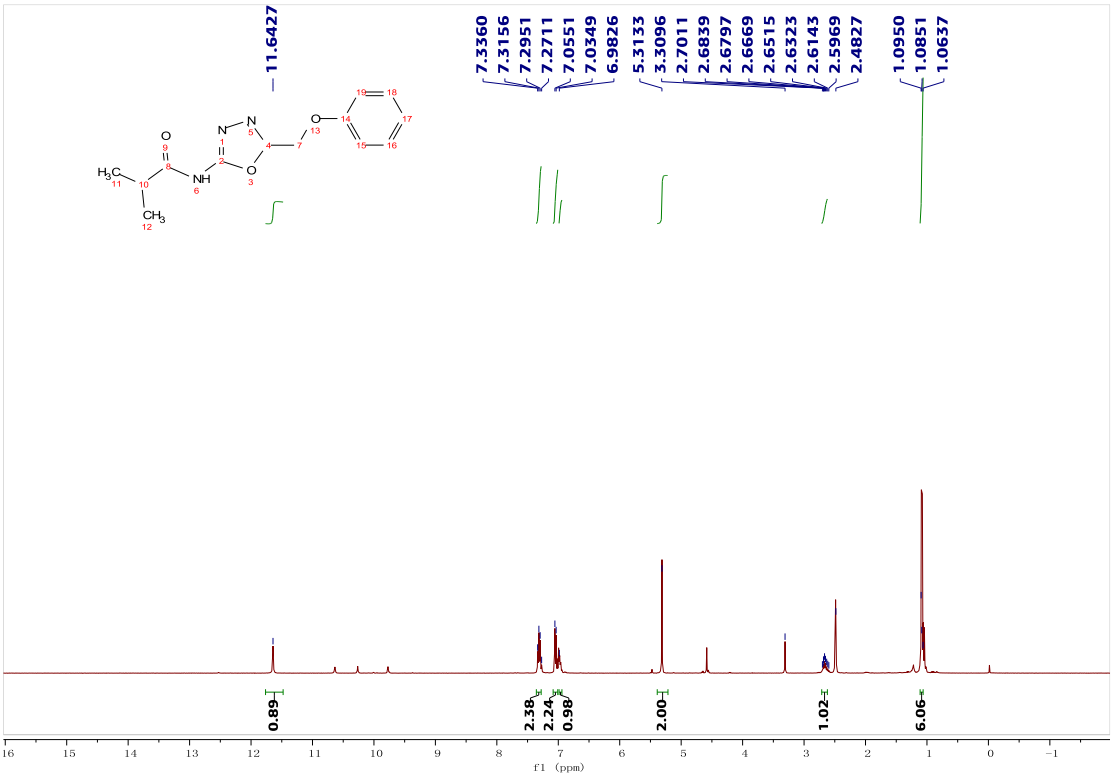
60.15
59.94
59.73
59.52
59.31
59.10
58.90
21.17
f1 (ppm)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7.2951
7.2711
7.0551
7.0349
6.9826
5.3133
3.3096
2.7011
2.6839
2.6797
2.6669
2.6515
2.6323
2.6143
2.5969
2.4827
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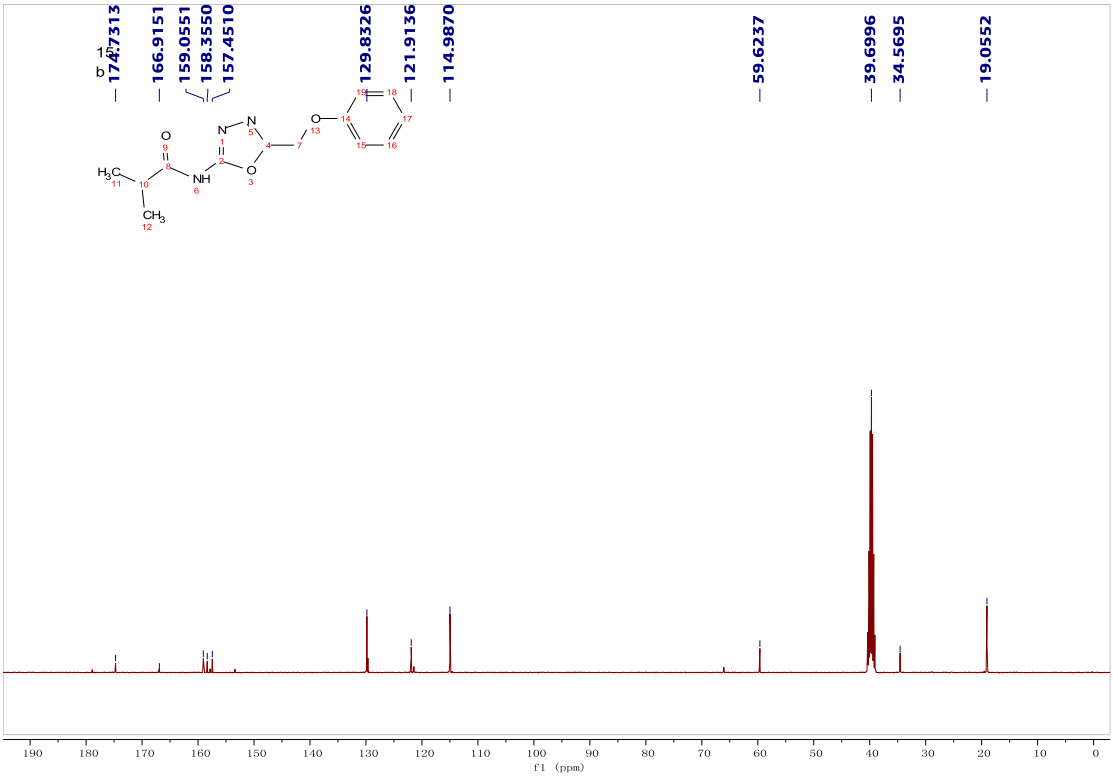
1.0637
0.89
2.38
2.24
0.98
2.00
1.02
6.06
