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Acetylene containing 2-(2-hydrazinyl)thiazole derivatives: Design, Synthesis, *in vitro* and *in silico* evaluation of antimycobacterial activity against *Mycobacterium tuberculosis*

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A In vitro anti-tubercular activity study

1. Preparation of sample

The stock solution was made by dissolving 10 mg of a sample in 1mL of DMSO. The working stock solutions of 1 mg/mL and 0.5 mg/mL were further prepared from this stock solution by the addition of an adequate volume of Middlebrook 7H9 broth. This was yet again sterilized by filtration with 0.45 µ filter.

2. Luciferase reporter mycobacteriophages (LRP) assay

Four cryovials per set (two for control and two for 100 µg/mL and 50 µg/mL concentrations) were taken. 400 µl of Middlebrook 7H9 broth was added into first two vials and 350 µl in the third and fourth vial. By the addition of 50 µl of 1mg/mL stock solution to the 3rd and 4th vials respectively, a total concentration of 400 µl was achieved. *M.tb*H_{37}Rv cell suspension of 100 µl concentration was added to the vials and these vials are incubated at 37 $^{\circ}$C for 72 h. Then, 50 µl of phage phAE202 and 40 µl of 0.1M $CaCl_2$ were introduced to all the vials making the cell-phage mixture, and incubated at 37 $^{\circ}$C for 4 h. After incubation, 100 µl of the cell-phage mixture was moved to a luminometer cuvette. 100 µl of D-luciferin was added and the relative light unit (RLU) was taken in a luminometer (Berthold) at 10S integration. The percentage of reduction in RLU of the test compared to control was calculated by using the following equation,

$$Percentage\ of\ Reduction\ in\ RLU = \frac{Control\ RLU - Test\ RLU}{Control\ RLU} \times 100$$

Compounds with 50% RLU reduction and above when compared with control were considered as active against *M.Tb*.

B. Spectroscopic data (^{1}H and ^{13}C NMR, FT-IR and Mass) of compounds from 1 to 32.

1. 2-(Prop-2-yn-1-yloxy)benzaldehyde (1)

White solid, Yield: 80%. M.P: 67-69°C. ^{1}H NMR (400 MHz, DMSO) δ 10.35 (s, 1H), 7.72 (d, *J* = 7.7 Hz, 1H), 7.68 (t, *J* = 7.0 Hz, 1H), 7.30 (d, *J* = 8.4 Hz, 1H), 7.13 (t, *J* = 7.5 Hz, 1H), 5.00 (s, 2H), 3.66 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 188.99, 159.50, 136.19, 127.88, 124.79, 121.53, 114.27, 79.06, 78.63, 56.43. FT-IR (KBr, cm^{-1}): 3270.2 (alkyne C-H stretch), 2973.3 (aromatic C-H), 2876 (aldehyde C-H stretch), 2116.1 (alkyne -C≡C- stretch), 1684.6 (aldehyde C=O stretch), 1598 (aromatic C=C), 1264.5 (C-O stretch). ESI-HRMS: Calculated for $C_{10}H_8O_2$ = 160.0524; $[M+H]^+$ found = 161.0599.

2. 3-Ethoxy-4-(prop-2-yn-1-yloxy)benzaldehyde (2)

Pale yellow solid, Yield: 78%. M.P: 74-75°C. ^{1}H NMR (400 MHz, DMSO) δ 9.82 (s, 1H), 7.53 (d, *J* = 6.7 Hz, 1H), 7.39 (s, 1H), 7.21 (d, *J* = 8.3 Hz, 1H), 4.92 (s, 2H), 4.07 (d, *J* = 7.0 Hz, 2H), 3.50 (s, 1H), 1.33 (d, *J* = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 191.79, 152.04, 148.80, 130.47, 125.45, 113.27, 111.15, 78.99, 78.82, 64.13, 56.20, 14.72. FT-IR (KBr, cm-1): 3253.8 (alkyne C-H stretch), 2988.2 (aromatic C-H), 2878.8 (aldehyde C-H stretch), 2736.3 (aldehyde C-H stretch), 2110 (alkyne -C≡C- stretch), 1688.2

(aldehyde C=O stretch), 1590.1 (aromatic C=C), 1268.1 (C-O stretch). ESI-HRMS: Calculated for $C_{12}H_{12}O_3$ = 204.0786; $[M+H]^+$ found = 205.0855.

3. 5-Bromo-2-(prop-2-yn-1-yloxy)benzaldehyde (3)

Light brown solid, Yield: 75%. M.P: 92-93°C. ^{1}H NMR (400 MHz, DMSO) δ 10.24 (s, 1H), 7.84 (d, *J* = 8.9 Hz, 1H), 7.76 (s, 1H), 7.28 (d, *J* = 8.9 Hz, 1H), 5.00 (s, 2H), 3.67 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 187.99, 158.56, 138.36, 130.14, 126.36, 117.09, 113.47, 79.48, 78.33, 56.89. FT-IR (KBr, cm-1): 3237.4 (alkyne C-H stretch), 2980.7 (aromatic C-H), 2880.1 (aldehyde C-H stretch), 2769.3 (aldehyde C-H stretch), 2116.7 (alkyne -C≡C- stretch), 1680.9 (aldehyde C=O stretch), 1590.2 (aromatic C=C), 1273.5 (C-O stretch), 693 (C-Br stretch). ESI-HRMS: Calculated for $C_{10}H_7BrO_2$ = 237.9629; $[M+H]^+$ found = 238.9701.

4. (*E*)-2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (4)

White solid, Yield: 75%. M.P: 174-176°C. 1H NMR (400 MHz, DMSO) δ 11.47 (s, 1H), 8.40 (s, 1H), 8.17 (s, 1H), 8.11 (s, 1H), 7.96 (s, 1H), 7.38 (s, 1H), 7.13 (s, 1H), 7.00 (s, 1H), 4.89 (s, 2H), 3.62 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 177.90, 155.75, 137.67, 131.07, 126.33, 122.91, 121.41, 113.29, 79.05, 78.68, 56.14. FT-IR (KBr, cm-1): 3385.8 (N-H stretch), 3270.2 (alkyne C-H stretch), 3023.2 (aromatic C-H), 2118.2 (alkyne -C≡C- stretch), 1595 (aromatic C=C), 1535.2 (C=N stretch), 1358.5 (C-N stretch), 1266 (C-O stretch). ESI-HRMS: Calculated for $C_{11}H_{11}N_3OS$ = 233.0623; $[M+H]^+$ found = 234.0695.

5. (*E*)-2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (5)

Light yellow solid, Yield: 78%. M.P: 190-192°C. ^{1}H NMR (400 MHz, DMSO) δ 11.31 (s, 1H), 8.14 (s, 1H), 8.02 (s, 1H), 7.95 (s, 1H), 7.51 (s, 1H), 7.14 (s, 1H), 7.04 (s, 1H), 4.83 (s, 2H), 4.09 (q, *J* = 7.0 Hz, 2H), 3.56 (s, 1H), 1.34 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 177.65, 148.79, 148.35, 142.49, 127.93, 121.74, 113.58, 109.99, 79.22, 78.55, 64.00, 55.94, 14.77. FT-IR (KBr, cm-1): 3321.9 (N-H stretch), 3265.9 (alkyne C-H stretch), 2982.4 (aromatic C-H), 2124.8 (alkyne -C≡C- stretch), 1593.5 (aromatic C=C), 1532.2 (C=N stretch), 1365.6 (C-N stretch), 1323, 1265.6 (C-O stretch). ESI-HRMS: Calculated for $C_{13}H_{15}N_3O2S$ = 277.0885; $[M+H]^+$ found = 278.0958.

6. (*E*)-2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (6)

Light brown solid, Yield: 80%. M.P: 204-206°C. ^{1}H NMR (400 MHz, DMSO) δ 11.49 (s, 1H), 8.33 (d, *J* = 10.8 Hz, 2H), 8.20 (s, 2H), 7.50 (s, 1H), 7.09 (s, 1H), 4.88 (s, 2H), 3.61 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 178.10, 154.86, 136.12, 133.25, 128.38, 125.25, 115.74, 113.91, 79.03, 78.73, 56.57. FT-IR (KBr, cm-1): 3435.5 (N-H stretch), 3278.2 (alkyne C-H stretch), 2971.5 (aromatic C-H), 2118.7 (alkyne -C≡C- stretch), 1595.2 (aromatic C=C), 1530.6 (C=N stretch), 1363.1 (C-N stretch), 1266.7 (C-O stretch), 650.2 (C-Br stretch). ESI-HRMS: Calculated for $C_{11}H_{10}BrN_3OS$ = 312.9707; $[M+H]^+$ found = 311.9798.

7. (*E*)-4-Phenyl-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (7)

White solid, Yield: 70%. M.P: 183-185°C. ^{1}H NMR (400 MHz, DMSO) δ 12.15 (s, 1H), 8.36 (s, 1H), 7.86 – 7.80 (m, 3H), 7.40 (s, 3H), 7.30 (d, *J* = 7.2 Hz, 2H), 7.16 (s, 1H), 7.06 (s, 1H), 4.90 (s, 2H), 3.61 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.42, 155.14, 150.57, 136.75, 134.73, 130.67, 128.81, 127.76, 125.71, 125.24, 123.24, 121.80, 113.56, 103.82, 79.21, 78.78, 56.21. FT-IR (KBr,

cm-1): 3448.5 (N-H stretch), 3276.7 (alkyne C-H stretch), 2915.4 (aromatic C-H), 2120.8 (alkyne -C≡C- stretch), 1603.8 (aromatic C=C), 1570.8 (C=N stretch), 1366.3 (C-N stretch), 1272.9 (C-O stretch). ESI-HRMS: Calculated for $C_{19}H_{15}N_3OS$ = 333.0936; $[M+H]^+$ found = 334.1004.

8. (*E*)-4-(4-Fluorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (8*)*

Pale yellow solid, Yield: 70%. M.P: 180-182°C. ^{1}H NMR (400 MHz, DMSO) δ 11.89 (s, 1H), 8.36 (s, 1H), 7.87 – 7.80 (m, 3H), 7.36 (s, 1H), 7.29 – 7.18 (m, 3H), 7.14 (d, *J* = 8.1 Hz, 1H), 7.05 (s, 1H), 4.89 (s, 2H), 3.60 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.56, 163.03, 160.60, 155.19, 149.40, 137.02, 131.28, 130.74, 127.78, 125.27, 123.21, 121.81, 115.74, 115.53, 113.57, 103.59, 79.20, 78.78, 56.24. FT-IR (KBr, cm-1): 3439.6 (N-H stretch), 3280.1 (alkyne C-H stretch), 3188.6 (aromatic C-H), 2100 (alkyne -C≡C- stretch), 1602.5 (aromatic C=C), 1569.5 (C=N stretch), 1434.4 (C-F stretch), 1362.4 (C-N stretch), 1273.7 (C-O stretch). ESI-HRMS: Calculated for $C_{19}H_{14}FN_3OS$ = 351.0842; $[M+H]^+$ found = 352.0912.

9. (*E*)-4-(4-Chlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (9)

White solid, Yield: 75%. M.P: 160-164°C. ^{1}H NMR (400 MHz, DMSO) δ 12.19 (s, 1H), 8.36 (s, 1H), 7.88 – 7.79 (m, 3H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.37 (d, *J* = 7.6 Hz, 2H), 7.16 (s, 1H), 7.06 (s, 1H), 4.91 (s, 2H), 3.63 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.39, 155.05, 149.23, 136.76, 133.50, 131.97, 130.54, 128.66, 127.28, 125.09, 123.07, 121.64, 113.45, 104.50, 79.07, 78.71, 56.12. FT-IR (KBr, cm-1): 3457.5 (N-H stretch), 3284.9 (alkyne C-H stretch), 2100 (alkyne -C≡C- stretch), 1627.5 (C=N stretch), 1602.6

(aromatic C=C), 1567.9 (C=N stretch), 1359 (C-N stretch), 1229.6 (C-O stretch), 828 (C-Cl stretch). ESI-HRMS: Calculated for $C_{19}H_{14}ClN_3OS$ = 367.0546; $[M+H]^+$ found = 368.0616.

10. (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (10)

White solid, Yield: 75%. M.P: 175-177^{0}C. ^{1}H NMR (400 MHz, DMSO) δ 12.19 (s, 1H), 8.36 (s, 1H), 8.06 (s, 1H), 7.80 (d, *J* = 7.9 Hz, 2H), 7.66 (s, 1H), 7.52 (s, 1H), 7.37 (s, 1H), 7.16 (s, 1H), 7.05 (s, 1H), 4.90 (s, 2H), 3.62 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.53, 155.10, 147.97, 136.97, 135.24, 131.49, 130.91, 130.65, 129.76, 127.21, 125.64, 125.14, 123.05, 121.68, 113.5, 105.96, 79.10, 78.72, 56.16. FT-IR (KBr, cm-1): 3450.9 (N-H stretch), 3295.5 (alkyne C-H stretch), 2100 (alkyne -C≡C- stretch), 1602 (aromatic C=C), 1568.1 (C=N stretch), 1356 (C-N stretch), 1226.4 (C-O stretch), 747.9 (C-Cl stretch). ESI-HRMS: Calculated for $C_{19}H_{13}C_{l2}N_3OS$ = 401.0156; $[M+H]^+$ found = 402.0230.

11. (*E*)-4-(4-Bromophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (11)

Light yellowish brown solid, Yield: 70%. M.P: 144-146°C. ^{1}H NMR (400 MHz, DMSO) δ 12.17 (s, 1H), 8.35 (s, 1H), 7.80 (d, *J* = 8.4 Hz, 3H), 7.59 (d, *J* = 8.4 Hz, 2H), 7.37 (s, 2H), 7.16 (s, 1H), 7.06 (s, 1H), 4.91 (s, 2H), 3.62 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.44, 155.07, 149.43, 136.73, 133.93, 131.60, 130.58, 127.63, 125.13, 123.12, 121.69, 120.59, 113.48, 104.6, 79.11, 78.71. FT-IR (KBr, cm-1): 3461.1 (N-H stretch), 3272.1 (alkyne C-H stretch), 3072.3 (aromatic C-H), 2100 (alkyne -C≡C- stretch), 1604.8 (aromatic C=C), 1569.4 (C=N stretch), 1357.3 (C-N stretch), 1225.1 (C-O stretch), 692.1 (C-Br stretch). ESI-HRMS: Calculated for $C_{19}H_{14}BrN_3OS$ = 413.0022; $[M+H]^+$ found = 412.0111.

12. (*E*)-4-(4-Nitrophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (12)

Orange red solid, Yield: 75%. M.P: 185-187°C. ^{1}H NMR (400 MHz, DMSO) δ 12.28 (s, 1H), 8.37 (s, 1H), 8.26 (d, *J* = 8.5 Hz, 2H), 8.09 (d, *J* = 8.7 Hz, 2H), 7.80 (d, *J* = 7.7 Hz, 1H), 7.69 (s, 1H), 7.38 (t, *J* = 7.7 Hz, 1H), 7.15 (d, *J* = 8.4 Hz, 1H), 7.06 (t, *J* = 7.5 Hz, 1H), 4.91 (s, 2H), 3.63 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.44, 155.07, 149.43, 136.73, 133.93, 131.60, 130.58, 127.63, 125.13, 123.12, 121.69, 120.59, 113.48, 104.6, 79.11, 78.71, 56.14. FT-IR (KBr, cm-1): 3310.6 (N-H stretch), 3267.7 (alkyne C-H stretch), 2110 (alkyne -C≡C- stretch), 1598.7 (aromatic C=C), 1564.9 (C=N stretch), 1500.1 (N-O stretch), 1329.7 (N-O stretch), 1280.8 (C-N stretch), 1239.7 (C-O stretch). ESI-HRMS: Calculated for $C_{19}H_{14}N_4O_3S$ = 378.0787; $[M+H]^+$ found = 379.0858.

13. (*E*)-4-(2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (13)

Light green solid, Yield: 65%. M.P: 150-152°C. ^{1}H NMR (400 MHz, DMSO) δ 12.23 (s, 1H),8.36 (s, 1H), 8.01 (d, *J* = 8.1 Hz, 2H), 7.84 (d, *J* = 8.1 Hz, 2H), 7.79 (s, 1H), 7.58 (s, 1H), 7.37 (s, 1H), 7.16 (s, 1H), 7.05 (s, 1H), 4.90 (s, 2H), 3.60 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.72, 155.19, 148.95, 138.85, 137.15, 136.92, 132.83, 130.76, 126.29, 125.24, 123.12, 121.79, 119.17, 109.71, 107.66, 79.18, 78.76, 56.24. FT-IR (KBr, cm-1): 3445.7 (N-H stretch), 3277.2 (alkyne C-H stretch), 2224.1 (C≡N stretch), 2110 (alkyne -C≡C- stretch), 1605.8 (aromatic C=C), 1566.8 (C=N stretch), 1361 (C-N stretch), 1228.1 (C-O stretch). ESI-HRMS: Calculated for $C_{20}H_{14}N_4OS$ = 358.0888; $[M+H]^+$ found = 359.0959.

14. (*E*)-2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (14)

White solid, Yield: 70%. M.P: 128-130°C. ^{1}H NMR (400 MHz, DMSO) δ 8.34 (s, 1H), 7.81 (s, 1H), 7.73 (d, *J* = 8.1 Hz, 2H), 7.37 (s, 1H), 7.20 (d, *J* = 5.8 Hz, 3H), 7.16 (s, 1H), 7.06 (s, 1H), 4.90 (s, 2H), 3.60 (s, 1H), 2.30 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.3, 155.11, 150.64, 137.01, 136.62, 132.09, 130.62, 129.35, 125.64, 125.20, 123.26, 121.79, 113.56, 102.87, 79.20, 78.75, 56.20, 20.96. FT-IR (KBr, cm-1): 3287.7 (alkyne C-H stretch), 2921.3 (aromatic C-H), 2110 (alkyne -C≡C- stretch), 1602.9 (aromatic C=C), 1568.7 (C=N stretch), 1362.4 (C-N stretch), 1224.9 (C-O stretch). ESI-HRMS: Calculated for $C_{20}H_{17}N_3OS$= 347.1092; $[M+H]^+$ found = 348.1161.

15. (*E*)-4-(4-Methoxyphenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (15)

White solid, Yield: 75%. M.P: 181-183°C. ^{1}H NMR (400 MHz, DMSO) δ 8.35 (s, 1H), 7.81 (dd, J = 7.8, 1.7 Hz, 1H), 7.77 (d, J = 8.9 Hz, 2H), 7.38 (s, 1H), 7.16 (d, J = 7.7 Hz, 2H), 7.06 (t, J = 7.5 Hz, 1H), 6.97 (d, J = 8.9 Hz, 2H), 4.91 (s, 2H), 3.78 (s, 3H), 3.63 (s, 1H). 13C NMR (101 MHz, DMSO) δ 168.34, 167.09, 159.17, 155.27, 148.15, 138.21, 130.94, 129.05, 127.22, 126.32, 125.30, 122.87, 121.71, 114.12, 109.07, 101.95, 79.09, 78.80, 56.21, 55.27, 39.52. FT-IR (KBr, cm-1): 3450.4 (N-H stretch), 3252.2 (alkyne C-H stretch), 3052.9 (aromatic C-H), 2115.9 (alkyne -C≡C- stretch), 1622.1 (aromatic C=C), 1567.6 (C=N stretch), 1329 (C-N stretch), 1256.6 (C-O stretch), 1184.2 (C-O stretch). ESI-HRMS: Calculated for C20H17N3O2S = 363.1041; [M+H] + found = 364.1112.

16. (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (16)

White solid, Yield: 72%. M.P: 221-223°C. ^{1}H NMR (400 MHz, DMSO) δ 8.01 (s, 1H), 7.84 (d, J = 7.1 Hz, 2H), 7.41 (t, J = 7.6 Hz, 2H), 7.31 (t, J = 7.3 Hz, 3H), 7.19 (dd, J = 8.4, 1.8 Hz, 1H), 7.08 (d, J = 8.4 Hz, 1H), 4.85 (s, 2H), 4.07 (d, J = 7.0 Hz, 2H), 3.59 (s, 1H), 1.36 (t, J = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.55, 167.18, 148.76, 148.15, 142.67, 133.69, 129.51, 128.84, 128.49, 128.01, 125.83, 120.24, 114.12, 110.08, 103.89, 90.74, 79.26, 78.67, 63.95, 56.09, 14.84. FT-IR (KBr, cm-1): 3428.5 (N-H stretch), 3201.8 (alkyne C-H stretch), 2934.3 (aromatic C-H), 2111.7 (alkyne -C≡C- stretch), 1624.2 (aromatic C=C), 1510.2 (C=N stretch), 1323.1 (C-N stretch), 1269.3 (C-O stretch), 1223.1 (C-O stretch). ESI-HRMS: Calculated for C21H19N3O2S = 377.1198; [M+H] + found = 378.1263.

17. (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (17)

Pale yellow solid, Yield: 78%.M.P: 152-154°C. ^{1}H NMR (400 MHz, DMSO) δ 12.05 (s, 1H), 7.96 (s, 1H), 7.87 (d, *J* = 8.9 Hz, 2H), 7.28 (s, 1H), 7.26 (s, 1H), 7.21 (d, *J* = 8.9 Hz, 2H), 7.16 (s, 1H), 7.08 (s, 1H), 4.84 (s, 2H), 4.08 (s, 2H), 3.56 (s, 1H), 1.36 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.52, 160.46, 149.55, 148.71, 147.87, 141.43, 131.40, 128.27, 127.52, 119.81, 115.53, 114.12, 109.90, 79.25, 78.56, 63.86, 56.03, 14.78. FT-IR (KBr, cm-1): 3449.7 (N-H stretch), 3278.5 (alkyne C-H stretch), 2983.8 (aromatic C-H), 2110 (alkyne -C≡C- stretch), 1570 (C=N stretch), 1511.1 (aromatic C=C), 1407.3 (C-F stretch), 1358 (C-N stretch), 1265.6 (C-O stretch), 1225.3 (C-O stretch). ESI-HRMS: Calculated for $C_{21}H_{18}FN_3O_2S$ = 395.1104; $[M+H]^+$ found = 396.1178.

18. (*E*)-4-(4-Chlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (18)

White solid, Yield: 65%. M.P: 185-186°C. ^{1}H NMR (400 MHz, DMSO) δ 12.06 (s, 1H), 7.96 (s, 1H), 7.86 (d, *J* = 8.6 Hz, 2H), 7.45 (d, *J* = 8.6 Hz, 2H), 7.34 (s, 1H), 7.27 (s, 1H), 7.16 (s, 1H), 7.08 (s, 1H), 4.84 (s, 2H), 4.08 (q, *J* = 7.0 Hz, 2H), 3.56 (s, 1H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.55, 149.35, 148.71, 147.89, 141.50, 133.63, 131.98, 128.69, 128.24, 127.28, 119.82, 114.13, 109.93, 104.32, 79.23, 78.54, 63.86, 56.03, 14.77. FT-IR (KBr, cm-1): 3437.8 (N-H stretch), 3310.5 (alkyne C-H stretch), 2875.9 (aromatic C-H), 2110 (alkyne -C≡C- stretch), 1572.4 (C=N stretch), 1508.5 (aromatic C=C), 1367.1 (C-N stretch), 1264.6 (C-O stretch), 1220.6 (C-O stretch), 826.4 (C-Cl stretch). ESI-HRMS: Calculated for $C_{21}H_{18}ClN_3O_2S$ = 411.0808; $[M+H]^+$ found = 412.0879.

19. (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (19)

White solid, Yield: 60%. M.P: 153-155°C. ^{1}H NMR (400 MHz, DMSO) δ 12.15 (s, 1H), 8.06 (s, 1H), 7.96 (s, 1H), 7.82 (d, *J* = 8.2 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.50 (s, 1H), 7.27 (s, 1H), 7.16 (d, *J* = 8.1 Hz, 1H), 7.07 (d, *J* = 8.3 Hz, 1H), 4.84 (s, 2H), 4.06 (q, *J* = 13.4, 6.6 Hz, 2H), 3.57 (s, 1H), 1.36 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.64, 148.69, 147.93, 141.71, 135.29, 131.51, 130.92, 129.73, 128.15, 127.21, 125.60, 119.89, 114.08, 109.89, 105.79, 79.22, 78.56, 63.84, 56.02, 14.77. FT-IR (KBr, cm-1): 3527.6 (N-H stretch), 3276.9 (alkyne C-H stretch), 2982.2, 2935.6 (aromatic C-H), 2115 (alkyne -C≡C- stretch), 1573.9 (C=N stretch), 1510.9 (aromatic C=C), 1356.1 (C-N stretch), 1264.2 (C-O stretch), 1220.3 (C-O stretch), 862 (C-Cl stretch). ESI-HRMS: Calculated for $C_{21}H_{17}Cl_2N_3O_2S$ = 445.0419; $[M+H]^+$ found = 446.0492.

20. (*E*)-4-(4-Bromophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (20)

Light brown solid, Yield: 75%. M.P: 187-189°C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.79 (d, *J* = 8.5 Hz, 2H), 7.58 (d, *J* = 8.5 Hz, 2H), 7.36 (s, 1H), 7.28 (s, 1H), 7.17 (d, *J* = 8.4 Hz, 1H), 7.07 (d, *J* = 8.4 Hz, 1H), 4.84 (s, 2H), 4.07 (q, *J* = 6.9 Hz, 2H), 3.57 (s, 1H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.55, 149.40, 148.70, 147.88, 141.51, 133.98, 131.61, 128.22, 127.60, 120.57, 119.84, 114.11, 109.89, 104.43, 79.23, 78.56, 63.85, 56.02, 14.78. FT-IR (KBr, cm-1): 3449 (N-H stretch), 3308 (alkyne C-H stretch), 2115 (alkyne -C≡C- stretch), 1571.8 (C=N stretch), 1508.3 (aromatic C=C), 1366.9 (C-N stretch), 1264.1 (C-O stretch), 1220.7 (C-O stretch), 621.7 (C-Br stretch). ESI-HRMS: Calculated for $C_{21}H_{18}BrN_3O_2S$ = 457.0284; $[M+H]^+$ found = 456.0363.