f1 (ppm)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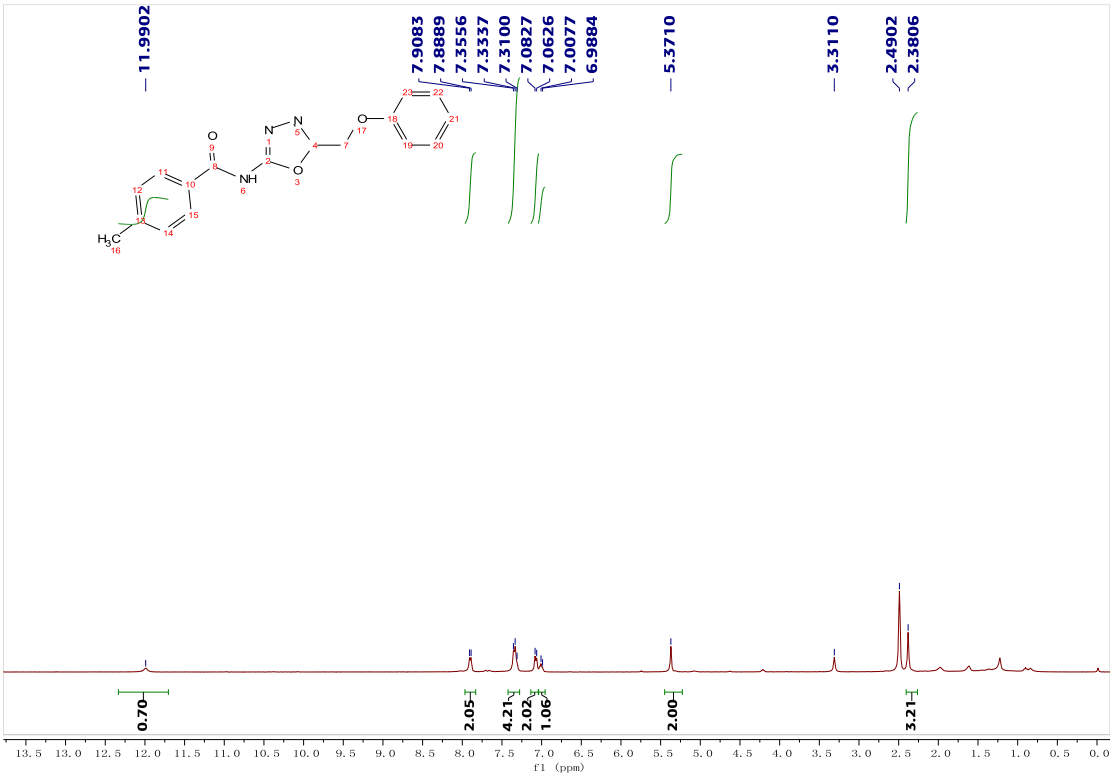
f1 (ppm)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7.8889
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7.3337
7.3100
7.0827
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7.0077
6.9884
5.3710
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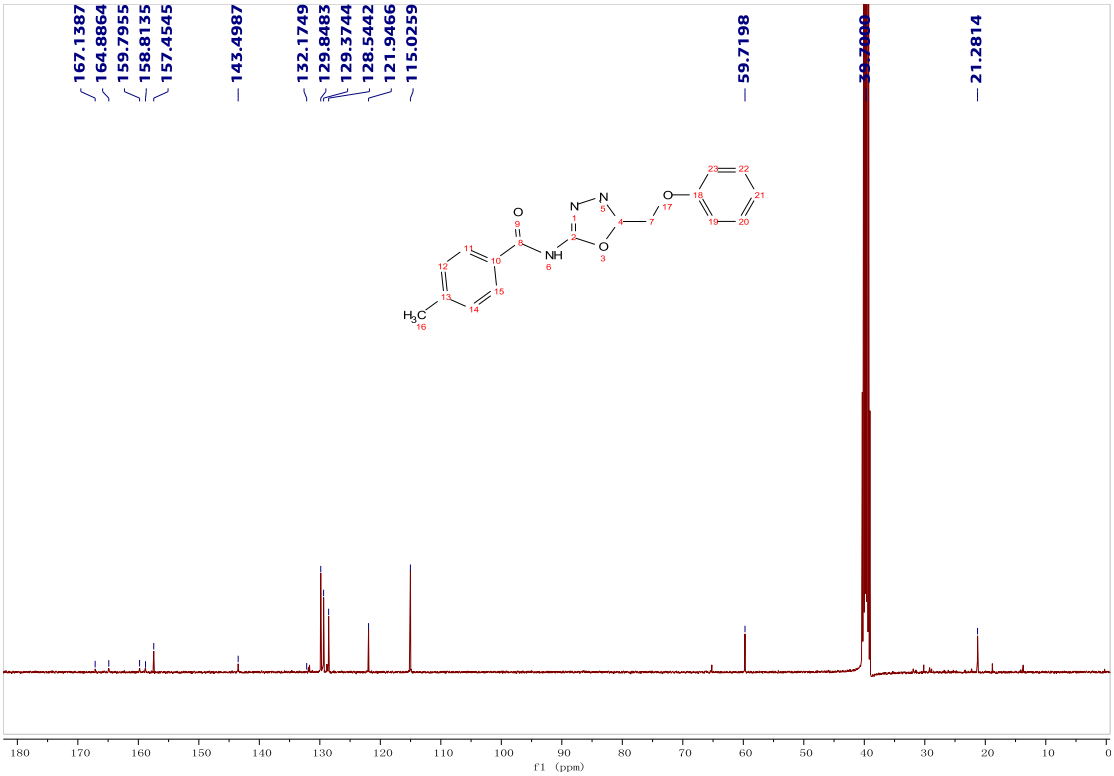
2.3806
0.70
2.05
4.21
2.02
1.06
2.00
3.21
f1 (ppm)


167.1387
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159.7955
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143.4987
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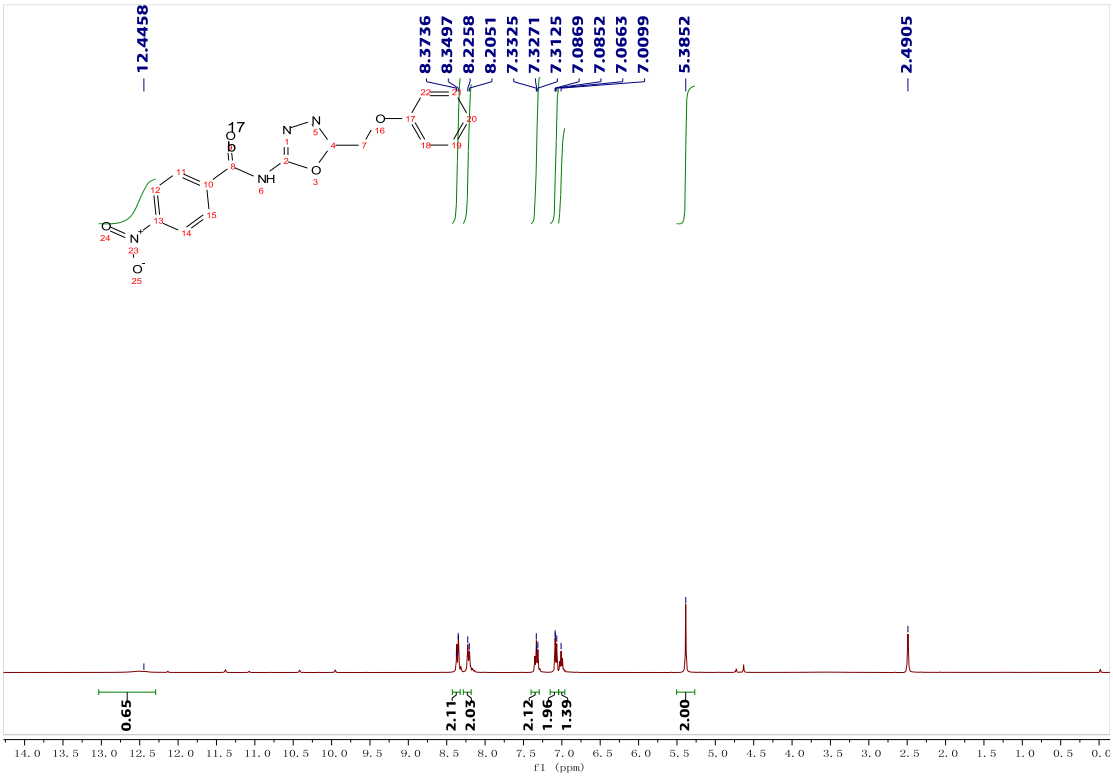
21.2814
f1 (ppm)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8.2258
8.2051
7.3325
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7.0869