21. (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-nitrophenyl)thiazole (21)

Orange red solid, Yield: 78%. M.P:191-193°C. ^{1}H NMR (400 MHz, DMSO) δ 12.15 (s, 1H), 8.25 (d, *J* = 9.0 Hz, 2H), 8.08 (d, *J* = 9.0 Hz, 2H), 7.97 (s, 1H), 7.66 (s, 1H), 7.27 (s, 1H), 7.17 (d, *J* = 8.4 Hz, 1H), 7.07 (d, *J* = 8.4 Hz, 1H), 4.84 (s, 2H), 4.08 (q, *J* = 7.0 Hz, 2H), 3.56 (s, 1H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.83, 148.71, 147.96, 146.24, 143.59, 140.78, 128.13, 126.38, 125.45, 124.18, 119.93, 114.07, 109.90, 108.45, 79.23, 78.57, 63.86, 56.03, 14.78. FT-IR (KBr, cm-1): 3450 (N-H stretch), 3279.1 (alkyne C-H stretch), 2936.2 (aromatic C-H), 2110 (alkyne -C≡C- stretch), 1597.2 (aromatic C=C), 1575.5 (C=N stretch), 1510.3 (N-O stretch), 1344.3 (N-O stretch), 1266.1 (C-N stretch), 1225.1 (C-O stretch). ESI-HRMS: Calculated for $C_{21}H_{18}N_4O_4S$ = 422.1049; $[M+H]^+$ found = 423.1118.

22. (*E*)-4-(2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (22)

Light grey solid, Yield: 70%. M.P: 178-180°C. ^{1}H NMR (400 MHz, DMSO) δ 12.10 (s, 1H), 8.04 – 7.96 (m, 3H), 7.87 (d, *J* = 17.9 Hz, 2H), 7.58 (s, 1H), 7.27 (s, 1H), 7.16 (s, 1H), 7.08 (s, 1H), 4.84 (s, 2H), 4.09 – 4.04 (q, 2H), 3.56 (s, 1H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.75, 148.77, 147.96, 141.84, 138.84, 132.78, 128.15, 126.21, 119.93, 119.12, 114.10, 109.93, 109.64, 107.45, 79.24, 78.59, 63.87, 56.04, 14.79. FT-IR (KBr, cm-1): 3528.6 (N-H stretch), 3290.1 (alkyne C-H stretch), 2879.6 (aromatic C-H), 2223.5 (C≡N stretch), 2115 (alkyne -C≡C- stretch), 1604.2 (aromatic C=C), 1572 (C=N stretch), 1356.3 (C-N stretch), 1266.2 (C-O stretch), 1221.9 (C-O stretch). ESI-HRMS: Calculated for $C_{22}H_{18}N_4O_2S$ = 402.1150; $[M+H]^+$ found = 403.1222.

23. (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (23)

White solid, Yield: 76%. M.P: 166-168°C. ^{1}H NMR (400 MHz, DMSO) δ 7.98 (s, 1H), 7.72 (d, *J* = 8.1 Hz, 2H), 7.28 (s, 1H), 7.20 (d, *J* = 6.2 Hz, 3H), 7.16 (s, 1H), 7.08 (s, 1H), 4.84 (d, *J* = 2.3 Hz, 2H), 4.07 (d, *J* = 7.0 Hz, 2H), 3.57 (s, 1H), 2.31 (s, 3H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.36, 150.09, 148.72, 147.92, 141.72, 137.03, 131.82, 129.30, 128.23, 125.60, 119.90, 114.12, 109.94, 102.69, 79.25, 78.58, 63.87, 56.04, 20.91, 14.79. FT-IR (KBr, cm-1): 3450.4 (N-H stretch), 3312.3 (alkyne C-H stretch), 2872.3 (aromatic C-H), 2115 (alkyne -C≡C- stretch), 1573.5 (C=N stretch), 1508.9 (aromatic C=C), 1368.8 (C-N stretch), 1264.8 (C-O stretch), 1220.1 (C-O stretch). ESI-HRMS: Calculated for $C_{22}H_{21}N_3O_2S$ = 391.1354; $[M+H]^+$ found = 392.1418.

24. (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (24)

White solid, Yield: 80%. M.P: 183-185°C. ^{1}H NMR (400 MHz, DMSO) δ 12.02 (s, 1H), 7.95 (s, 1H), 7.77 (d, *J* = 8.8 Hz, 2H), 7.27 (s, 1H), 7.15 (s, 1H), 7.09 (d, *J* = 8.6 Hz, 2H), 6.96 (d, *J* = 8.9 Hz, 2H), 4.84 (s, 2H), 4.07 (q, *J* = 6.9 Hz, 2H), 3.77 (s, 3H), 3.57

(s, 1H), 1.36 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.29, 158.84, 151.40, 148.70, 147.82, 141.21, 128.33, 127.65, 126.92, 119.76, 114.08, 109.88, 101.36, 79.25, 78.55, 63.86, 56.03, 55.19, 14.79. FT-IR (KBr, cm-1): 3446.9 (N-H stretch), 3287.1 (alkyne C-H stretch), 2838.4 (aromatic C-H), 2118.9 (alkyne -C≡C- stretch), 1574.9 (C=N stretch), 1507.5 (aromatic C=C), 1368.9 (C-N stretch), 1264.3 (C-O stretch), 1220.3 (C-O stretch), 1177.3 (C-O stretch). ESI-HRMS: Calculated for $C_{22}H_{21}N_3O_3S$ = 407.1304; $[M+H]^+$ found = 408.1374.

25. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (25)

White solid, Yield: 70%. M.P: 195-197°C. ^{1}H NMR (400 MHz, DMSO) δ 8.27 (s, 1H), 7.90 – 7.80 (m, 3H), 7.52 (d, *J* = 2.6 Hz, 1H), 7.49 – 7.38 (m, 2H), 7.38 – 7.16 (m, 2H), 7.13 (d, *J* = 8.9 Hz, 1H), 4.91 (s, 2H), 3.65 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.13, 154.21, 150.24, 135.20, 134.40, 132.73, 128.62, 127.92, 127.06, 125.71, 125.46, 116.07, 113.62, 104.11, 79.12, 78.75, 56.59. FT-IR (KBr, cm-1): 3339.9 (N-H stretch), 3296.3 (alkyne C-H stretch), 2867.8 (aromatic C-H), 2120 (alkyne -C≡C- stretch), 1620.2 (aromatic C=C), 1565.2 (C=N stretch), 1362.8 (C-N stretch), 1227.6 (C-O stretch), 628.2 (C-Br stretch). ESI-HRMS: Calculated for $C_{19}H_{14}BrN_3OS$ = 413.0022; $[M+H]^+$ found = 412.0115.

26. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (26)

Pale yellow solid, Yield: 80%. M.P: 207-209°C. ^{1}H NMR (400 MHz, DMSO) δ 8.27 (s, 1H), 7.88 (dd, J = 8.7, 5.6 Hz, 2H), 7.85 (s, 1H), 7.54 (dd, J = 8.8, 2.6 Hz, 1H), 7.32 (s, 1H), 7.23 (t, J = 8.9 Hz, 2H), 7.14 (d, J = 8.9 Hz, 1H), 4.92 (s, 2H), 3.67 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.23, 166.85, 163.07, 160.62, 154.29, 146.94, 136.03, 132.96, 130.11, 127.74, 127.13, 125.11,

115.44 (s), 113.65, 103.91, 91.18, 79.14, 78.68, 56.61, 39.52. FT-IR (KBr, cm-1): 3424.8 (N-H stretch), 3213.1 (alkyne C-H stretch), 2932.4 (aromatic C-H), 2115.4 (alkyne -C≡C- stretch), 1622.2 (aromatic C=C), 1507.5 (C=N stretch), 1477.7, 1414.1 (C-F stretch), 1367 (C-N stretch), 1233.3 (C-O stretch), 626.6 (C-Br stretch). ESI-HRMS: Calculated for C19H13BrFN3OS = 430.9927; [M+H] + found = 430.0019.

27. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-chlorophenyl)thiazole (27)

White solid, Yield: 75%. M.P: 209-211°C. 1H NMR (400 MHz, DMSO) δ 8.27 (s, 1H), 7.85 (t, J = 5.4 Hz, 3H), 7.54 (dd, J = 8.8, 2.6 Hz, 1H), 7.46 (d, J = 8.6 Hz, 2H), 7.40 (s, 1H), 7.14 (d, J = 8.9 Hz, 1H), 4.92 (s, 2H), 3.67 (s, 1H). 13C NMR (101 MHz, DMSO) δ 168.23, 166.90, 154.28, 146.63, 136.04, 132.89, 132.40, 129.62, 128.72, 128.45, 127.39, 127.12, 125.36, 125.06, 115.92, 104.85, 91.91, 79.13, 78.66, 56.58, 48.71, 39.52. FT-IR (KBr, cm-1): 3425 (N-H stretch), 3211.9 (alkyne C-H stretch), 2877 (aromatic C-H), 2116.9 (alkyne -C≡C- stretch), 1627.3 (aromatic C=C), 1522.6 (C=N stretch), 1364.1 (C-N stretch), 1225 (C-O stretch), 822.5 (C-Cl stretch), 626.1 (C-Br stretch). ESI-HRMS: Calculated for C19H13BrClN3OS = 446.9629; [M+H] + found = 445.9723.

28. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(3,4-dichlorophenyl)thiazole (28)

White solid, Yield: 68%. M.P: 213-215°C. ^{1}H NMR (400 MHz, DMSO) δ 12.46 (s, 1H), 8.25 (s, 1H), 8.04 (s, 1H), 7.82 (d, *J* = 18.2 Hz, 2H), 7.64 (s, 1H), 7.53 (d, *J* = 5.2 Hz, 2H), 7.13 (s, 1H), 4.91 (s, 2H), 3.65 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.26, 166.93, 154.28, 147.96, 145.04, 134.02, 131.16, 130.73, 129.40, 127.69, 125.36, 124.98, 115.87, 113.59, 106.21, 93.07, 79.12, 78.66, 56.57, 39.57. FT-IR (KBr, cm-1): 3436.8 (N-H stretch), 3295.9 (alkyne C-H stretch), 2927.9 (aromatic C-H), 2118.1 (alkyne -C≡C- stretch), 1621.2 (aromatic C=C),

1370.8 (C-N stretch), 1224.7 (C-O stretch), 810.5 (C-Cl stretch), 770.9 (C-Cl stretch), 626.9 (C-Br stretch). ESI-HRMS: Calculated for $C_{19}H_{12}BrCl_2N_3OS$ = 480.9238; $[M+H]^+$ found = 479.9334.

29. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-bromophenyl)thiazole (29)

Light reddish brown solid, Yield: 65%. M.P: 208-210°C. 1H NMR (400 MHz, DMSO) δ 12.38 (s, 1H), 8.26 (s, 1H), 7.85 (d, J = 2.6 Hz, 1H), 7.81 (dd, J = 8.7, 4.4 Hz, 2H), 7.67 (d, J = 8.7 Hz, 1H), 7.59 (d, J = 8.6 Hz, 1H), 7.56 (s, 1H), 7.42 (s, 1H), 7.14 (d, J = 8.9 Hz, 1H), 4.93 (s, 2H), 3.67 (s, 1H). 13C NMR (101 MHz, CDCl3) δ 168.22, 154.19, 149.22, 146.77, 133.70, 132.77, 131.66, 129.94, 127.69, 125.39, 121.60, 120.75, 116.03, 113.58, 104.97, 91.97, 79.14, 78.73, 56.15, 39.52, 18.65. FT-IR (KBr, cm-1): 3412.9 (N-H stretch), 3209.7 (alkyne C-H stretch), 2874.5 (aromatic C-H), 2116.7 (alkyne -C≡C- stretch), 1625.6 (aromatic C=C), 1364.5 (C-N stretch), 1225.0 (C-O stretch), 626.4 (C-Br stretch). Calculated for C19H13Br2N3OS = 490.9126; [M+H] + found = 489.9218.

30. (*E*)-4-(2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (30)

Light grey solid, Yield: 65%. M.P: 199-201°C. ^{1}H NMR (400 MHz, DMSO) δ 12.37 (s, 1H), 8.26 (s, 1H), 8.01 (d, *J* = 8.6 Hz, 2H), 7.87 (d, *J* = 15.8 Hz, 3H), 7.61 (s, 1H), 7.53 (d, 1H), 7.12 (d, *J* = 9.0 Hz, 1H), 4.91 (s, 2H), 3.64 (s, 1H). ^{13}C NMR (101 MHz, DMSO) δ 168.41, 154.21, 148.95, 138.75, 135.27, 132.80, 128.53, 127.05, 126.26, 125.38, 119.13, 116.04, 113.61, 109.72, 107.91, 79.12, 78.75, 56.59. FT-IR (KBr, cm-1): 3406.3 (N-H stretch), 3265.2 (alkyne C-H stretch), 3112.8 (aromatic C-H), 2226.2 (C≡N stretch), 2115 (alkyne -C≡C- stretch), 1624.9 (aromatic C=C), 1564.3 (C=N stretch), 1270.1 (C-N stretch), 1226.5 (C-O stretch), 631.6 (C-Br stretch). Calculated for $C_{20}H_{13}BrN_4OS$ = 437.9974; $[M+H]^+$ found = 437.0069.

31. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (31)

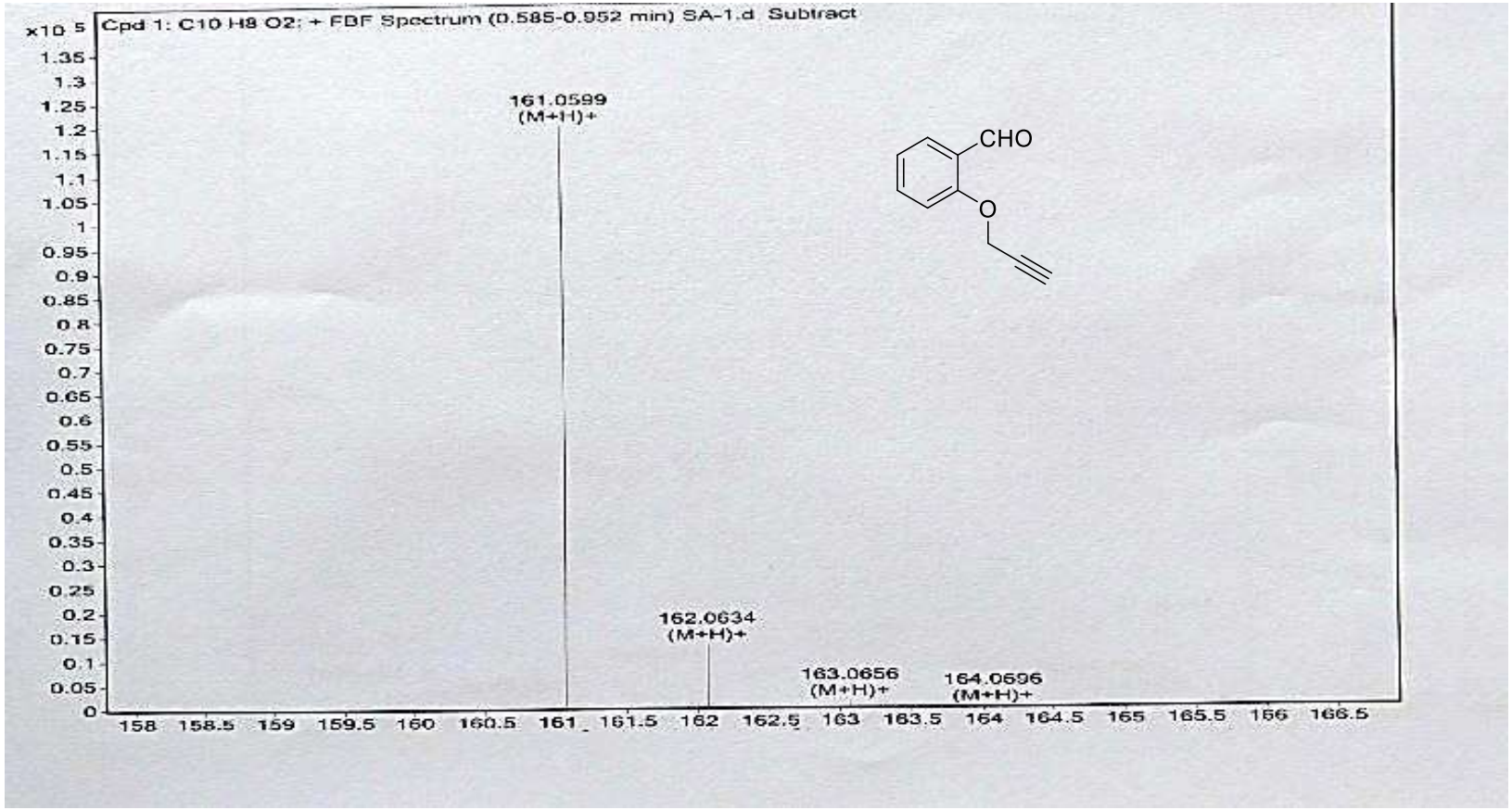
White solid, Yield: 70%. M.P: 191-193°C. ^{1}H NMR (400 MHz, DMSO) δ 8.29 (s, 1H), 7.86 (s, 1H), 7.72 (d, J = 6.9 Hz, 2H), 7.54 (d, J = 8.9 Hz, 1H), 7.26 (s, 1H), 7.21 (d, J = 8.1 Hz, 2H), 7.14 (d, J = 8.9 Hz, 1H), 4.92 (s, 2H), 3.67 (s, 1H), 2.31 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.12, 166.71, 154.27, 147.87, 137.79, 135.90, 132.91, 130.80, 128.95, 127.88, 127.11, 125.15, 115.97, 113.63, 103.35, 90.63, 79.14, 78.67, 56.60, 48.71, 39.52, 21.00. FT-IR (KBr, cm-1): 3407.2 (N-H stretch), 3236 (alkyne C-H stretch), 2917 (aromatic C-H), 2117.6 (alkyne -C≡C- stretch), 1621.5 (aromatic C=C), 1507.4 (C=N stretch), 1270.4 (C-N stretch), 1228 (C-O stretch), 628.2 (C-Br stretch). Calculated for C20H16BrN3OS = 427.0178; [M+H] + found = 426.0272.

32. (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (32)

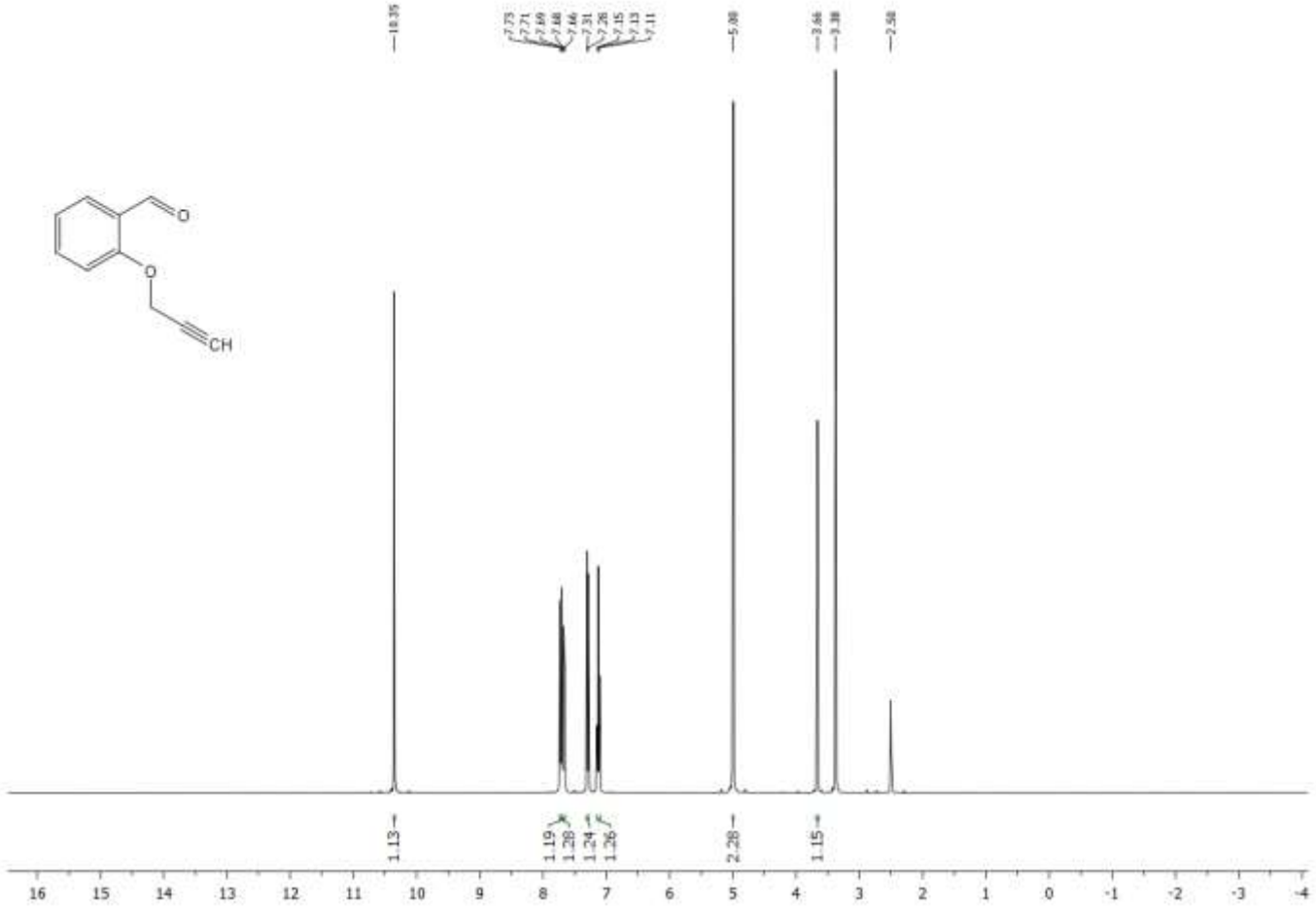
Pale yellow solid, Yield: 60%. M.P: 184-187°C. ^{1}H NMR (400 MHz, DMSO) δ 12.00 (s, 1H), 8.27 (s, 1H), 7.90 (d, J = 7.6 Hz, 3H), 7.60 (d, J = 9.0 Hz, 1H), 7.13 (s, 1H), 7.12 (d, J = 2.6 Hz, 2H), 6.89 (d, J = 9.0 Hz, 1H), 4.92 (s, 2H), 3.87 (s, 1H), 3.71 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 168.10, 166.65, 159.17, 154.32, 147.72, 135.96, 132.94, 129.42, 127.24, 125.33, 116.10, 114.18, 113.64, 109.33, 102.18, 89.70, 79.18, 78.75, 56.64, 55.32, 39.52. FT-IR (KBr, cm-1): 3379.4 (N-H stretch), 3285.4 (alkyne C-H stretch), 2832.8 (aromatic C-H), 2120.8 (alkyne -C≡C- stretch), 1623.6 (aromatic C=C), 1511.1 (C=N stretch), 1359.9 (C-N stretch), 1228.3 (C-O stretch), 1186.6 (C-O stretch), 634.3 (C-Br stretch). Calculated for C20H16BrN3O2S = 443.0128; [M+H] + found = 442.0218.