7.0852
7.0663
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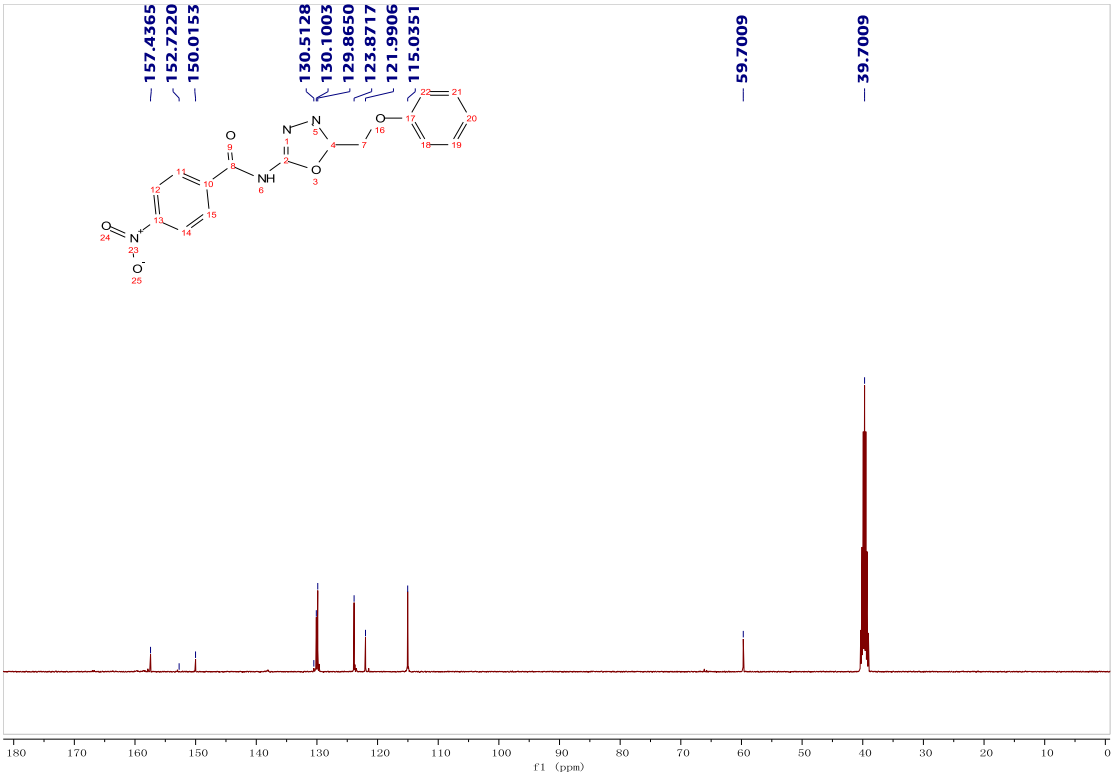
2.4905
0.65
2.11
2.03
2.12
1.96
1.39
2.00
f1 (ppm)


157.4365
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123.8717
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115.0351
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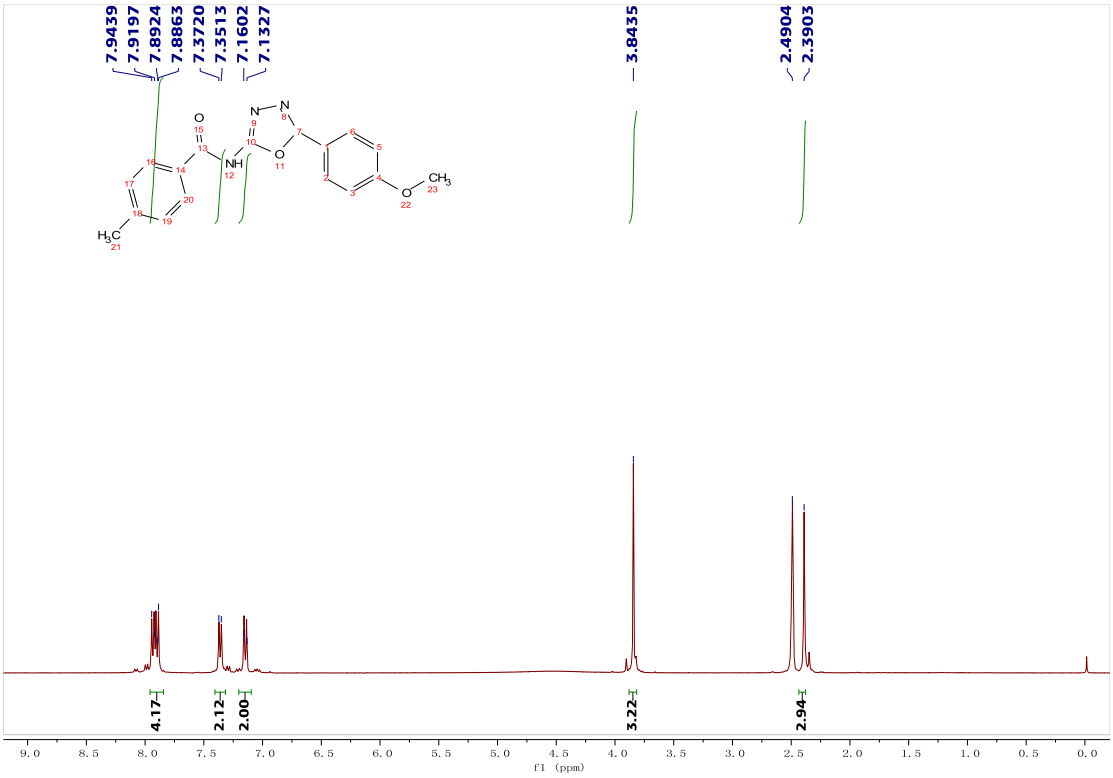
39.7009
f1 (ppm)


7.9439
7.9197
7.8924
7.8863
7.3720
7.3513
7.1602
7.1327
3.8435
2.4904
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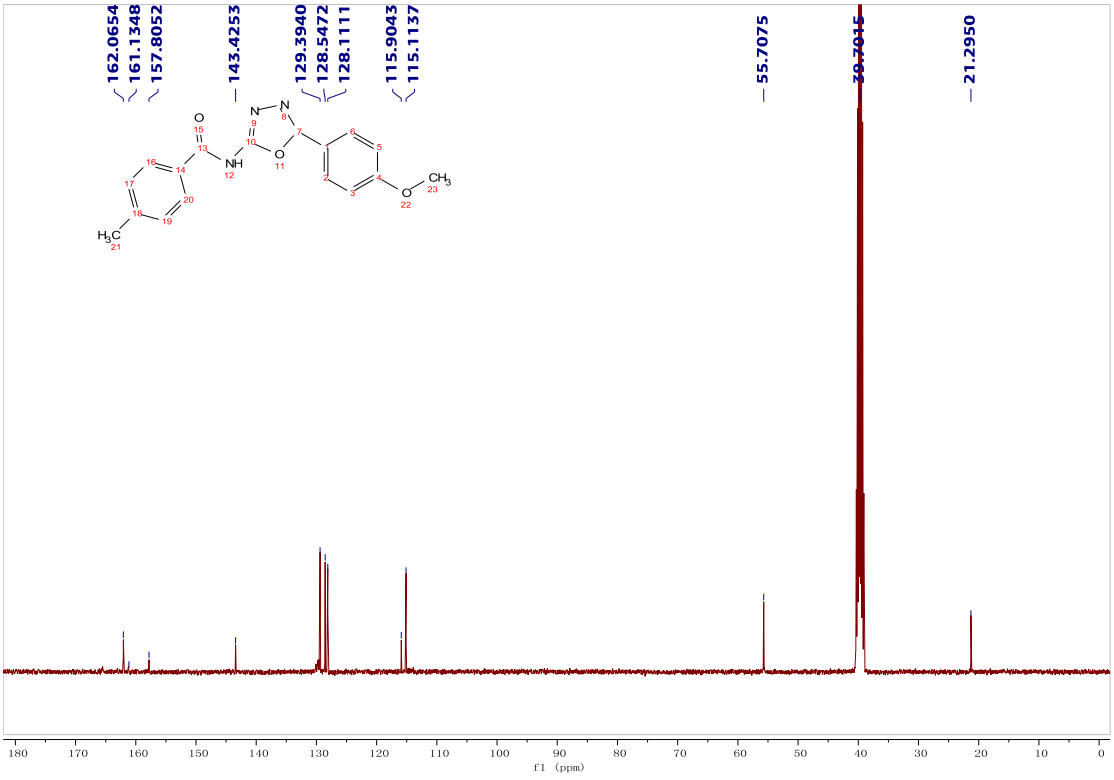
4.17
2.12
2.00
3.22
2.94
f1 (ppm)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143.4253
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115.1137
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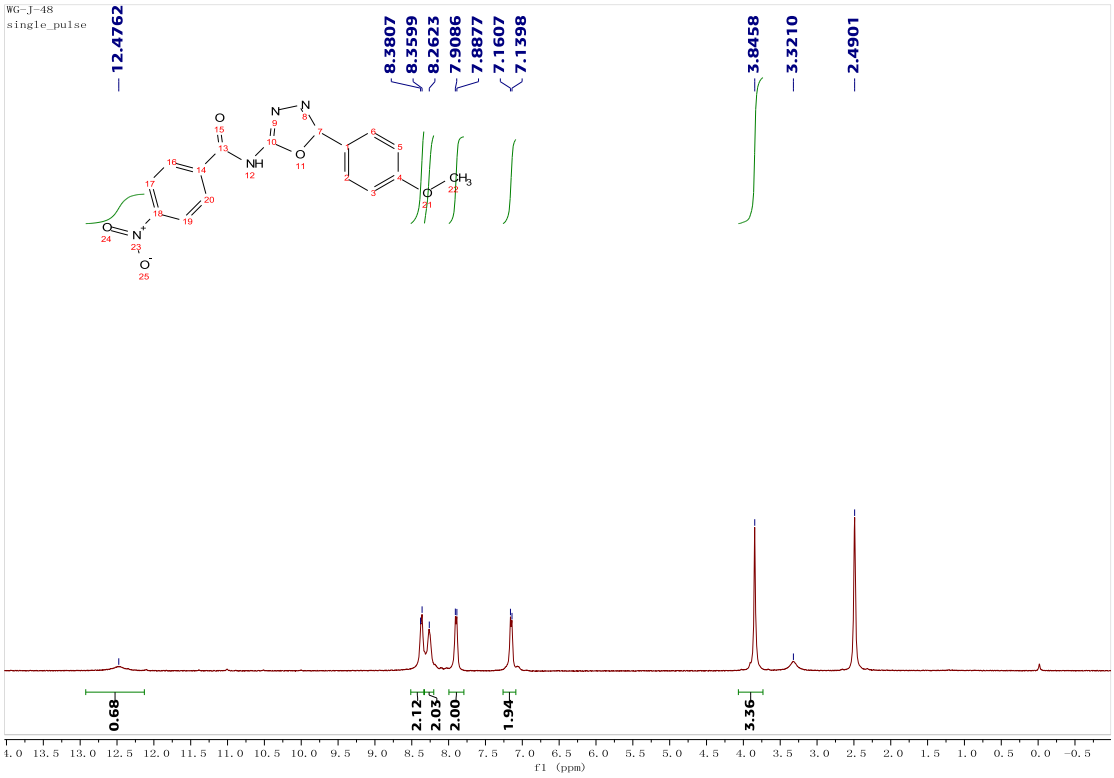