C. Spectra (Mass, ^{1}H and ^{13}C NMR, and FT-IR) of compounds from 1 to 32

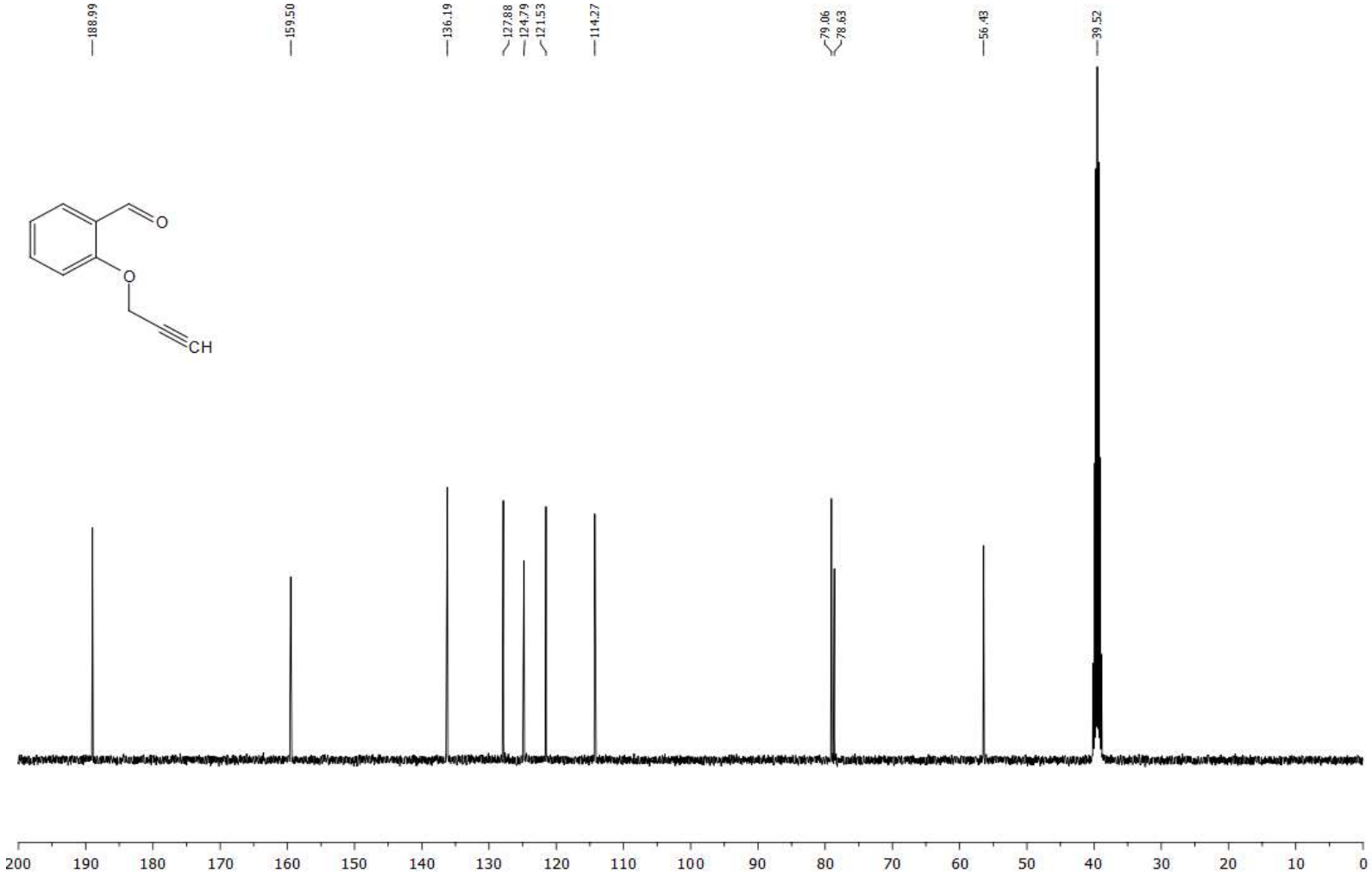
Mass spectrum of 2-(Prop-2-yn-1-yloxy)benzaldehyde (1)



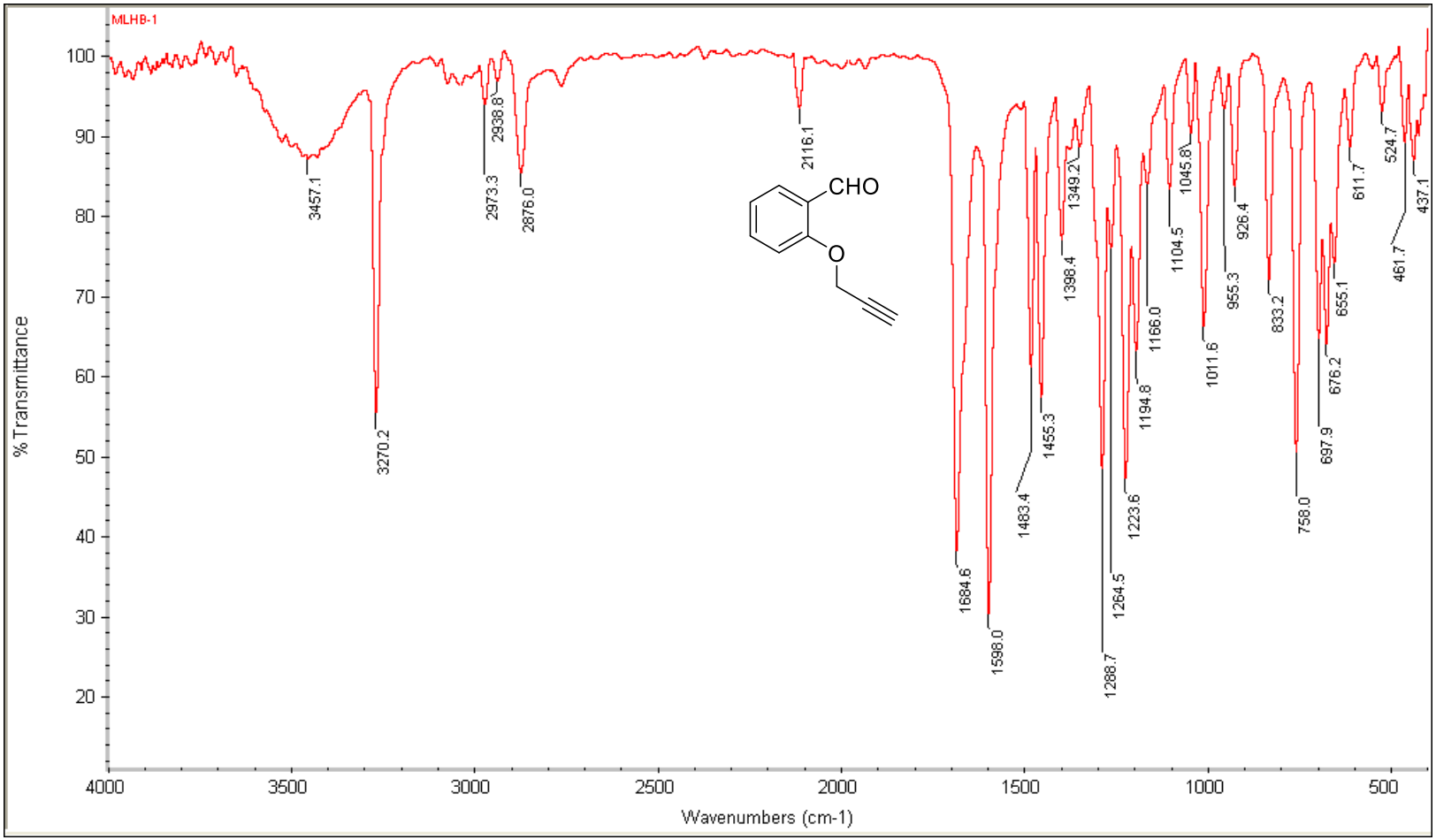
[1]H NMR spectrum of 2-(Prop-2-yn-1-yloxy)benzaldehyde (1)



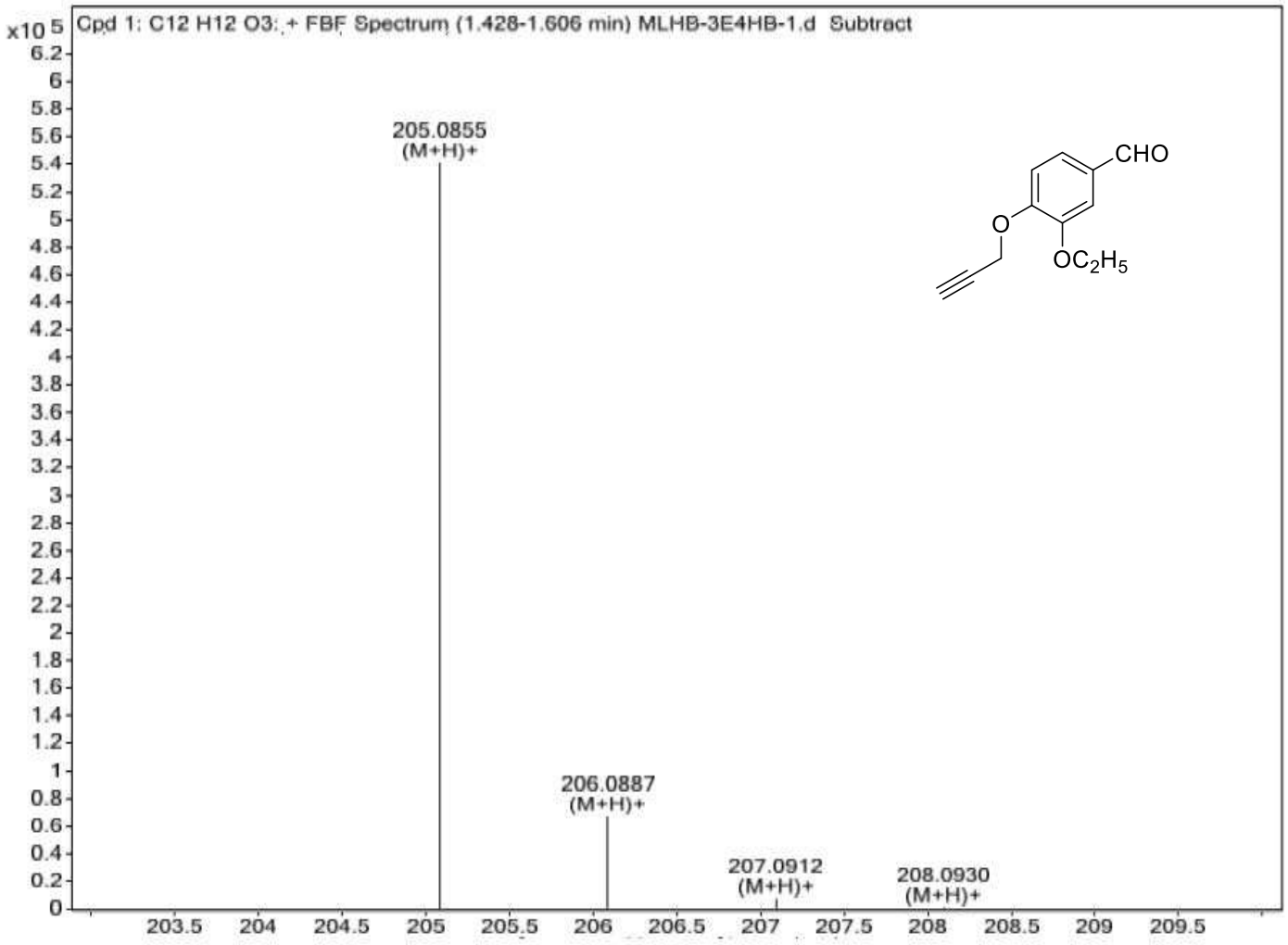
^{13}C NMR spectrum of 2-(Prop-2-yn-1-yloxy)benzaldehyde (1)



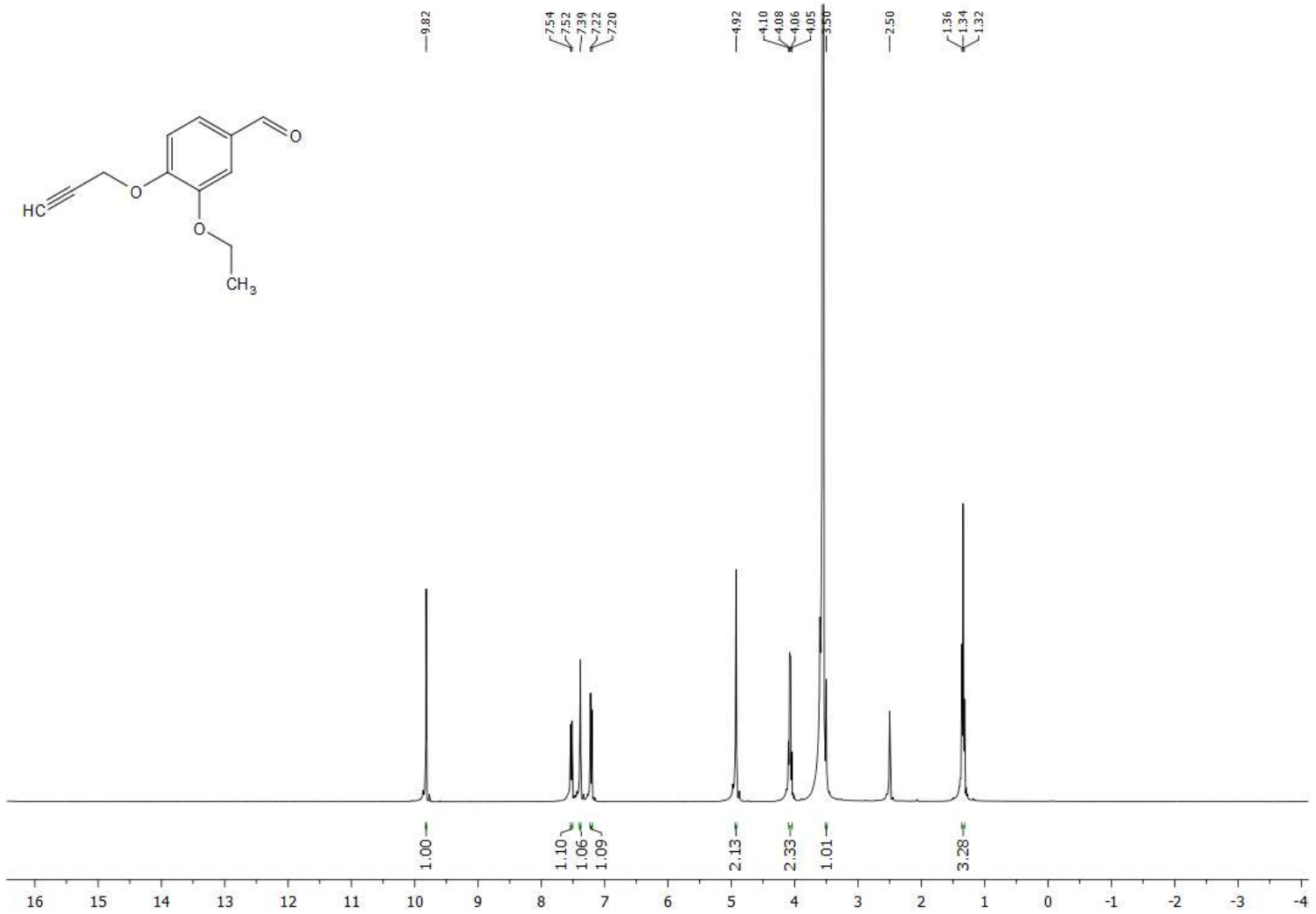
FT-IR spectrum of 2-(Prop-2-yn-1-yloxy)benzaldehyde (1)



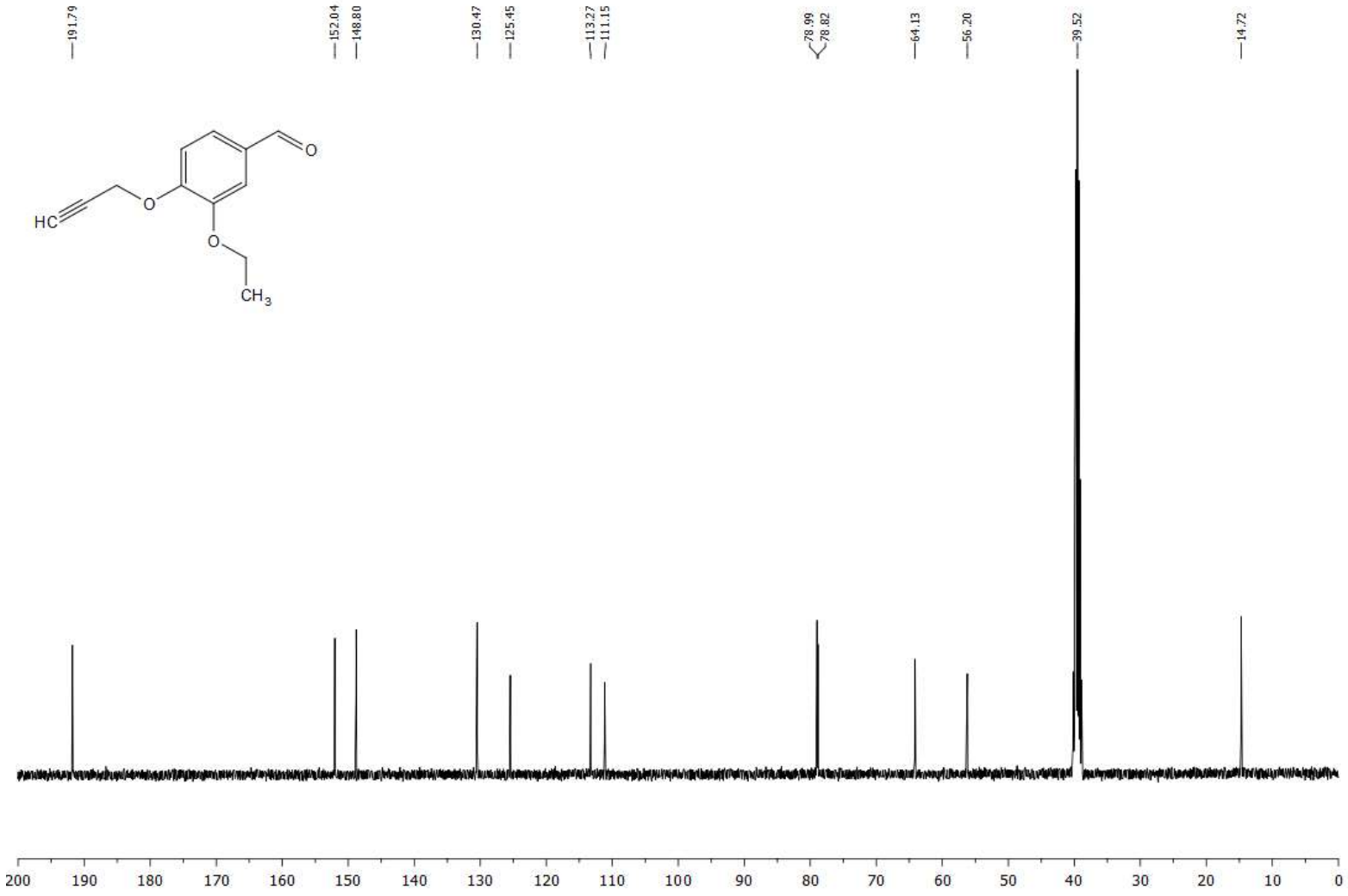
Mass spectrum of 3-Ethoxy-4-(prop-2-yn-1-yloxy)benzaldehyde (2)



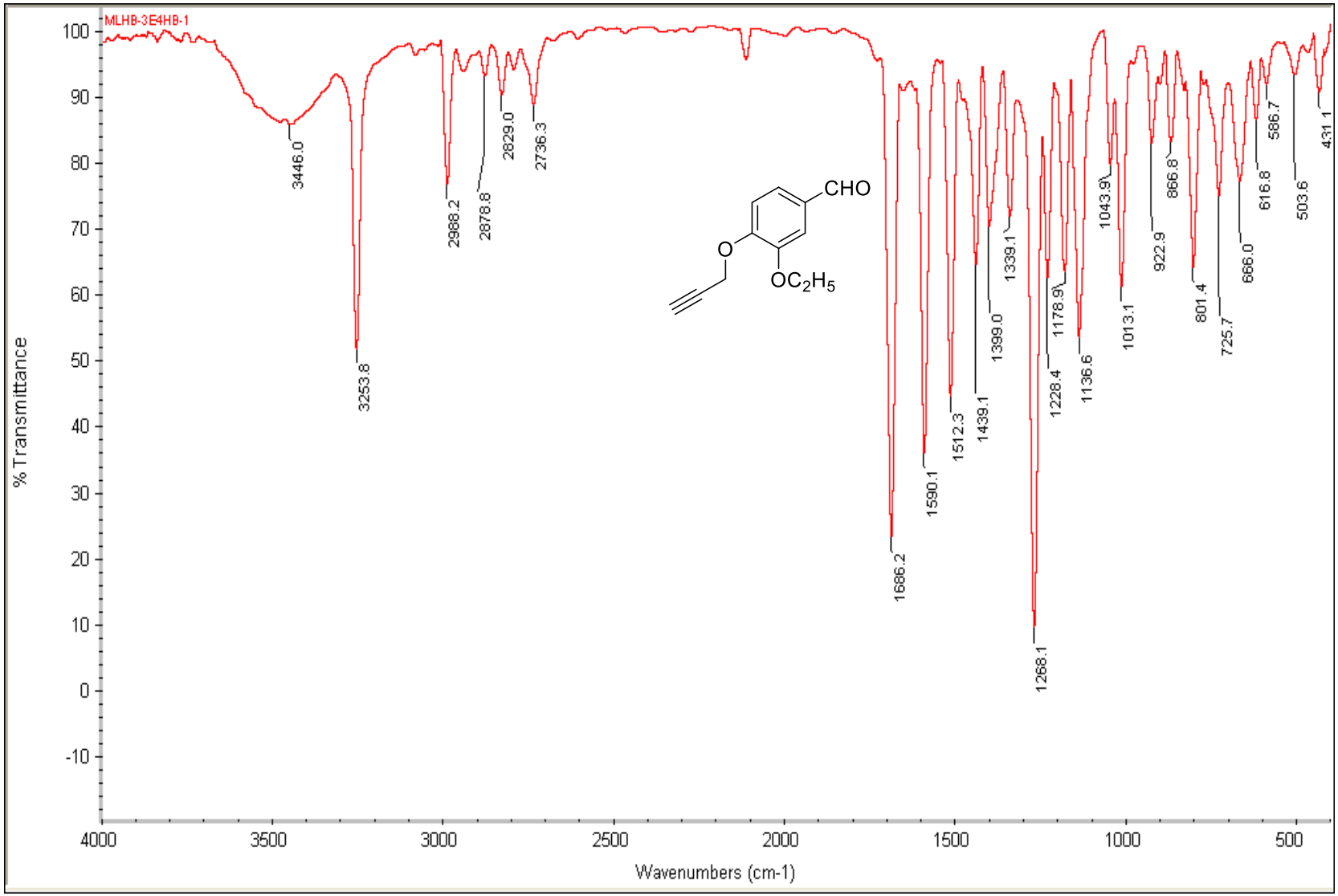
[1]H NMR spectrum of 3-Ethoxy-4-(prop-2-yn-1-yloxy)benzaldehyde (2)



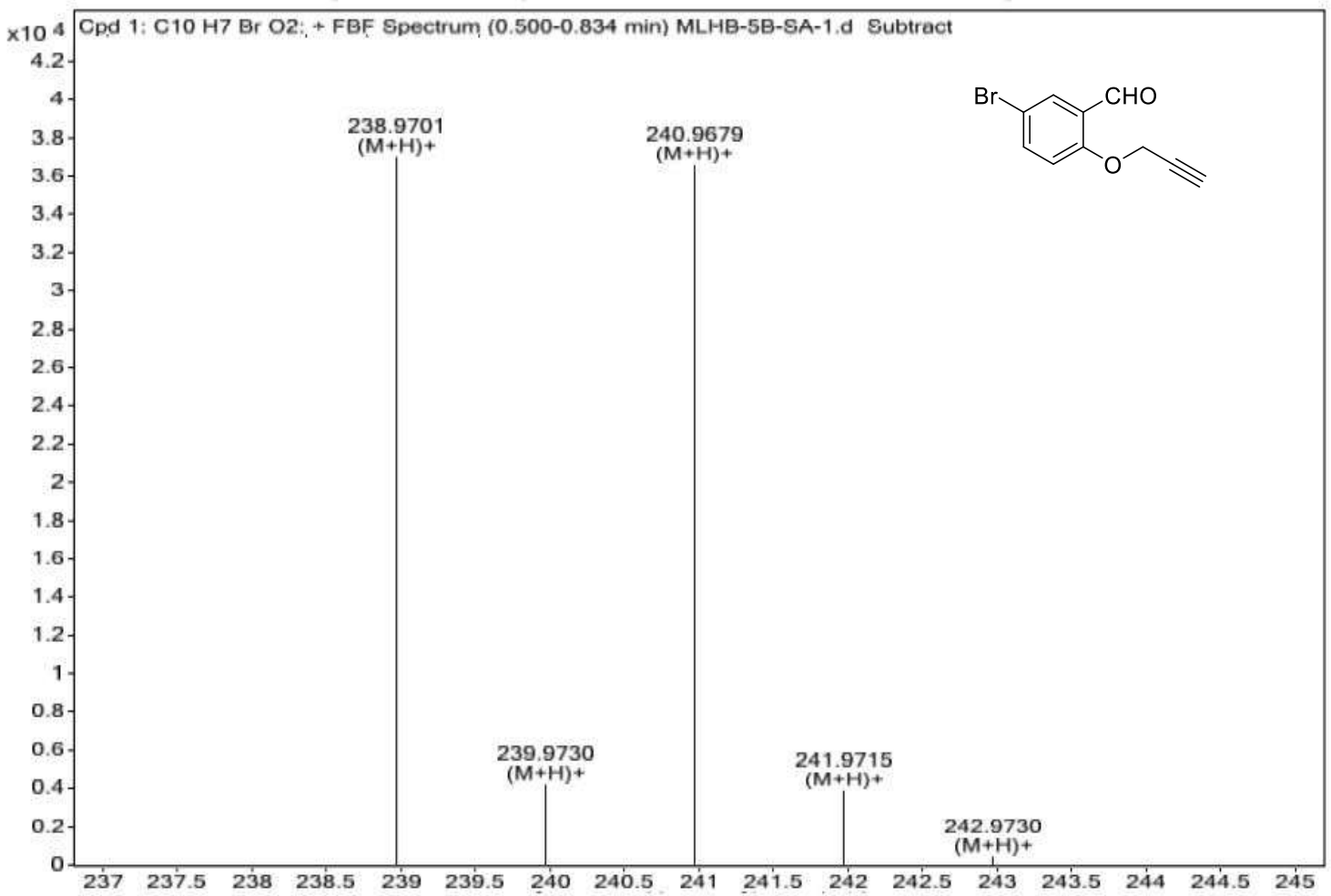
^{13}C NMR spectrum of 3-Ethoxy-4-(prop-2-yn-1-yloxy)benzaldehyde (2)



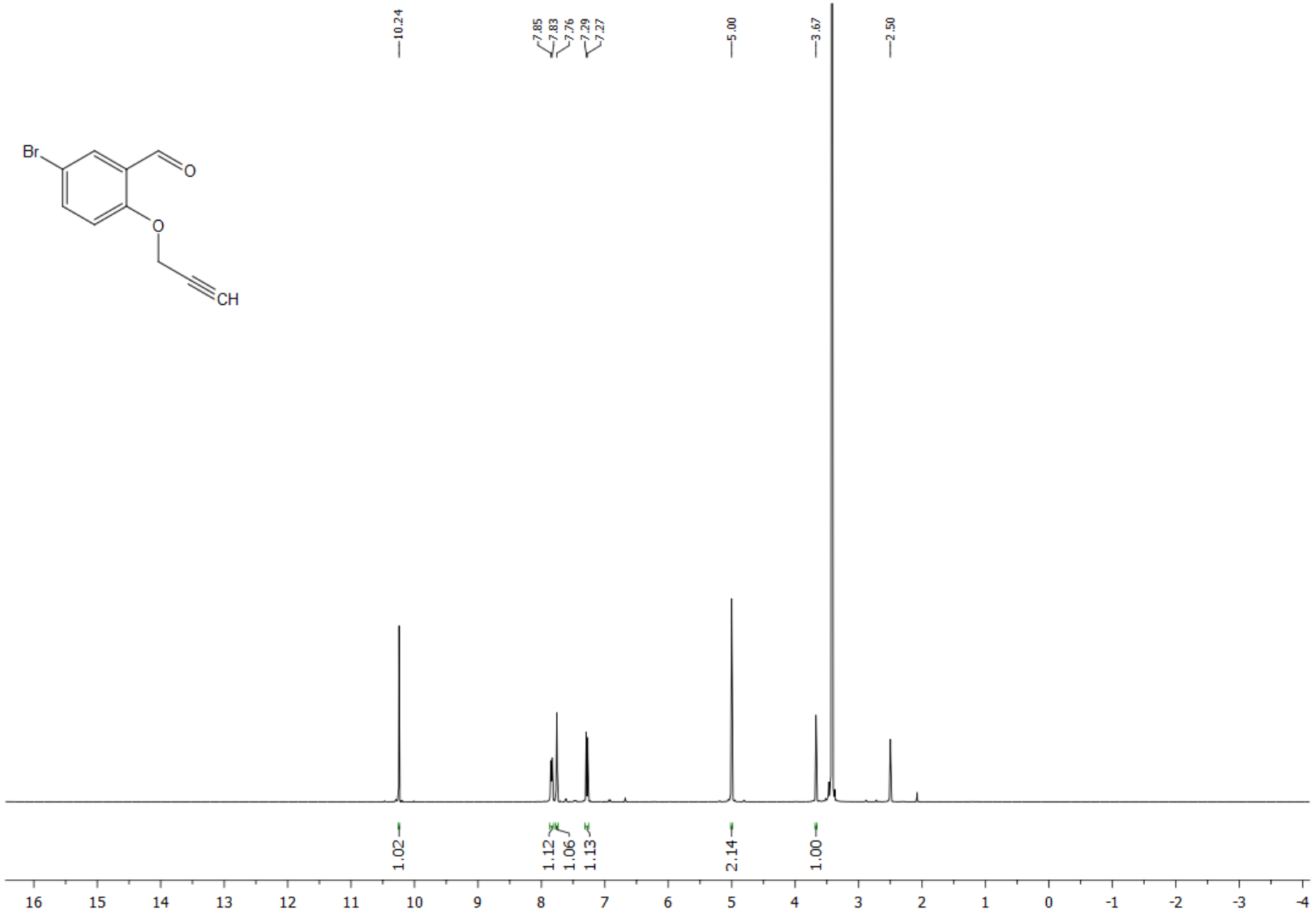
FT-IR spectrum of 3-Ethoxy-4-(prop-2-yn-1-yloxy)benzaldehyde (2)



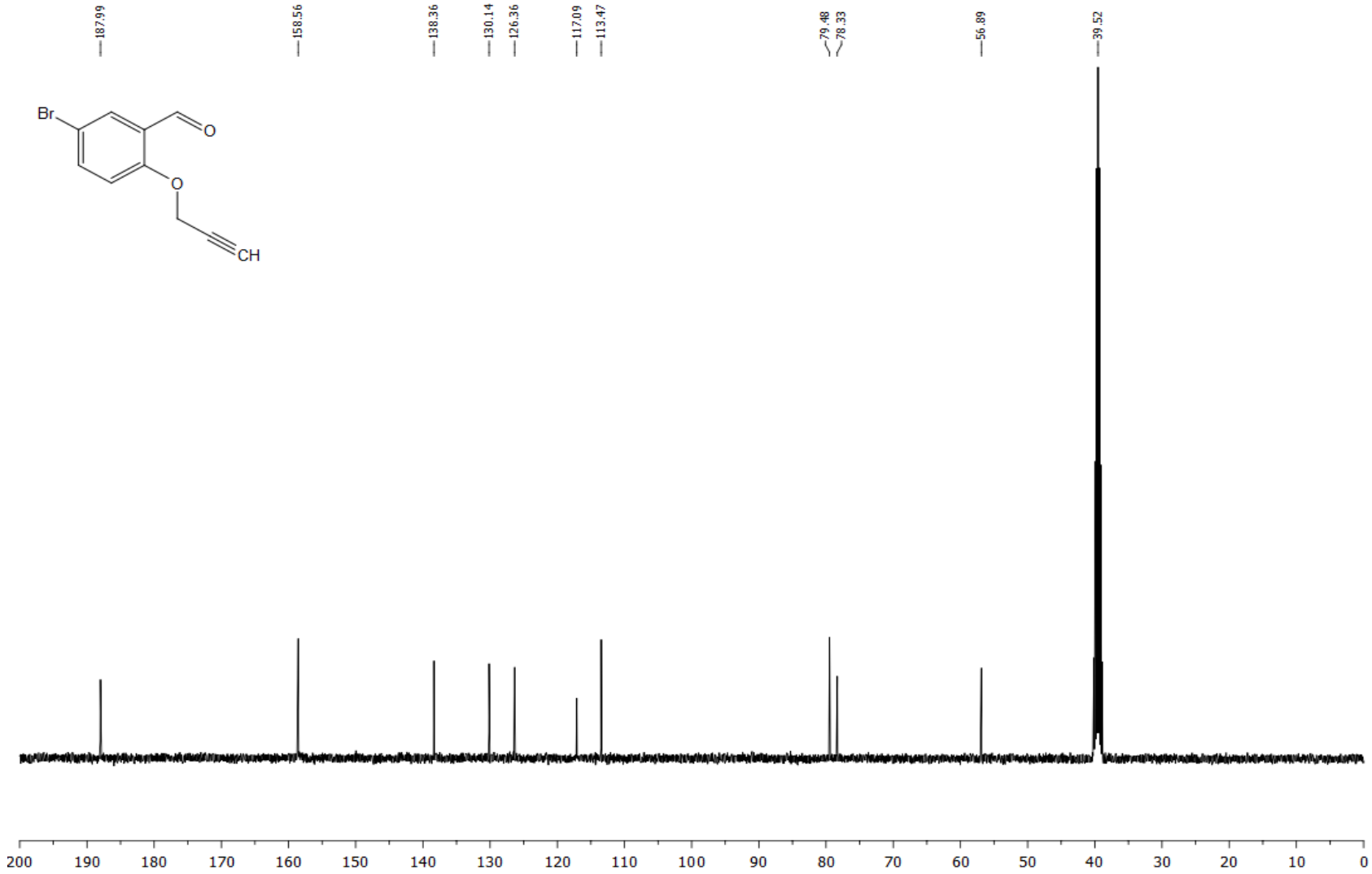
Mass spectrum of 5-Bromo-2-(prop-2-yn-1-yloxy)benzaldehyde (3)



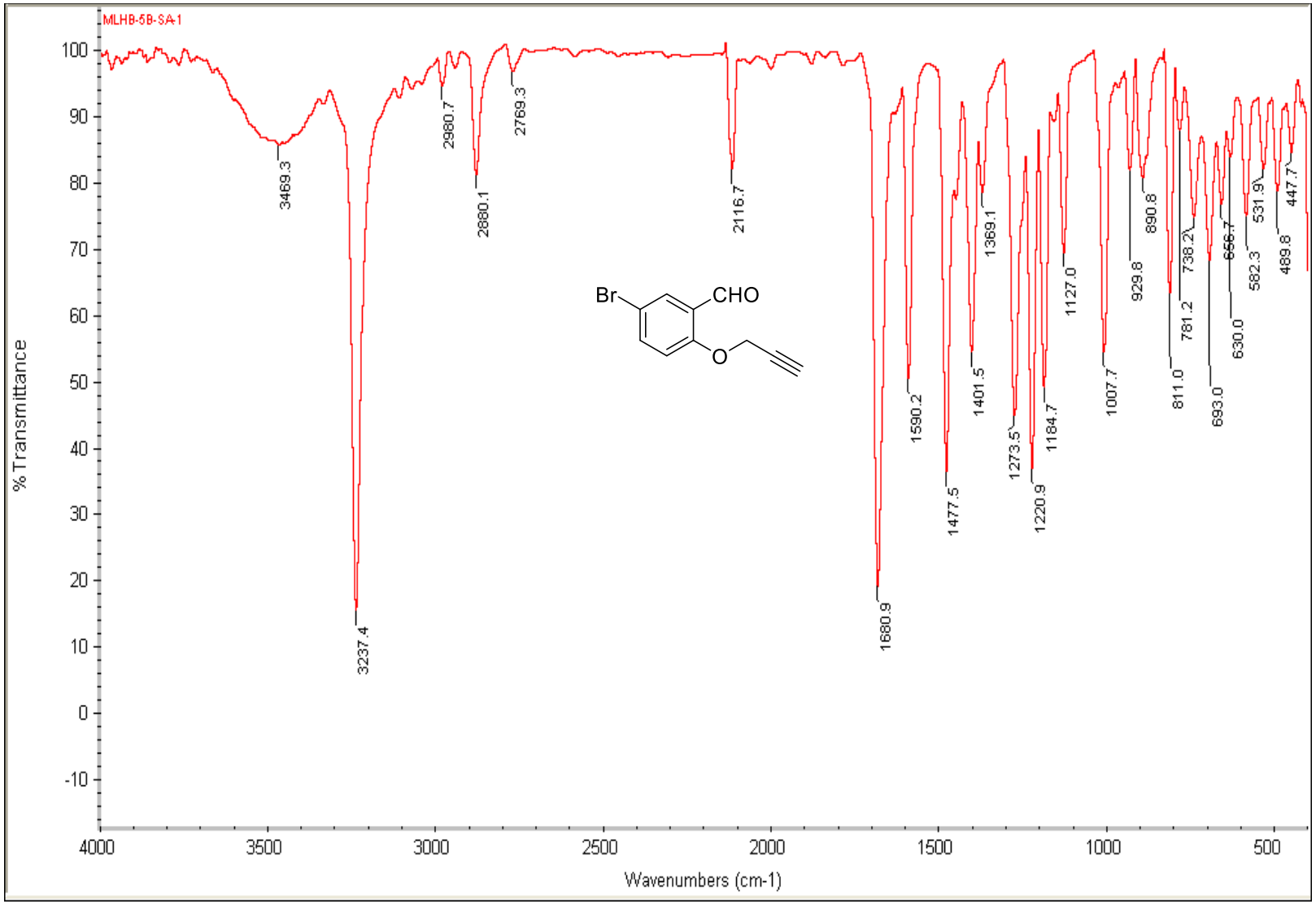
^{1}H NMR spectrum of 5-Bromo-2-(prop-2-yn-1-yloxy)benzaldehyde (3)



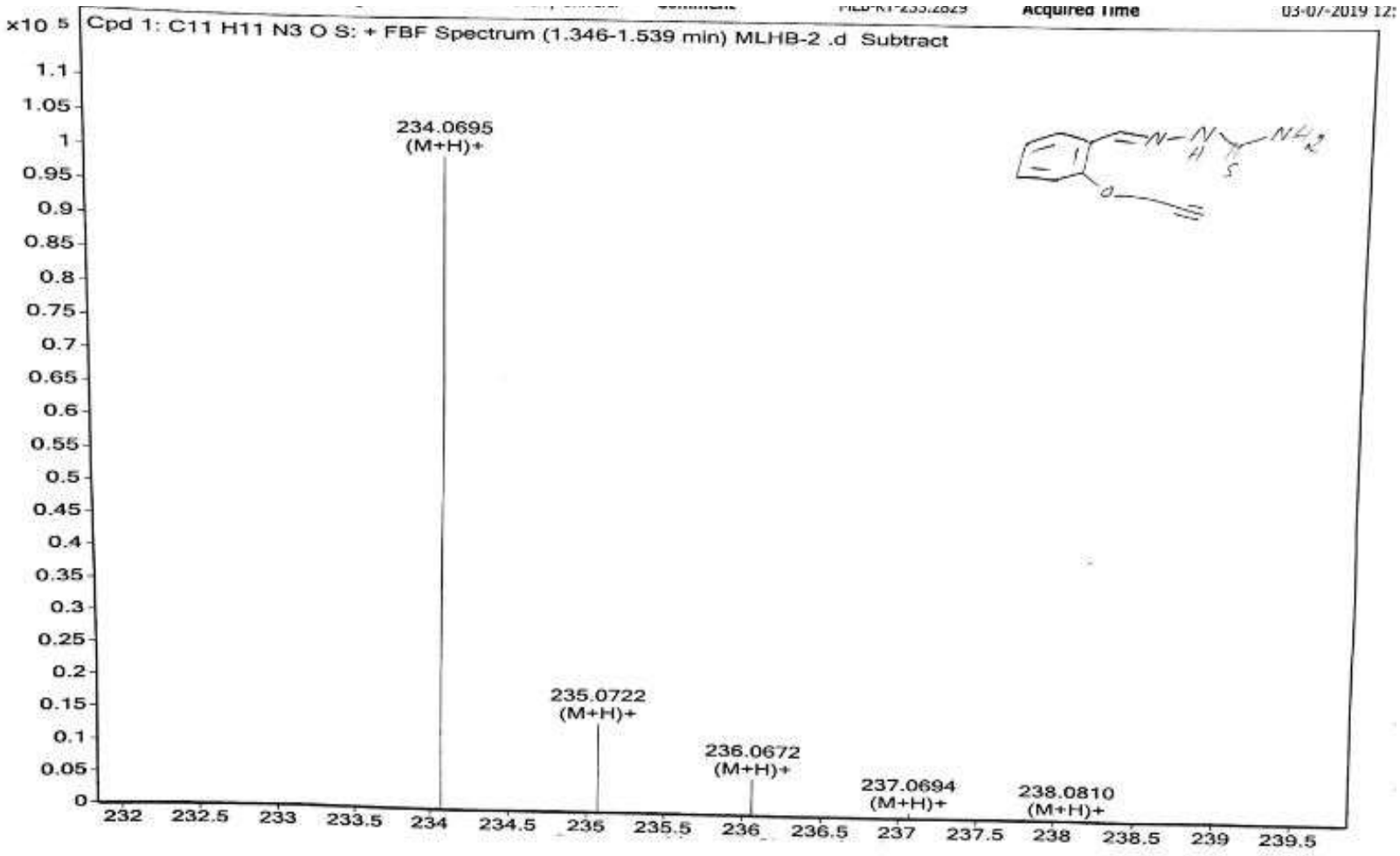
^{13}C NMR spectrum of 5-Bromo-2-(prop-2-yn-1-yloxy)benzaldehyde (3)



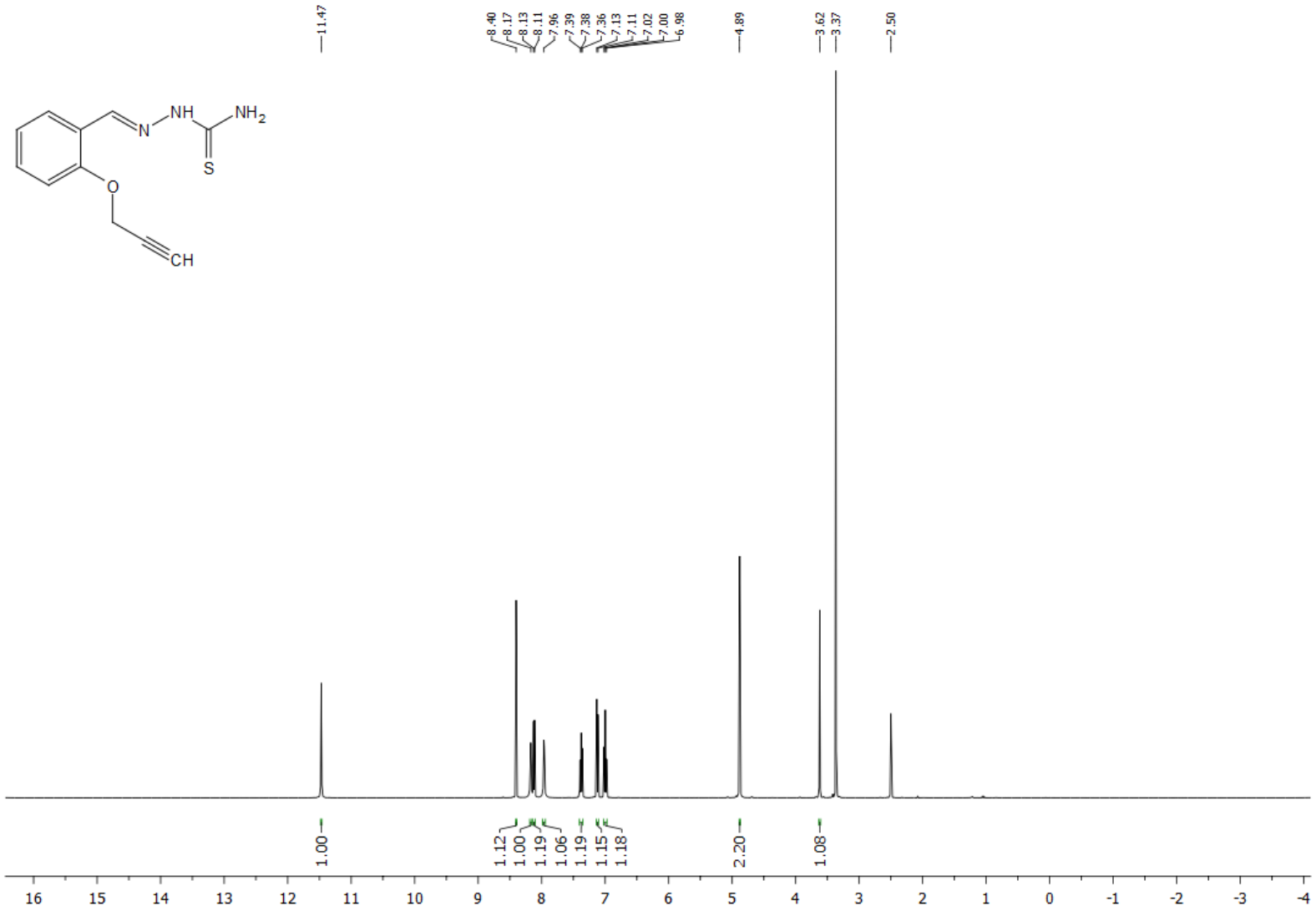
FT-IR spectrum of 5-Bromo-2-(prop-2-yn-1-yloxy)benzaldehyde (3)



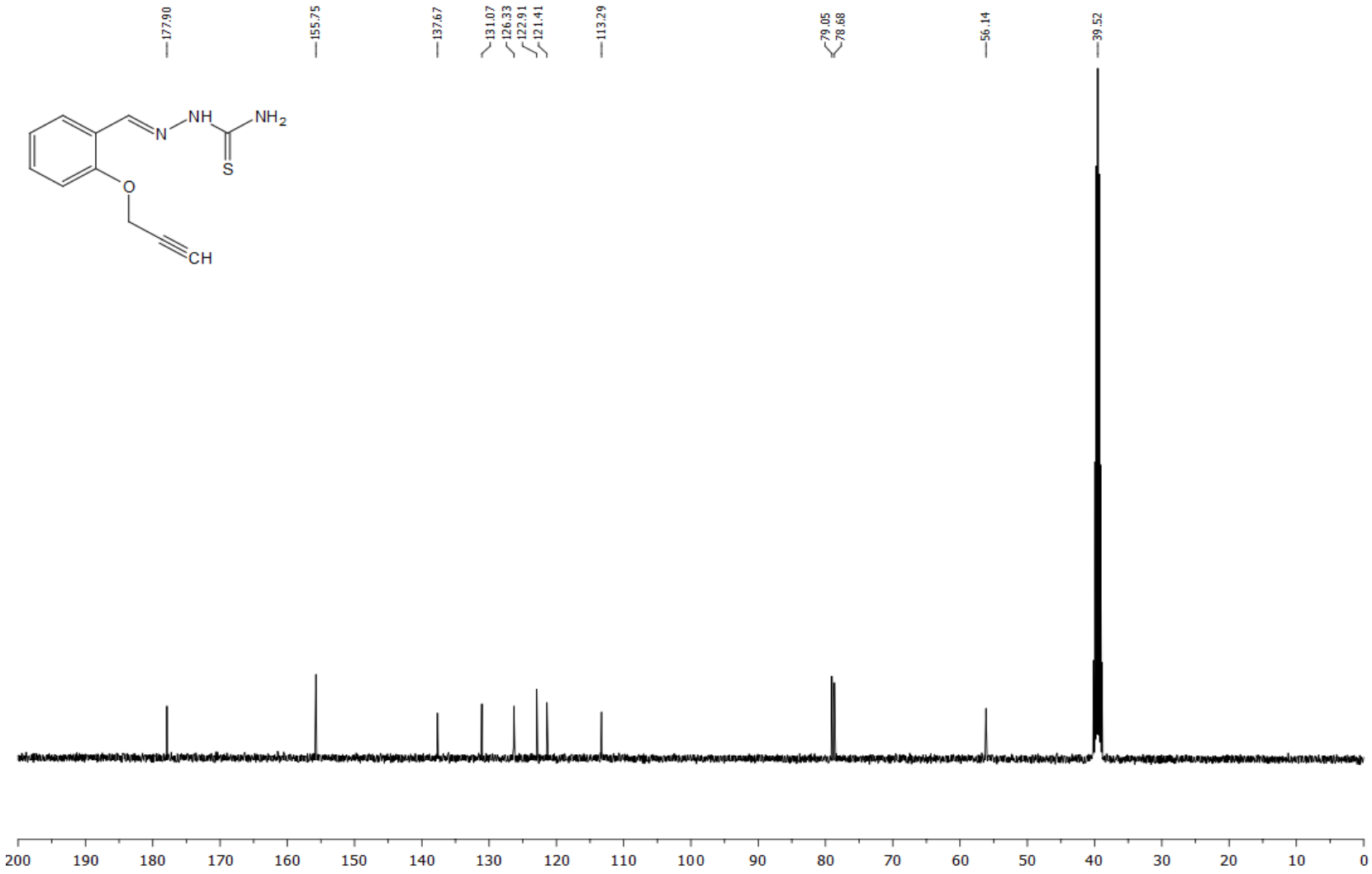
Mass spectrum of (*E*)-2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (4)



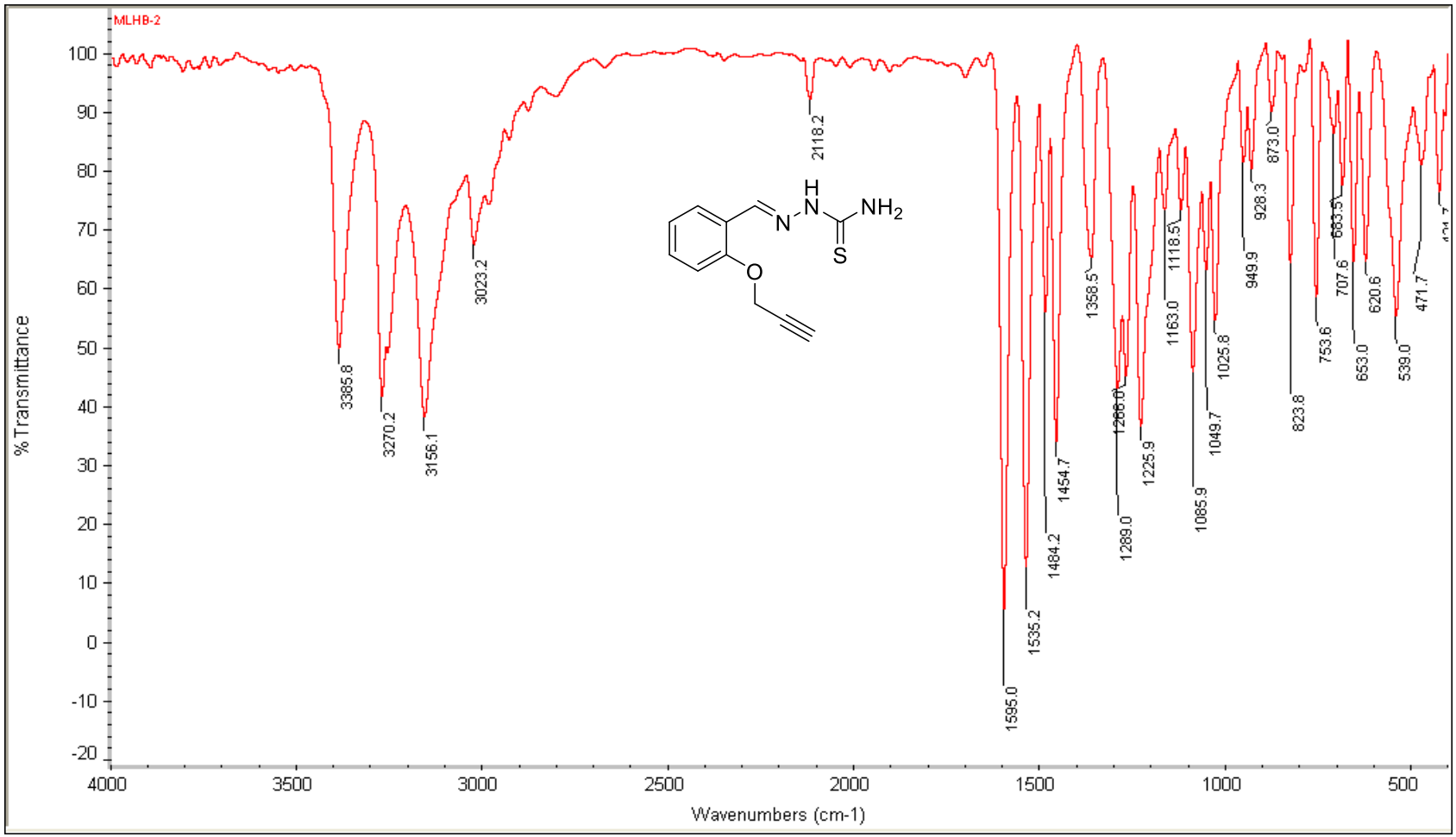
^{1}H NMR spectrum of (*E*)-2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (4)