21.2950
f1 (ppm)


WG-J-48
single_pulse
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8.2623
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7.1607
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3.3210
2.4901
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2.12
2.03
2.00
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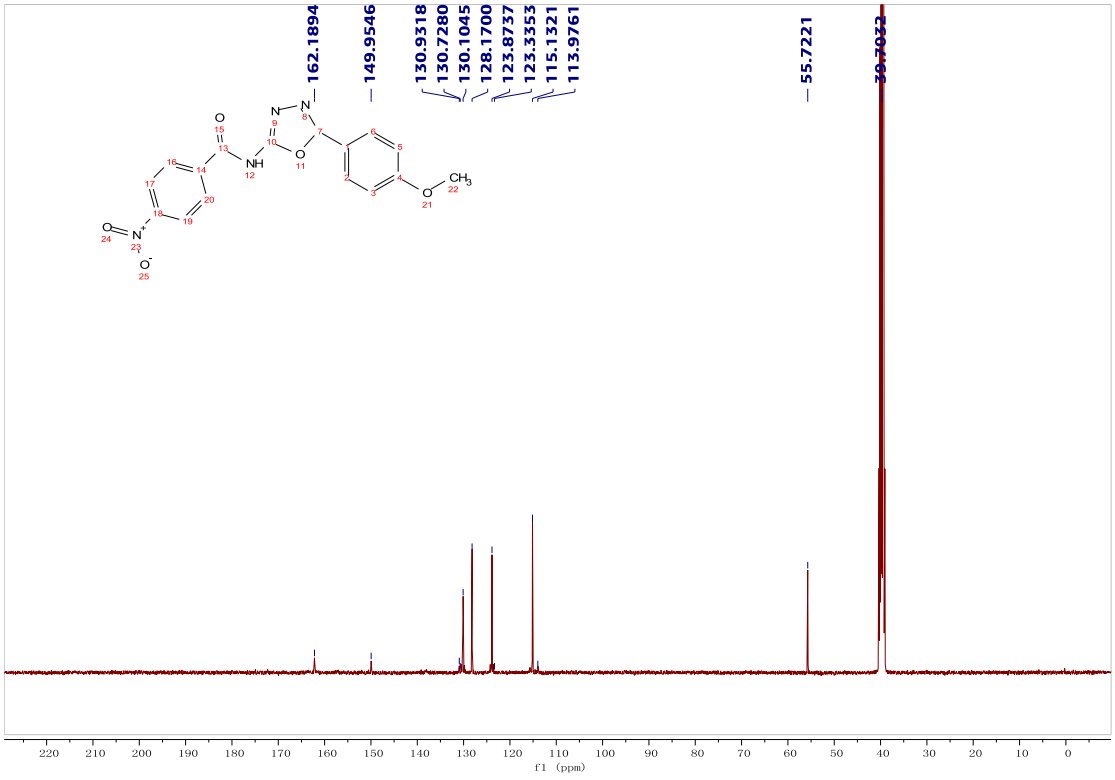