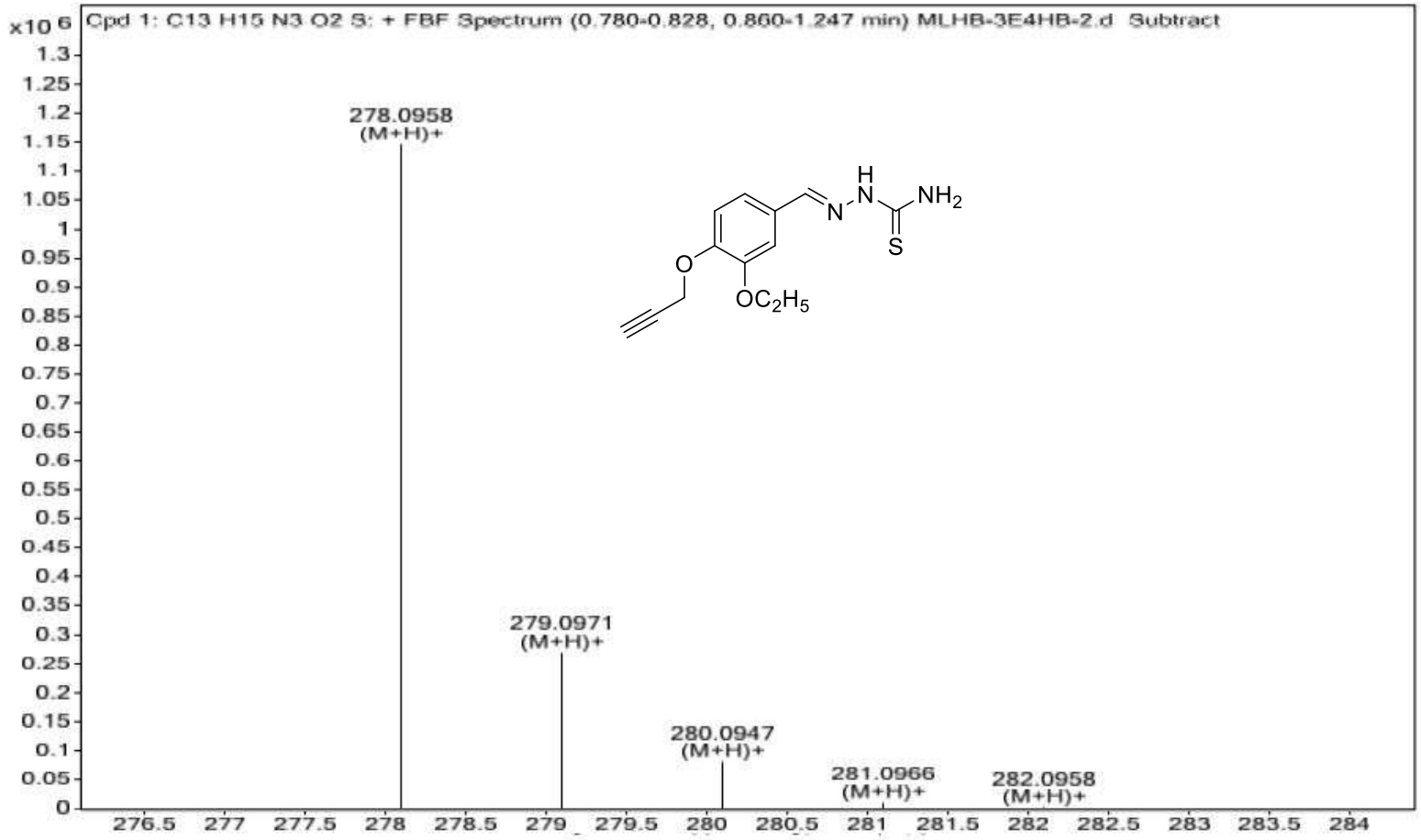
^{13}C NMR of (*E*)-2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (4)



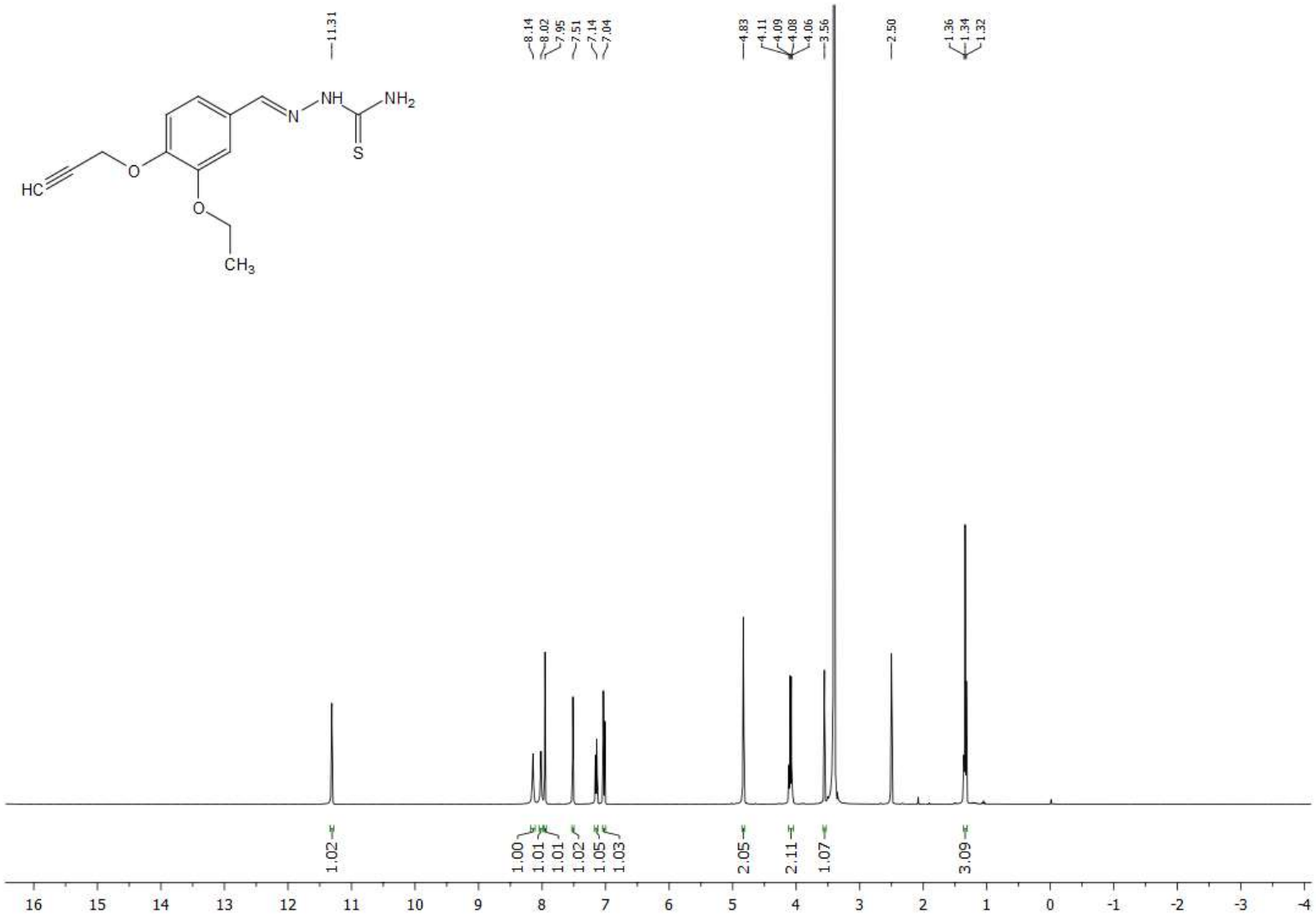
FT-IR spectrum of (*E*)-2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (4)



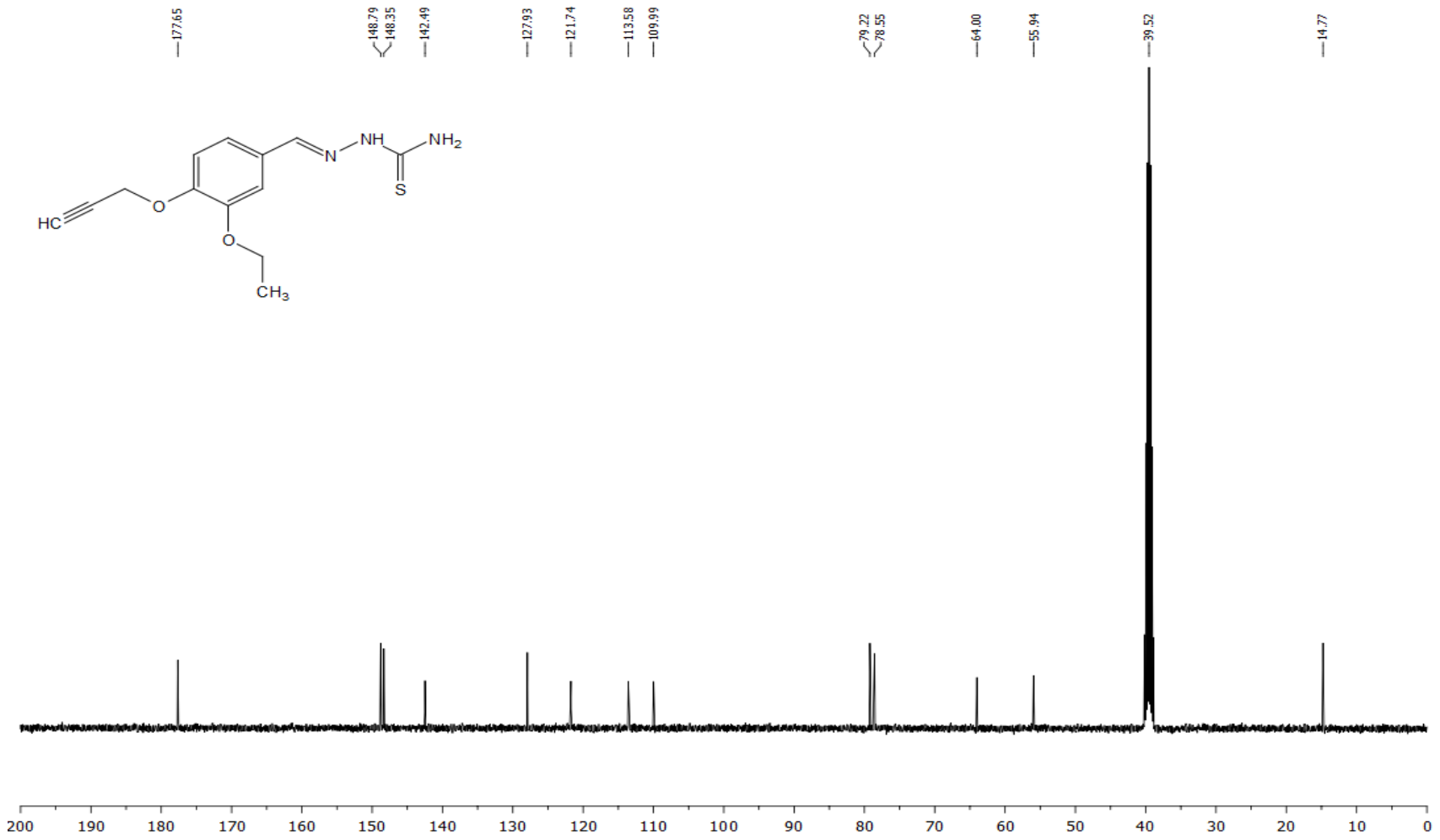
Mass spectrum of (*E*)-2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (5)



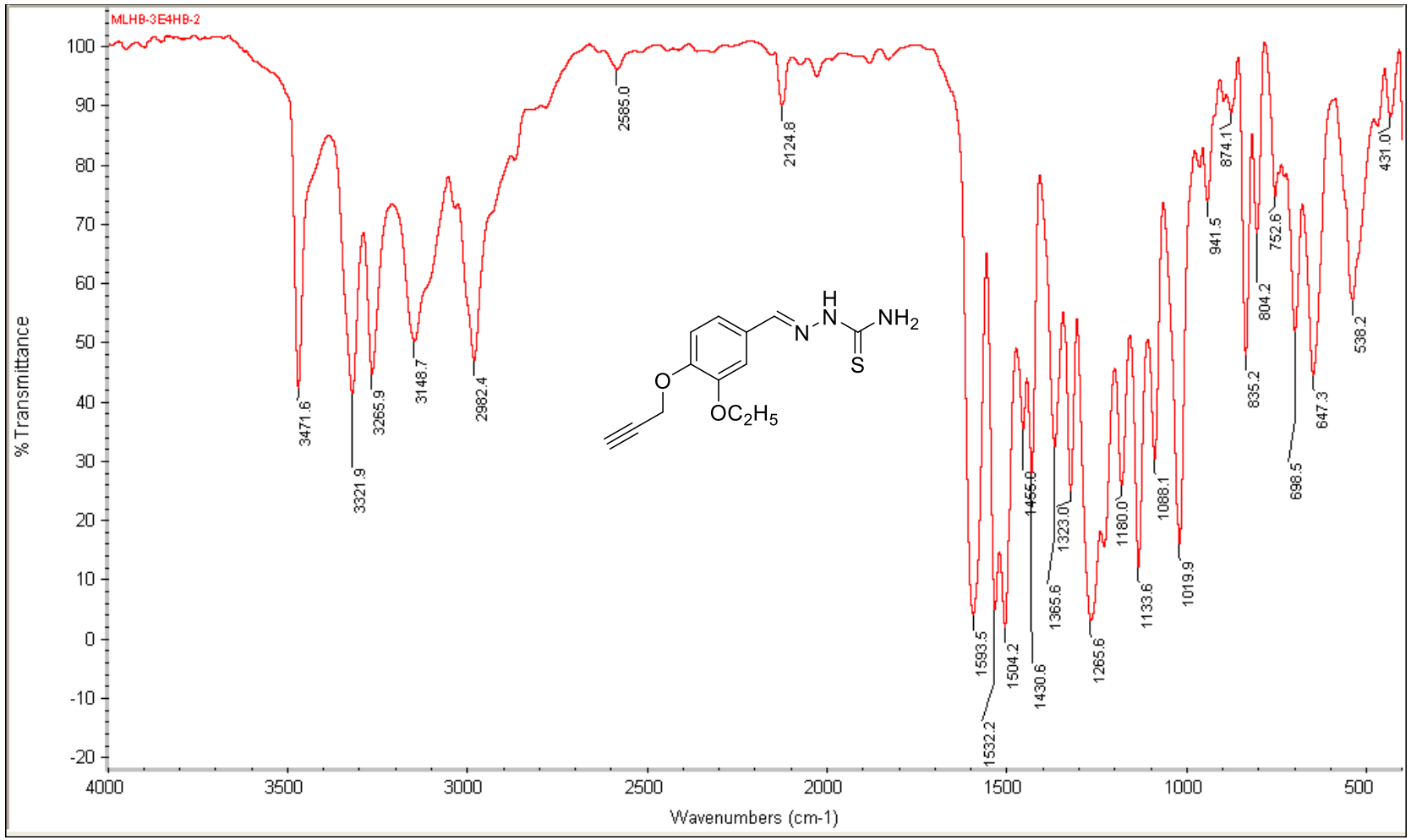
^{1}H NMR spectrum of (*E*)-2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (5)



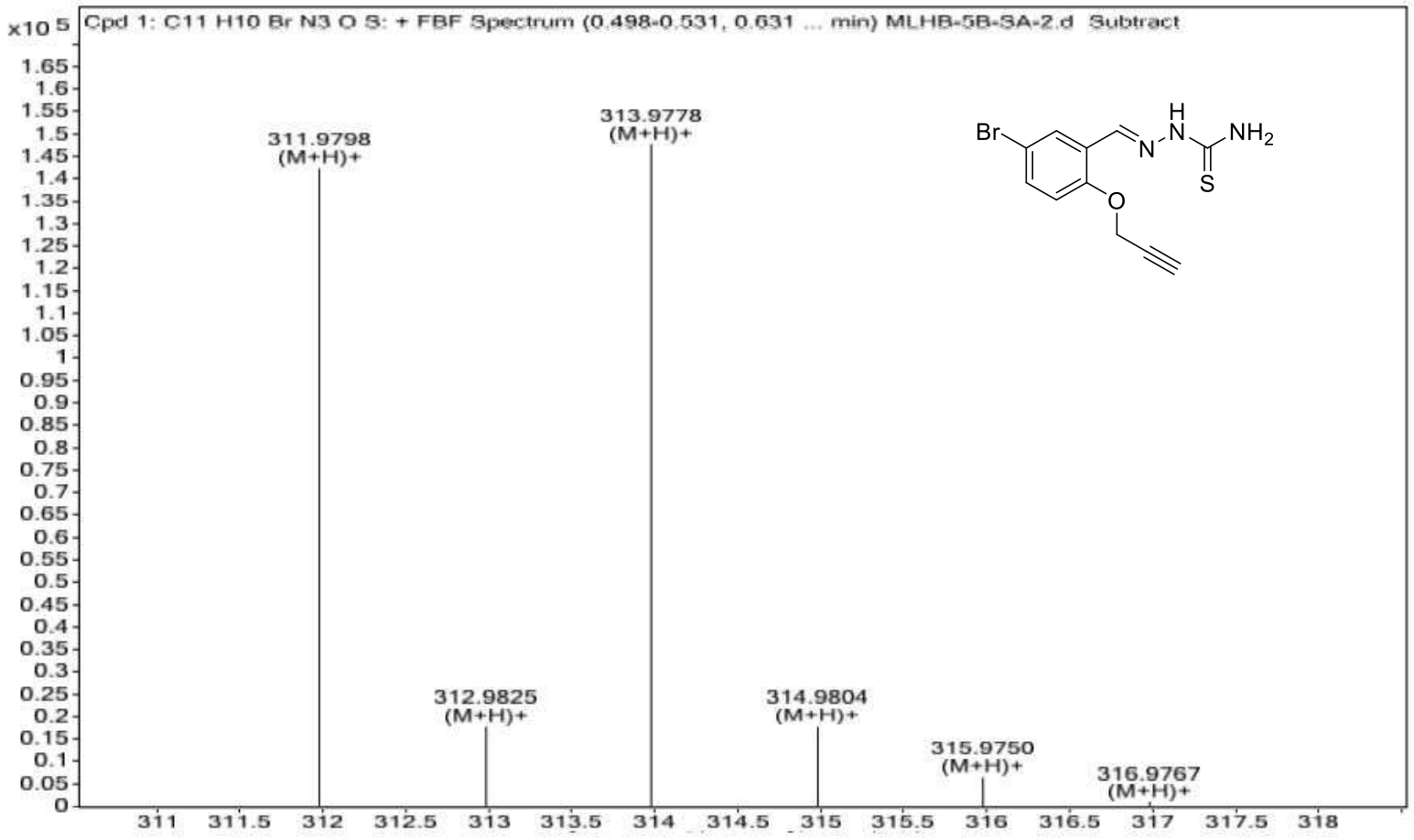
^{13}C NMR spectrum of (*E*)-2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (5)



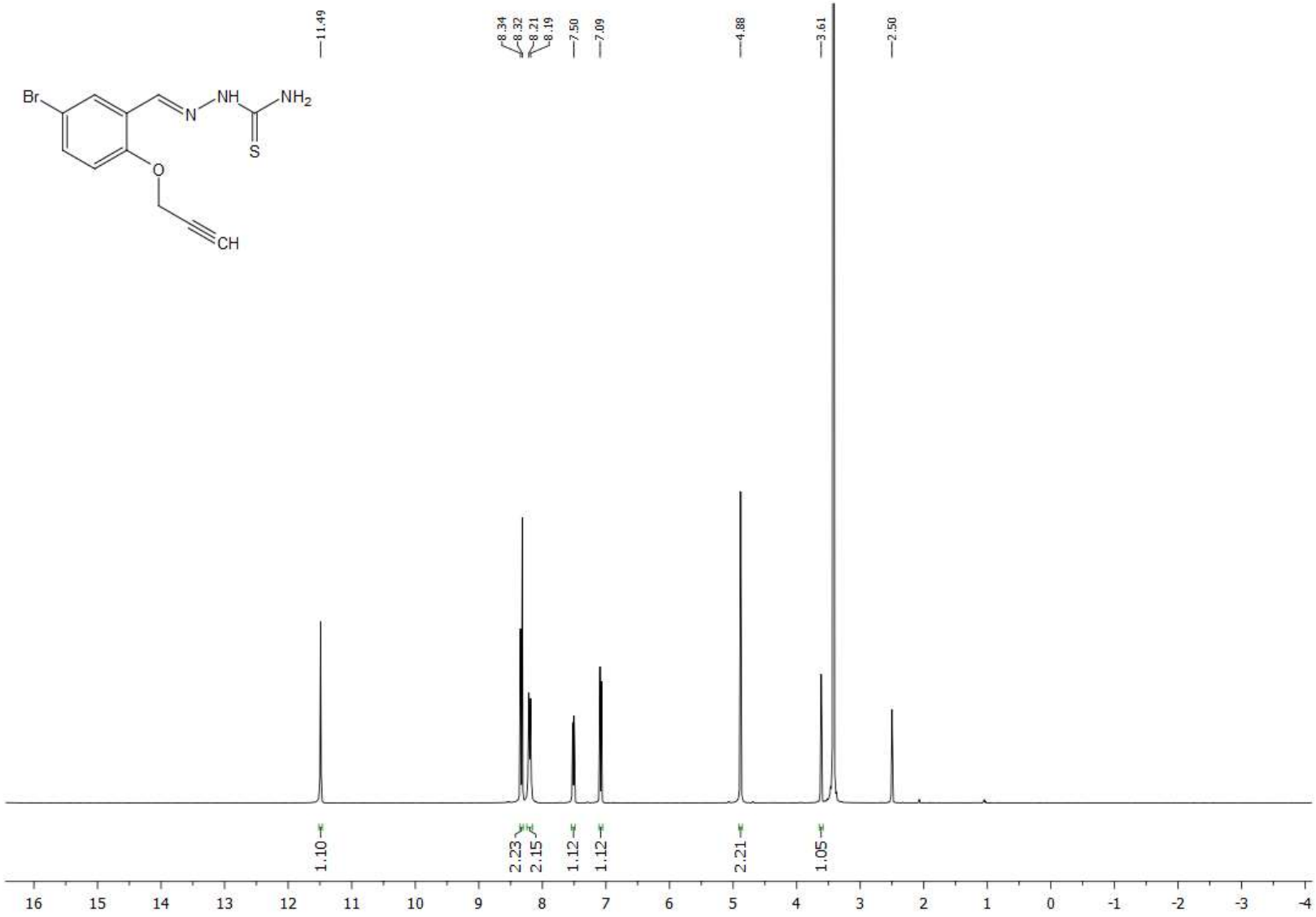
FT-IR spectrum of (*E*)-2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (5)



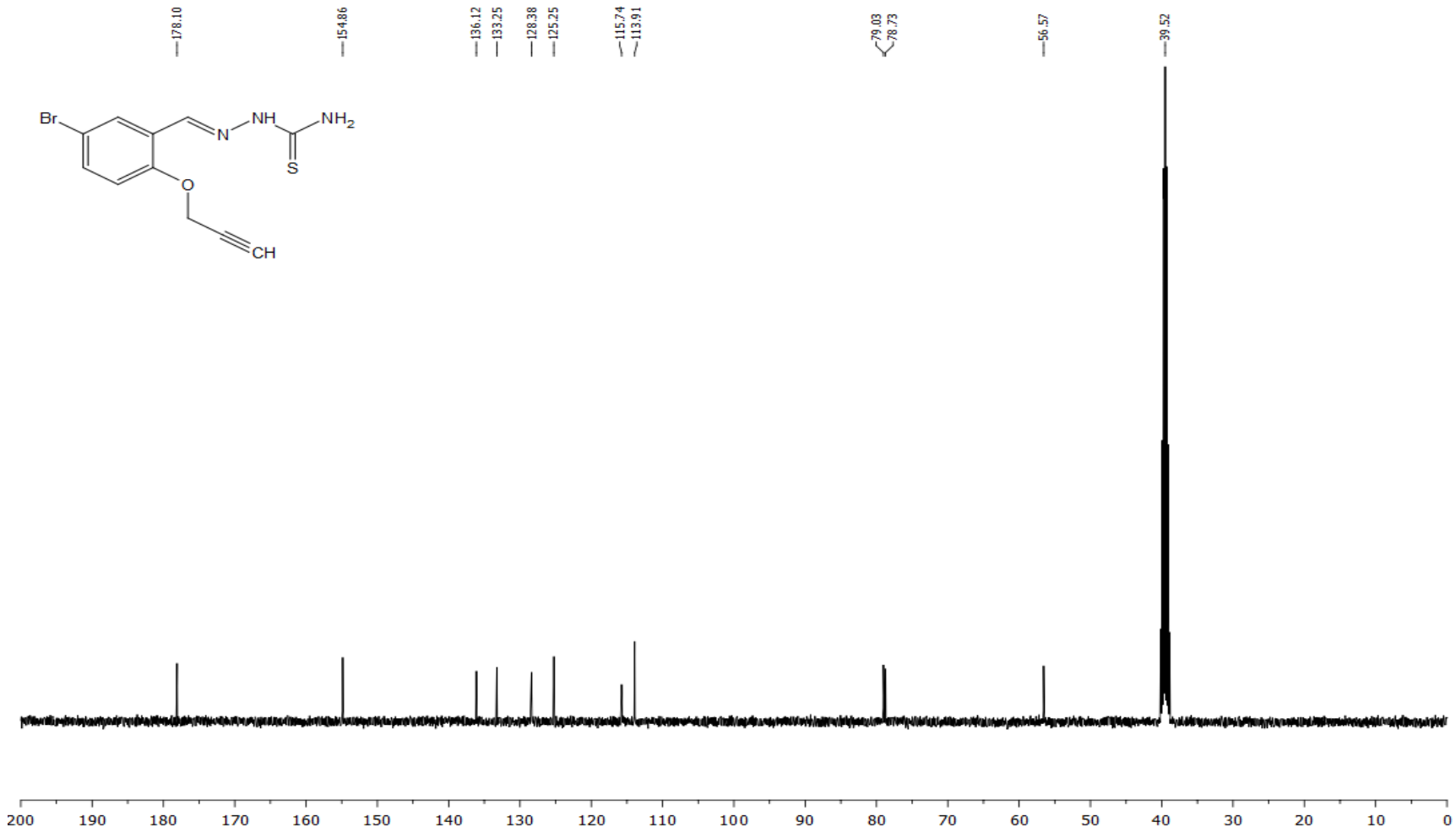
Mass spectrum of (*E*)-2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (6)



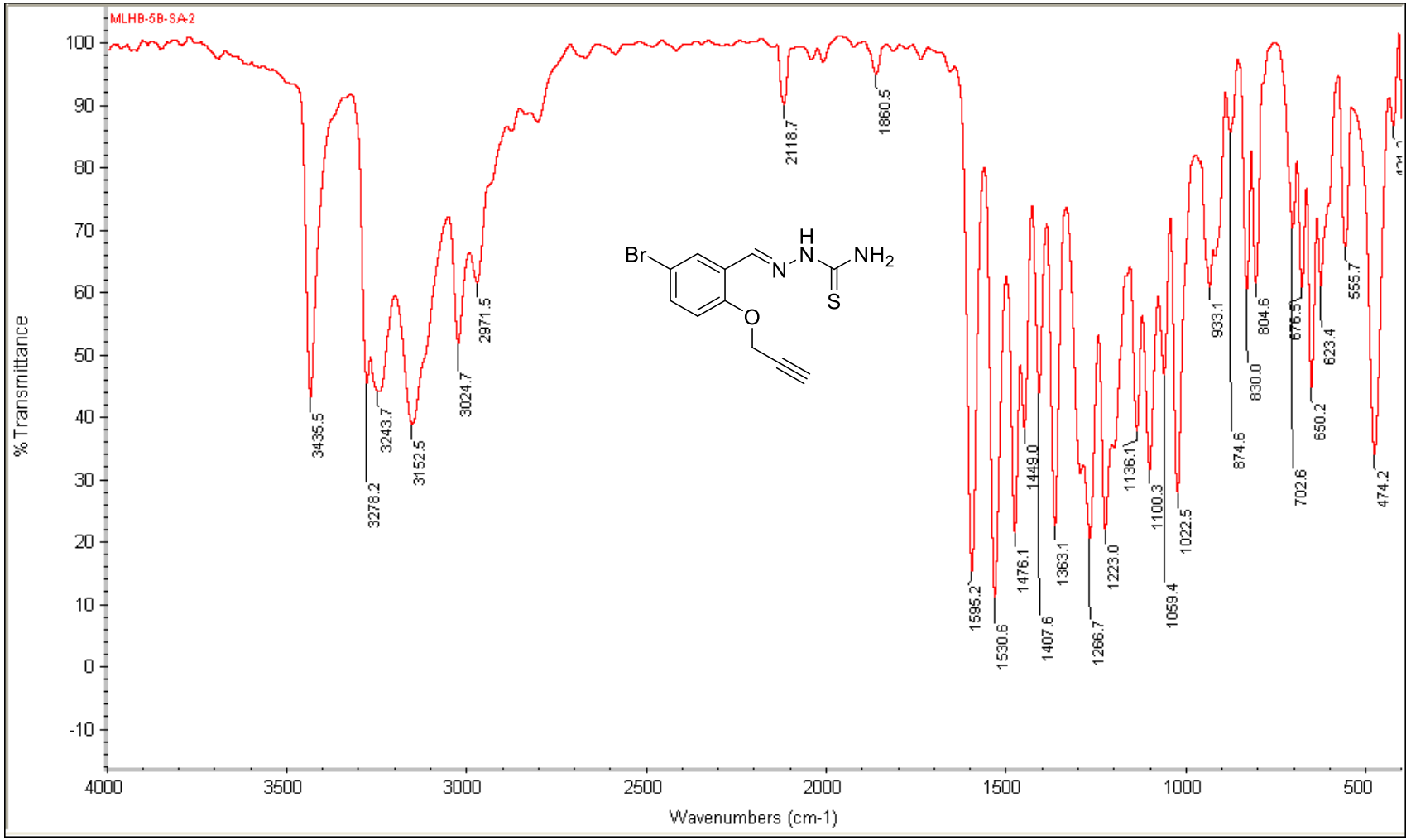
^{1}H NMR spectrum of (*E*)-2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (6)



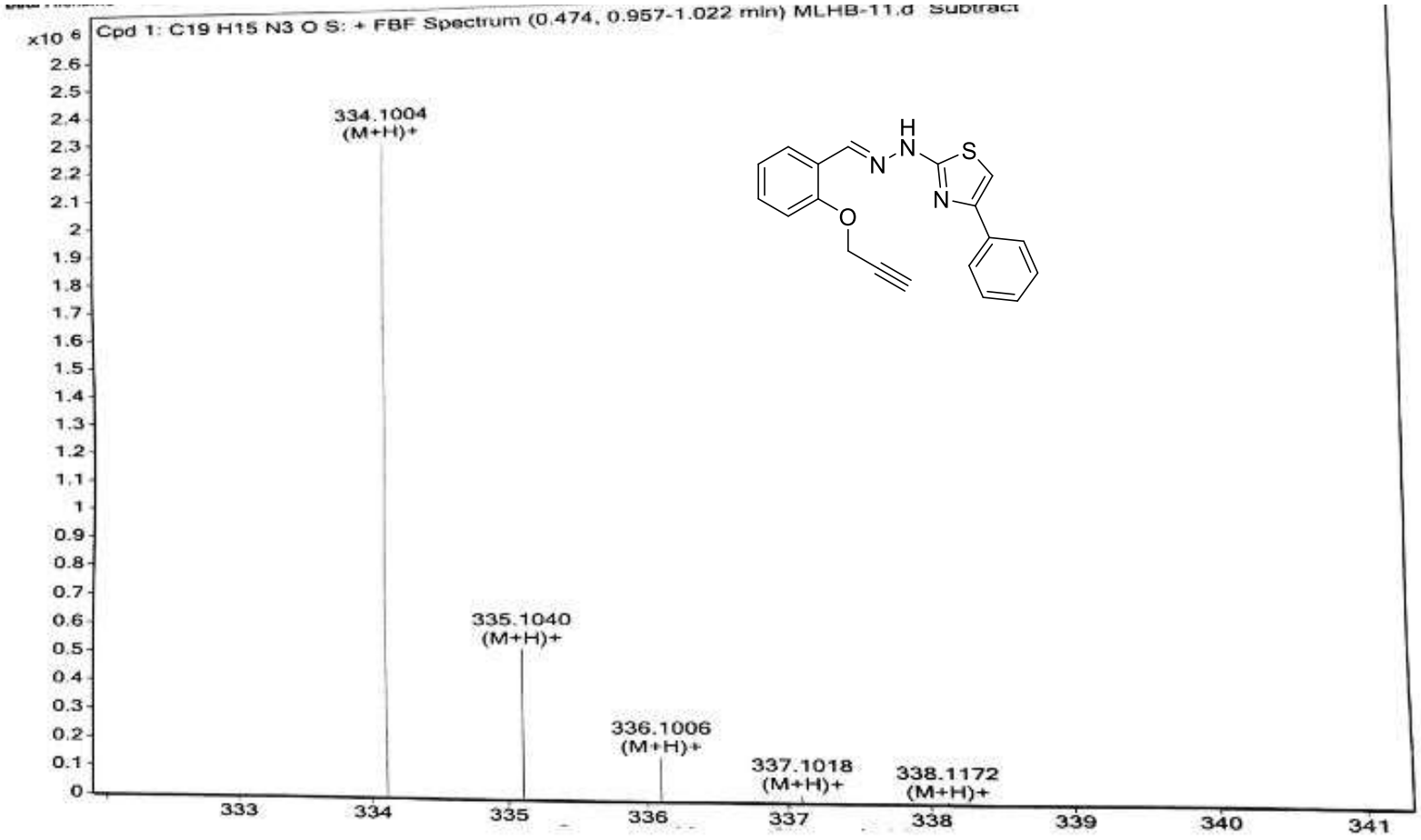
^{13}C NMR spectrum of (*E*)-2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (6)



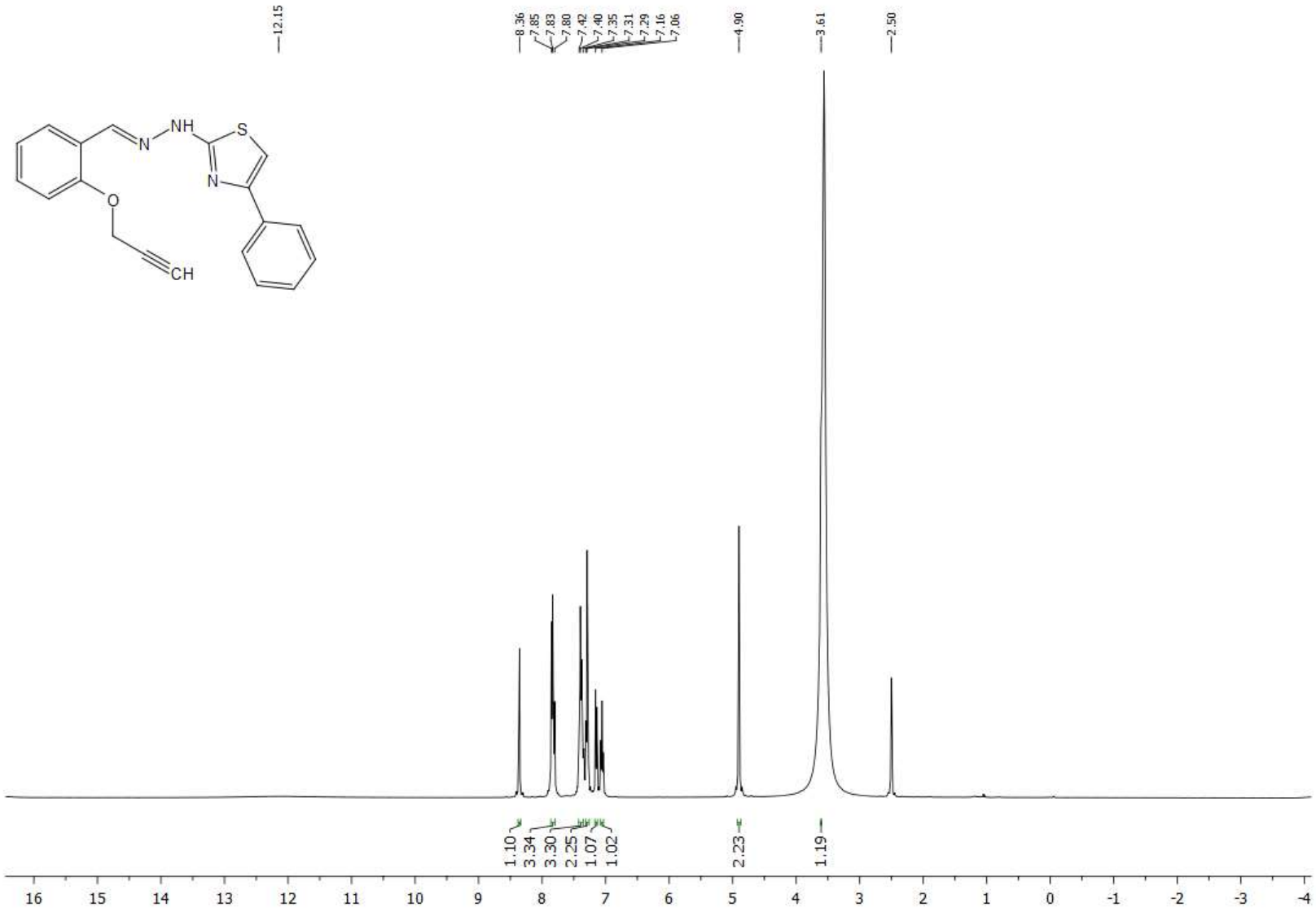
FT-IR spectrum of (*E*)-2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazine-1-carbothioamide (6)



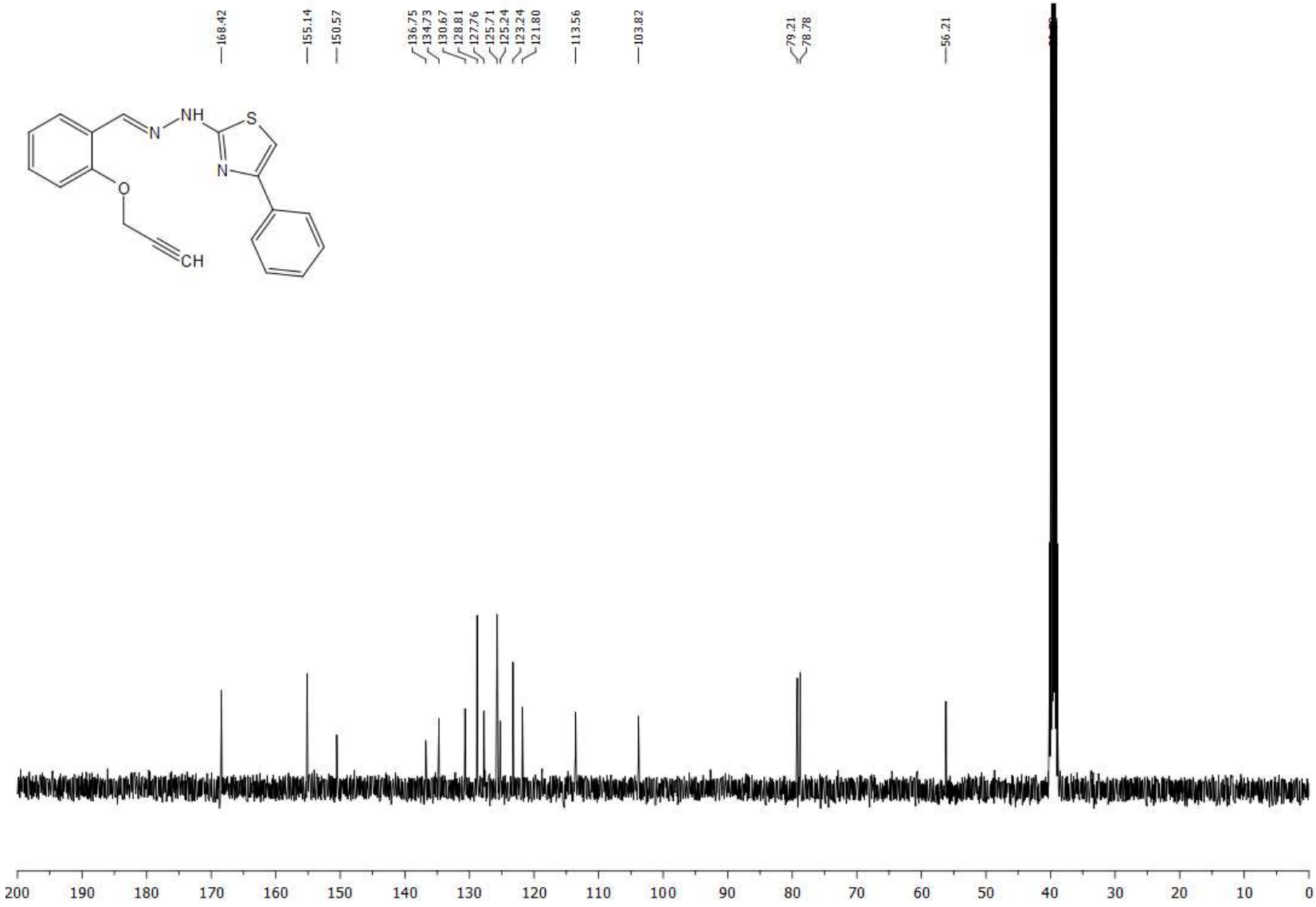
Mass spectrum of (*E*)-4-Phenyl-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (7)



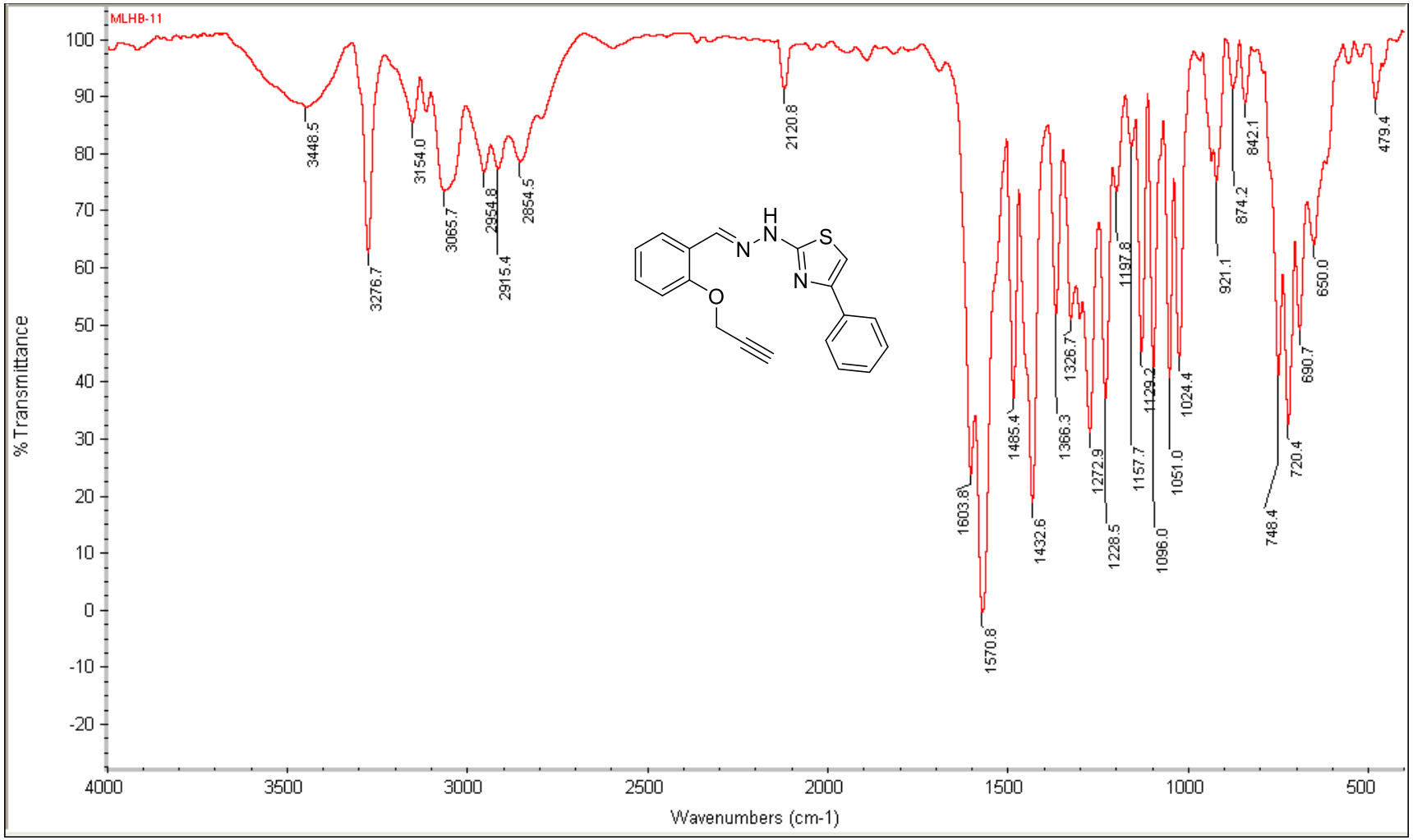
^{1}H NMR spectrum of (*E*)-4-Phenyl-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (7)



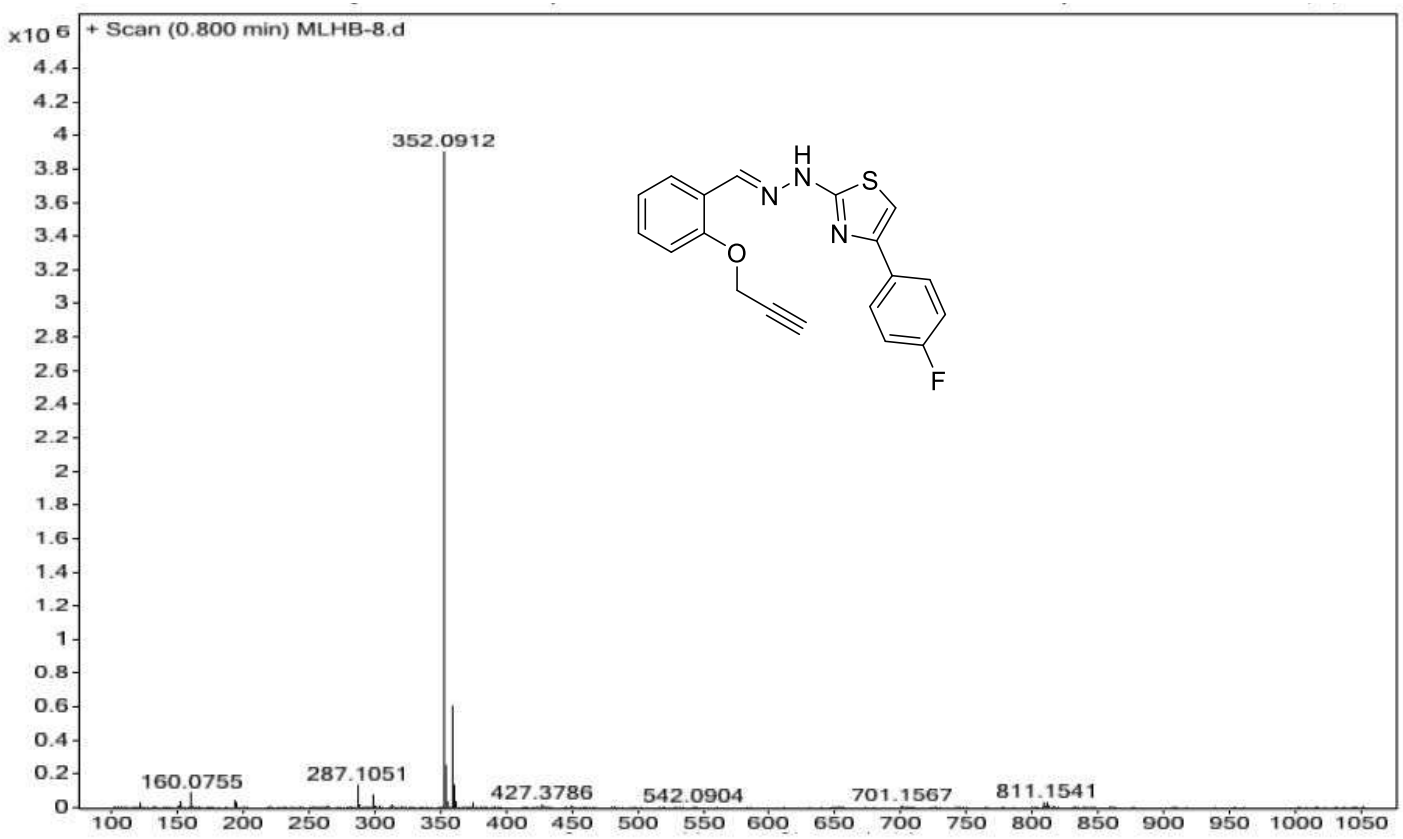
^{13}C NMR spectrum of (*E*)-4-Phenyl-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (7)



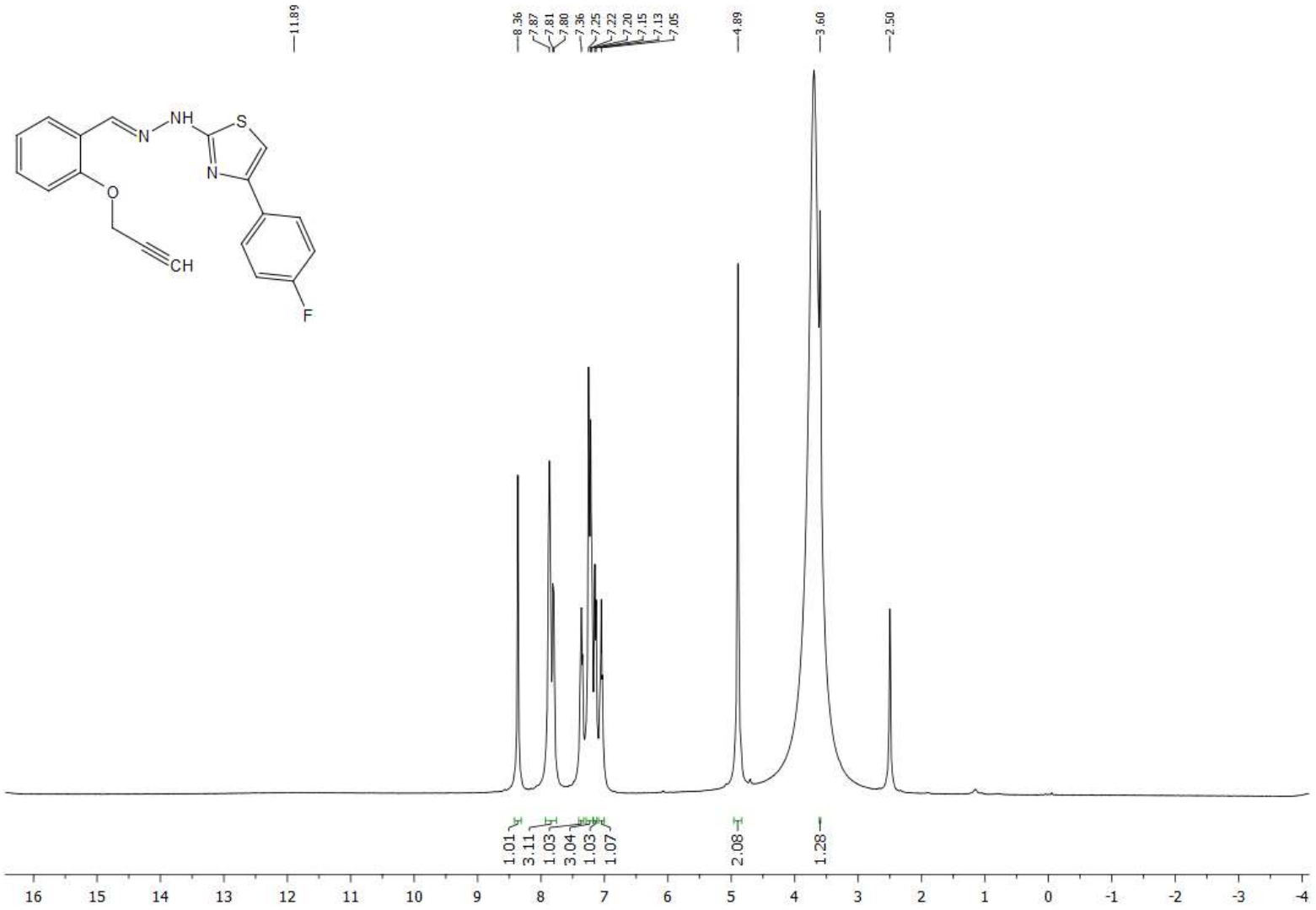
FT-IR spectrum of (*E*)-4-Phenyl-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (7)