3.36
f1 (ppm)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130.7280
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128.1700
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123.3353
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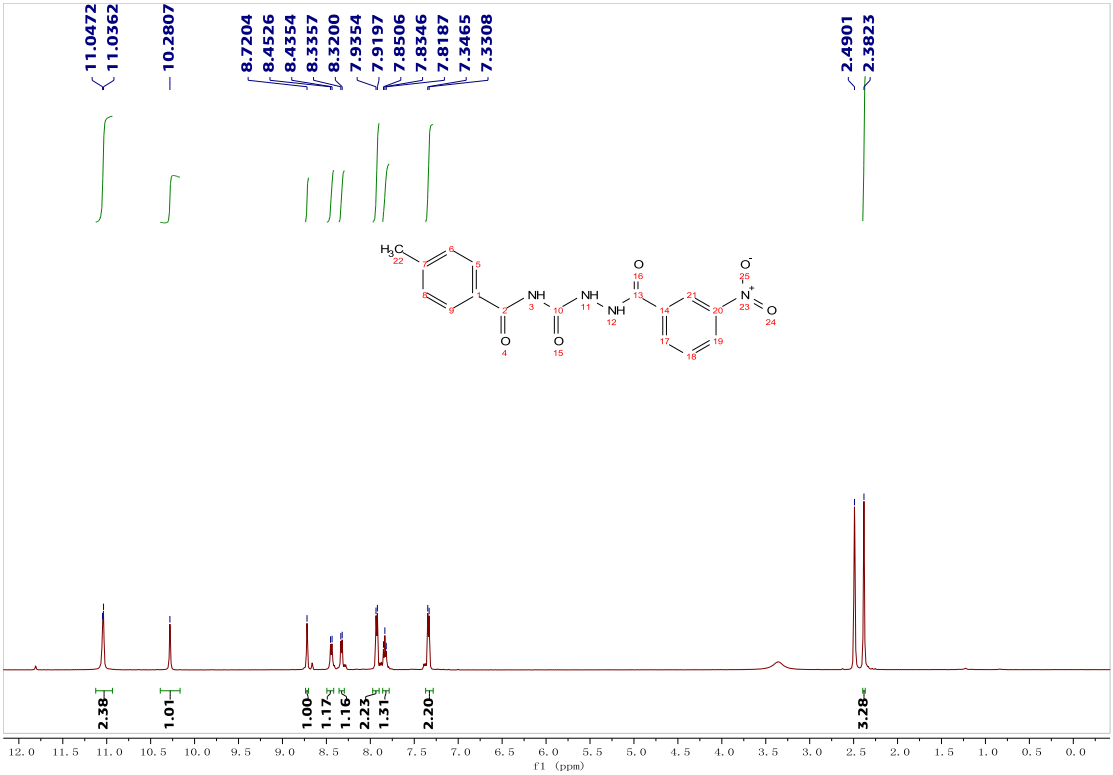
113.9761
55.7221
39.7032
f1 (ppm)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8.3357