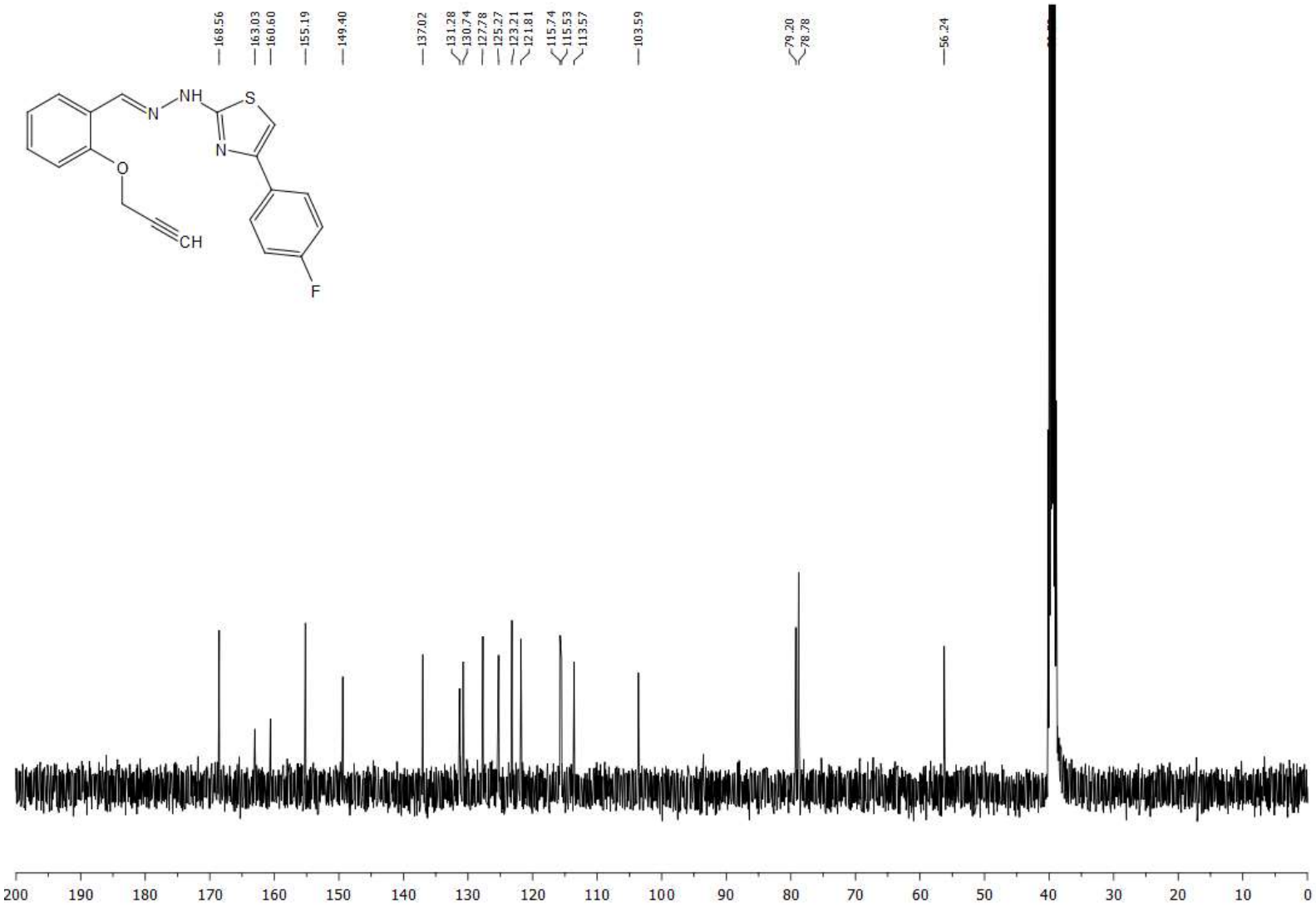
Mass spectrum of (*E*)-4-(4-Fluorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (8)



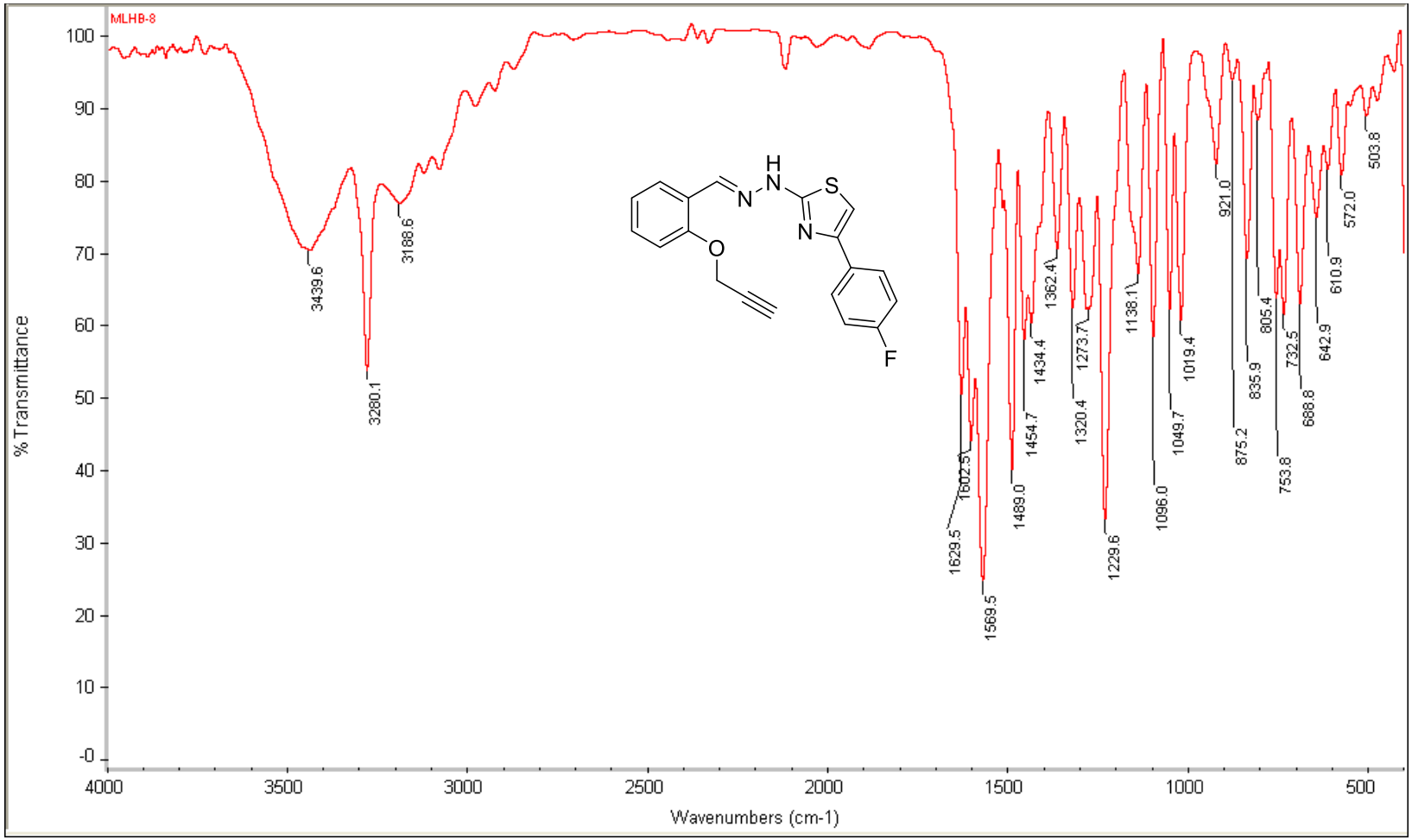
^{1}H NMR spectrum of (*E*)-4-(4-Fluorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (8)



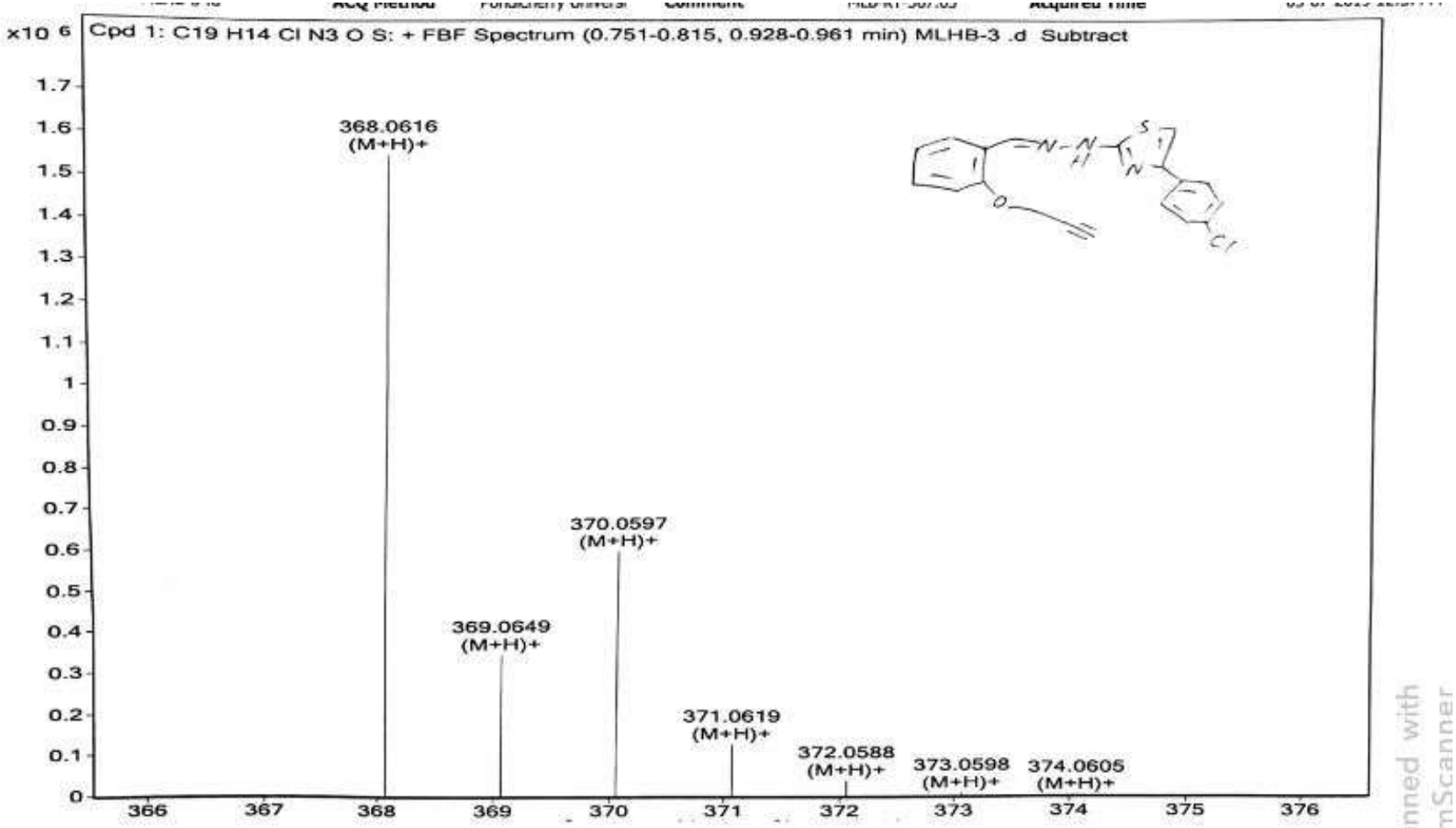
^{13}C NMR spectrum of (*E*)-4-(4-Fluorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (8)



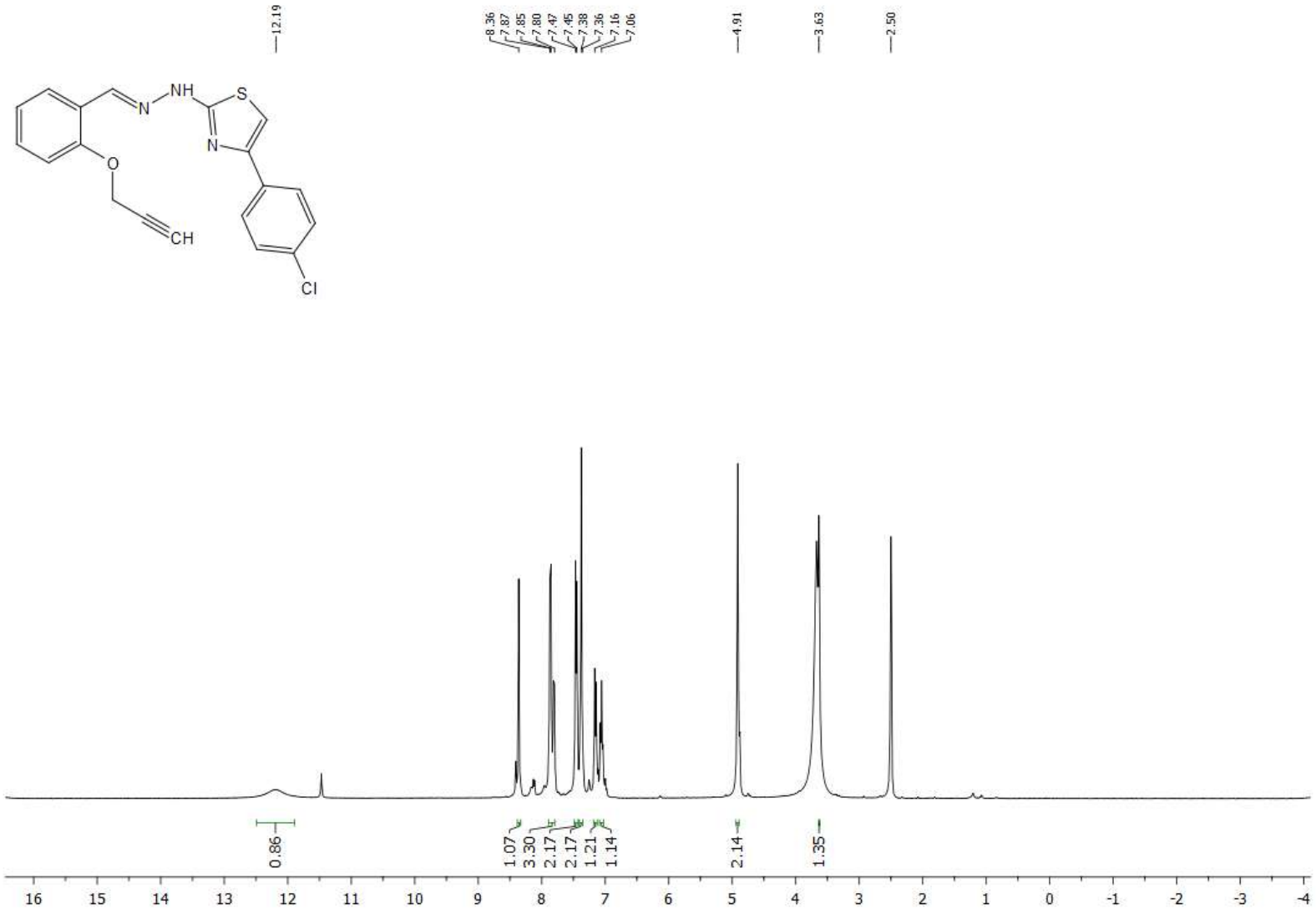
FT-IR spectrum of (*E*)-4-(4-Fluorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (8)



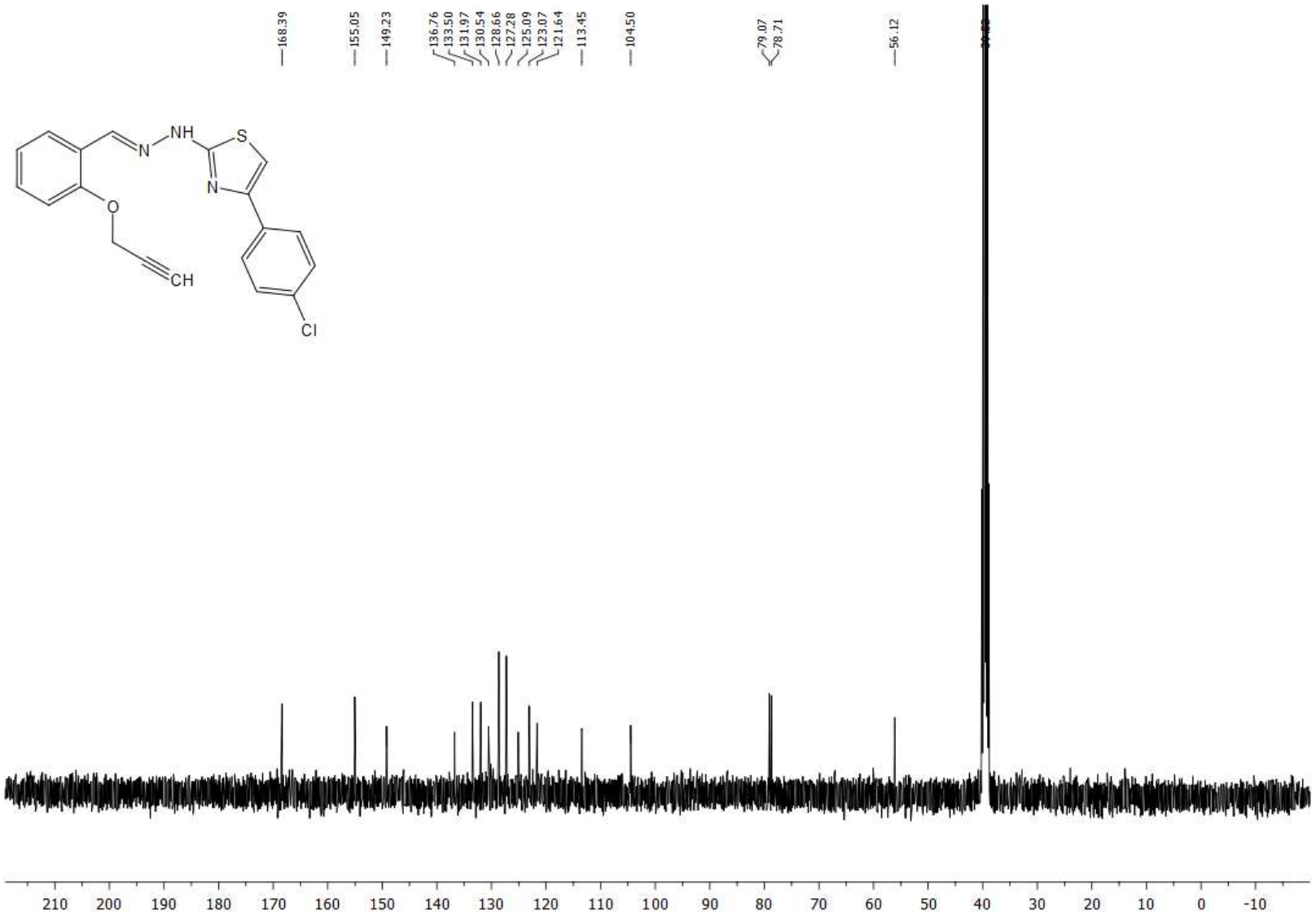
Mass spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (9)



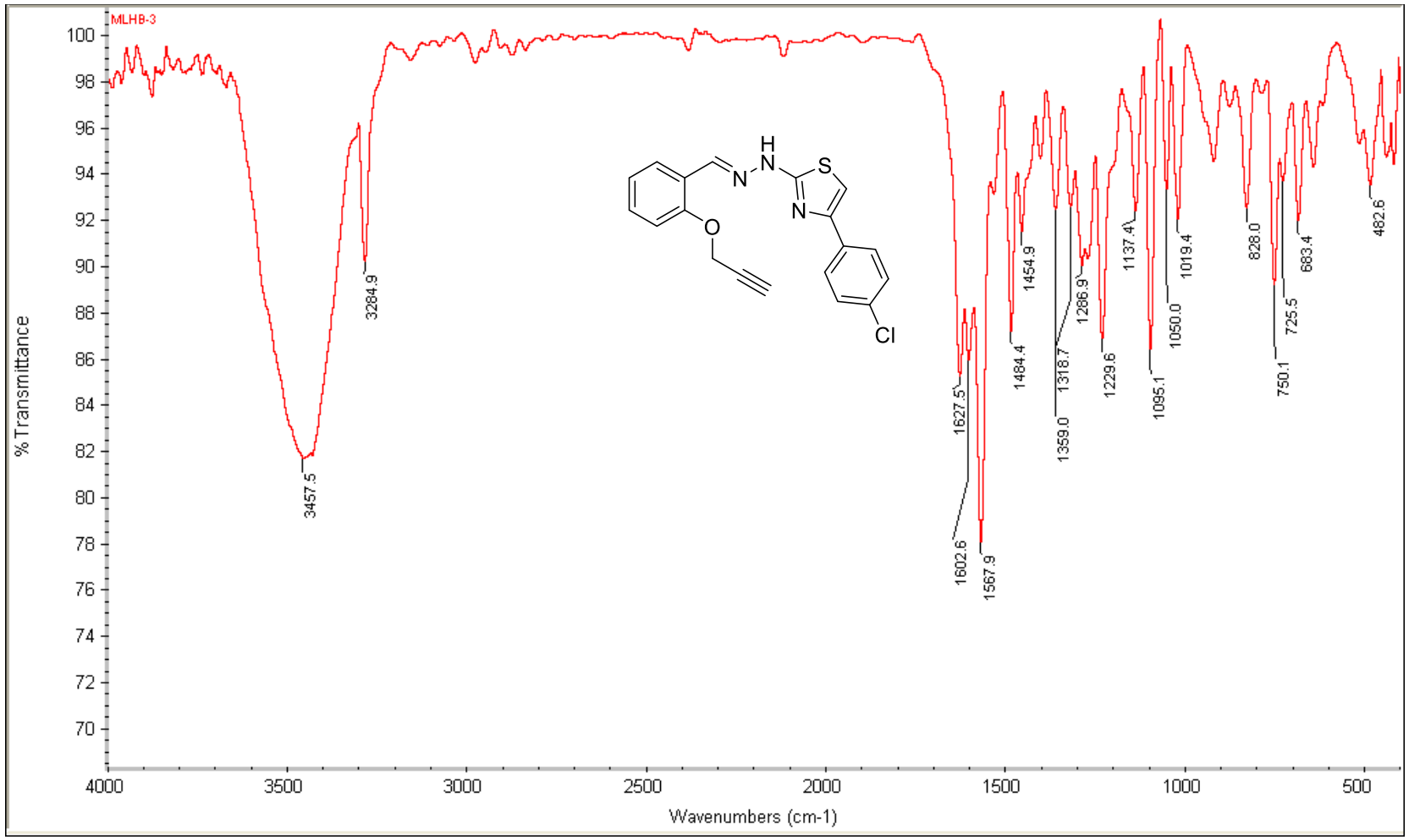
^{1}H NMR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (9)



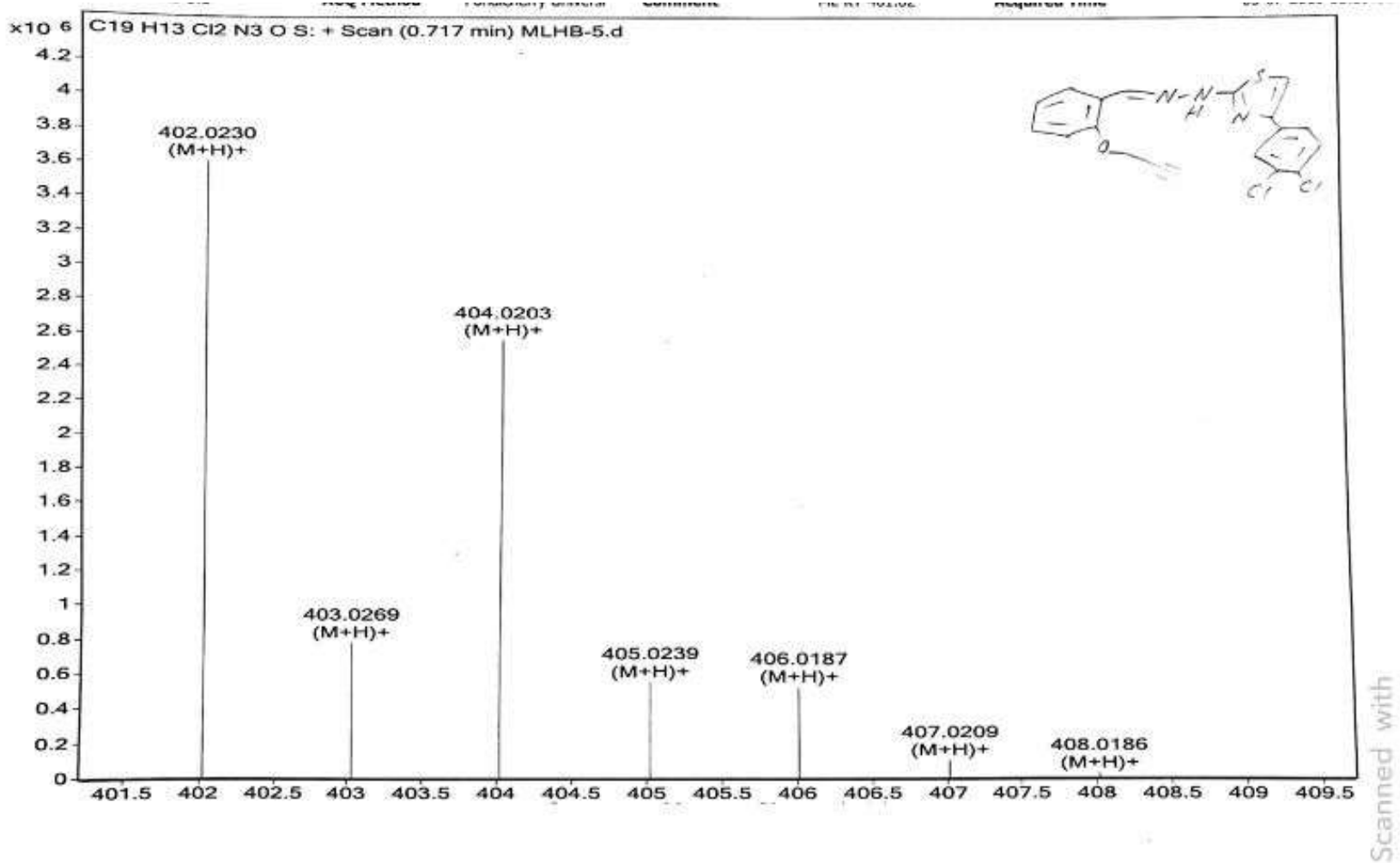
^{13}C NMR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (9)