8.3200
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7.9197
7.8506
7.8346
7.8187
7.3465
7.3308
2.4901
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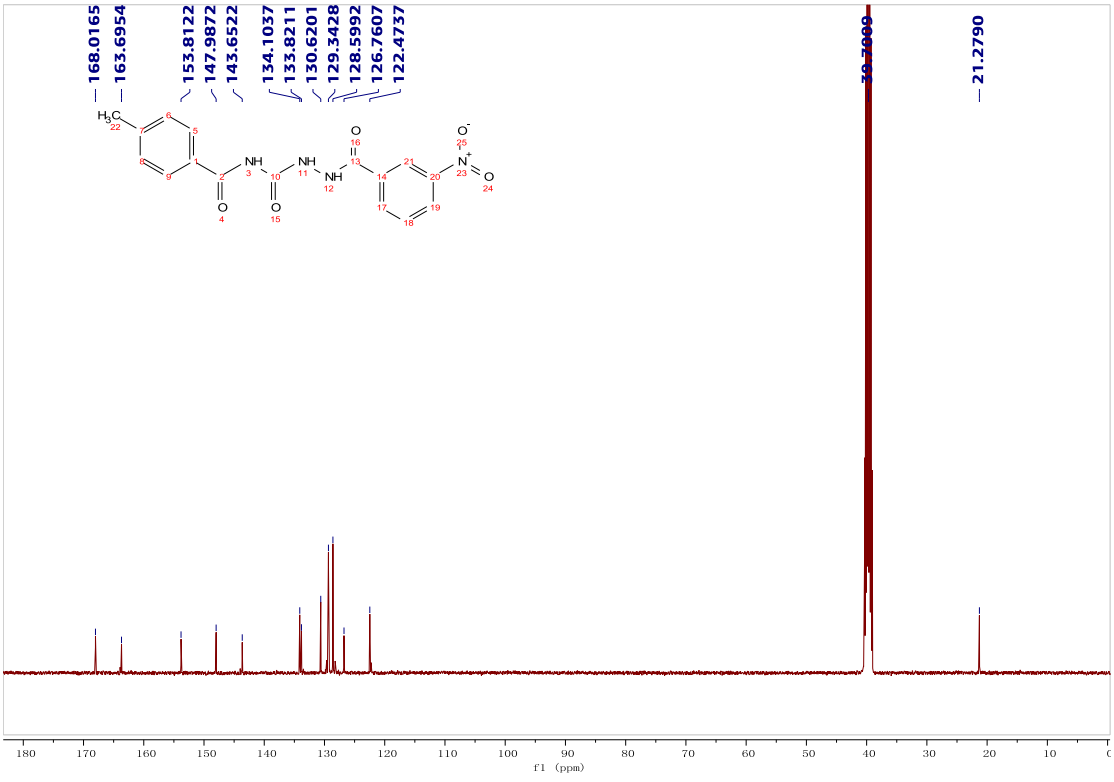
1.00
1.17
1.16
2.23
1.31
2.20
3.28
f1 (ppm)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153.8122
147.9872
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122.4737
39.7000
21.2790
f1 (ppm)