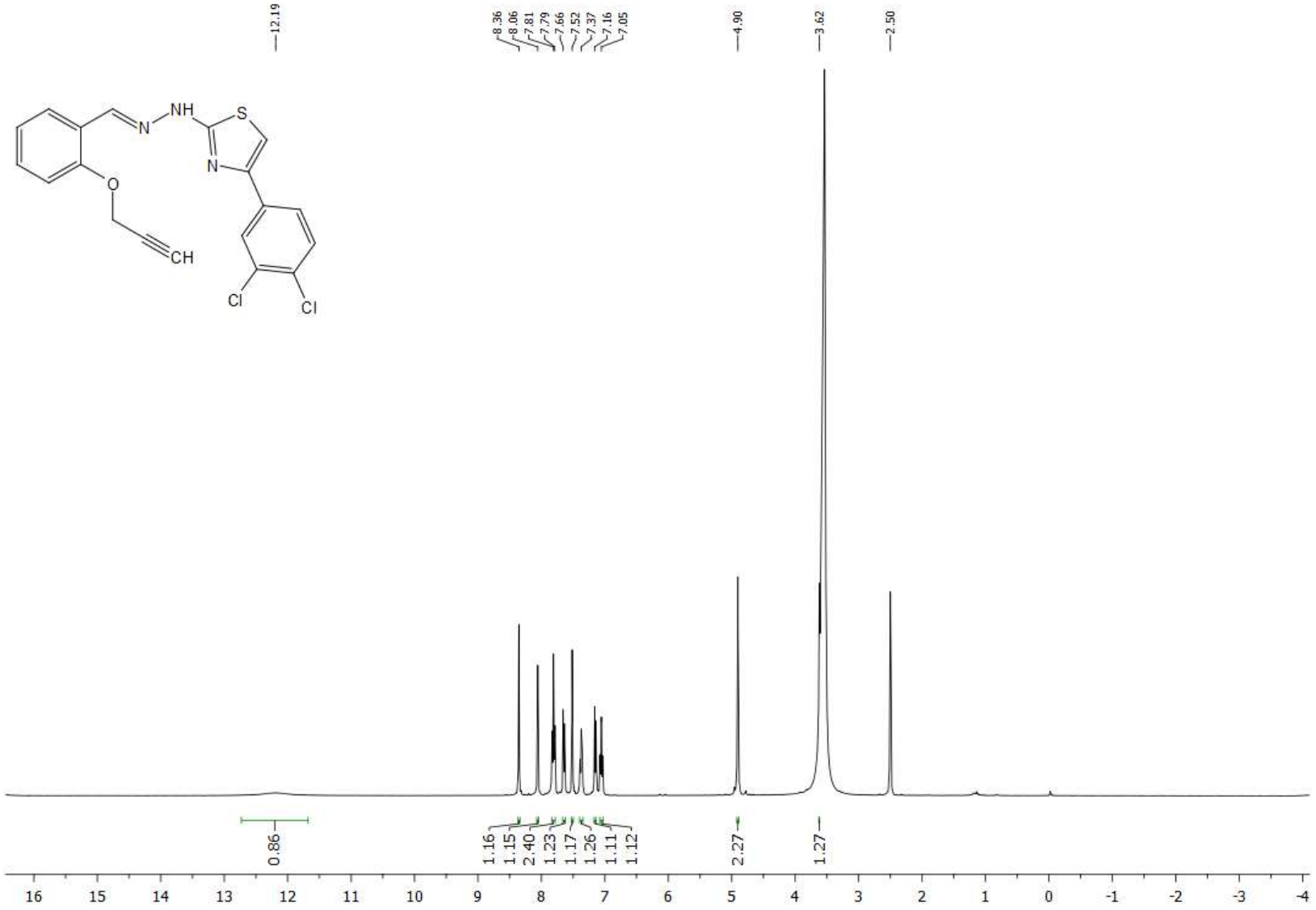
FT-IR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (9)



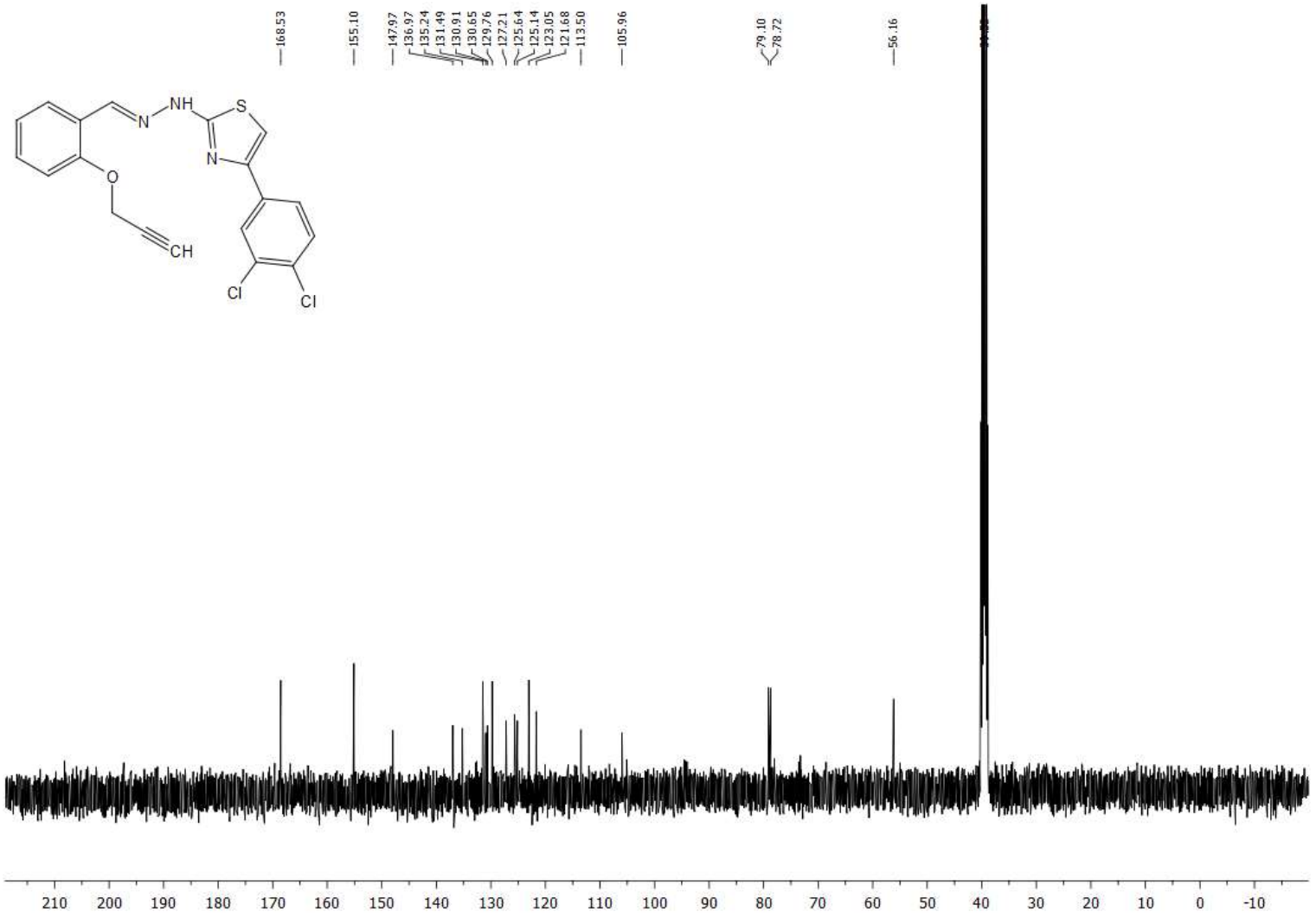
Mass spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (10)



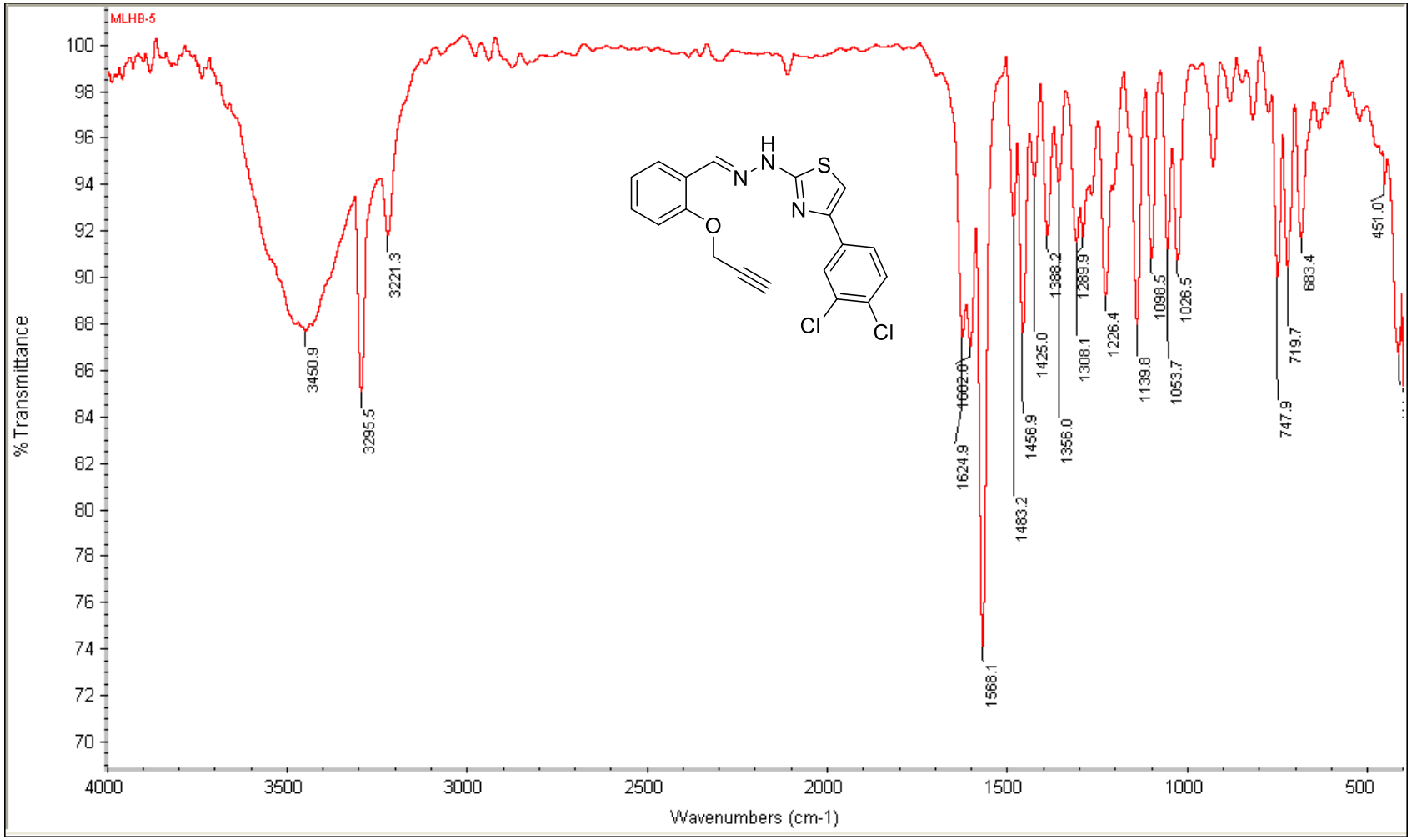
^{1}H NMR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (10)



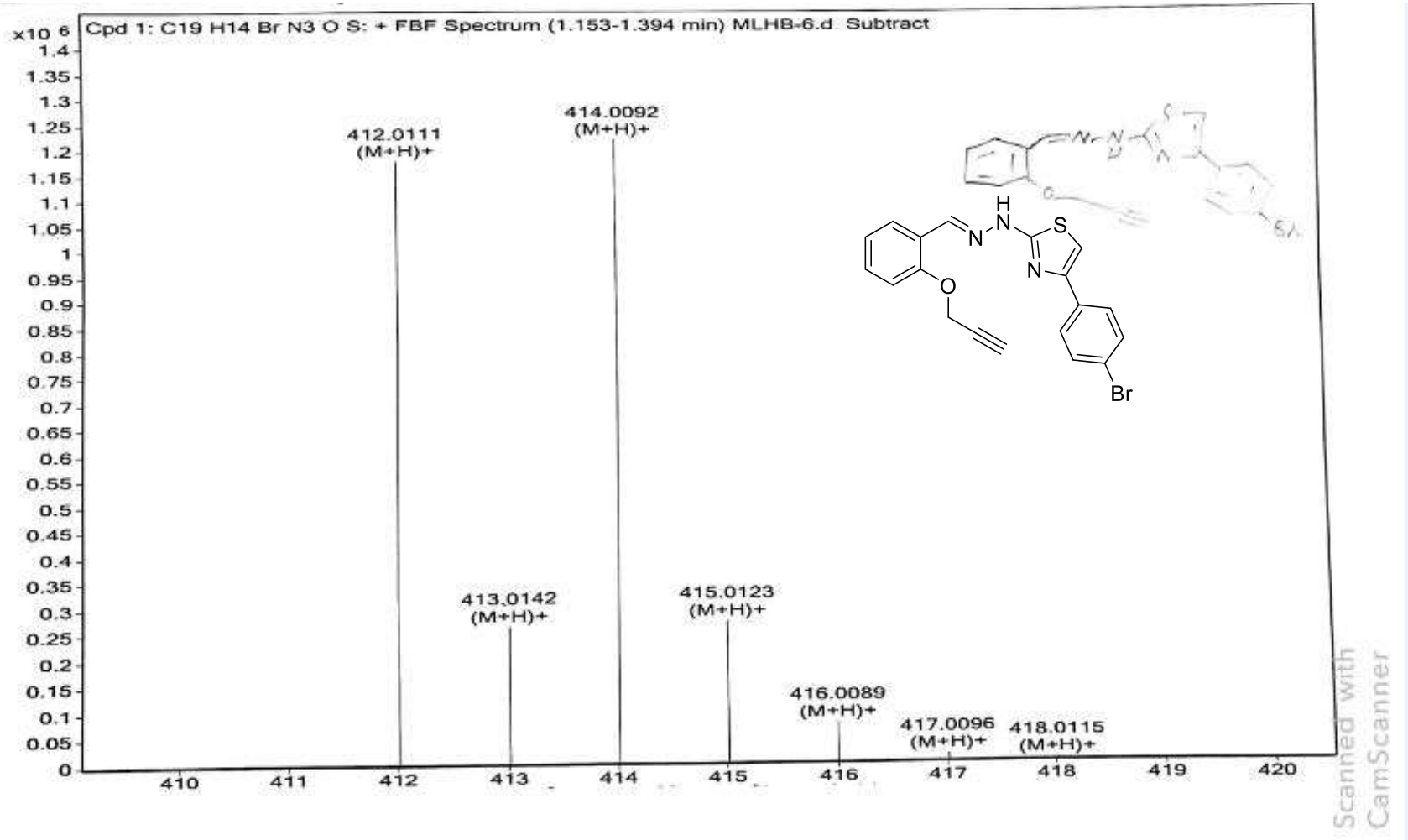
^{13}C NMR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (10)



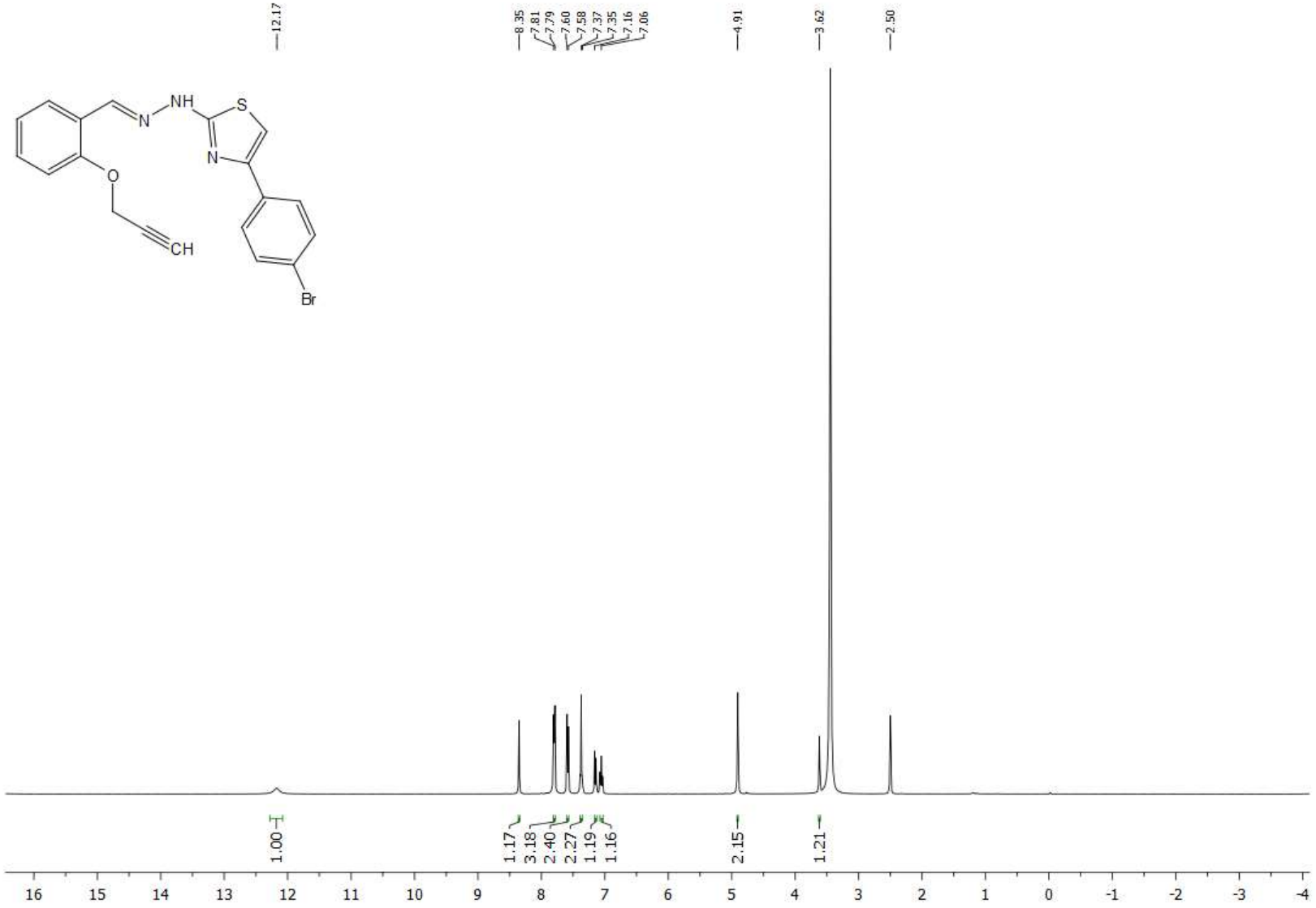
FT-IR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (10)



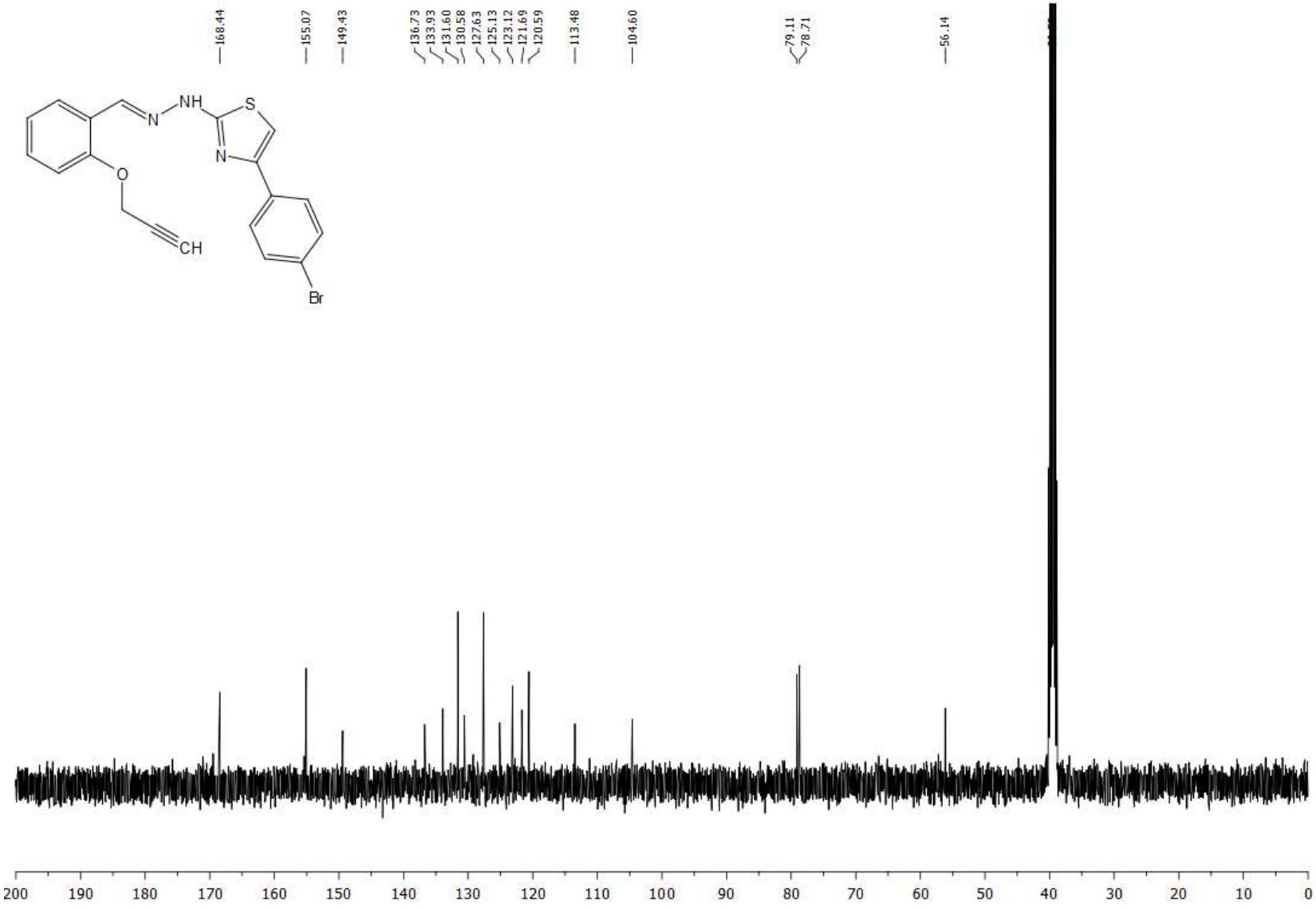
Mass spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (11)



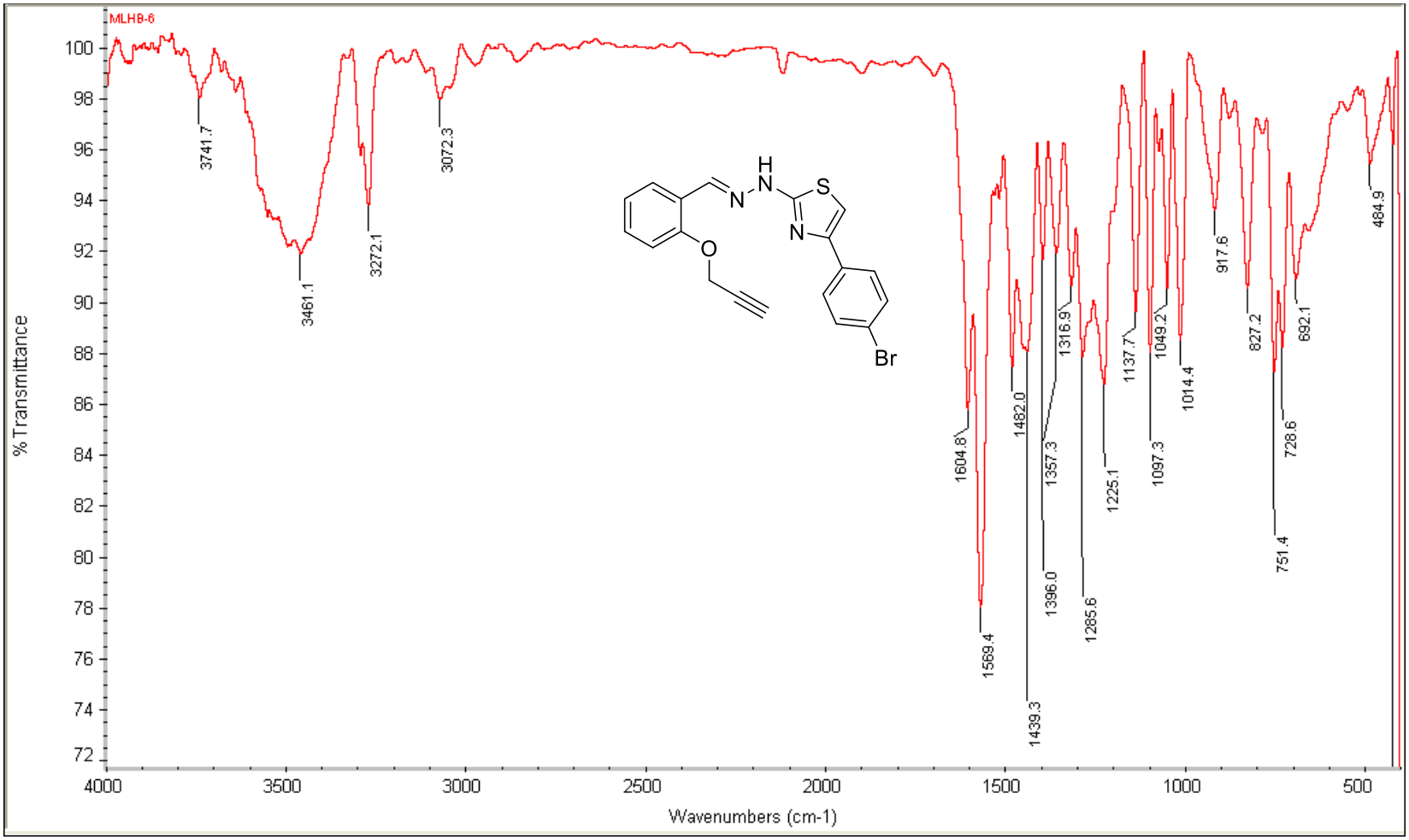
^{1}H NMR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (11)



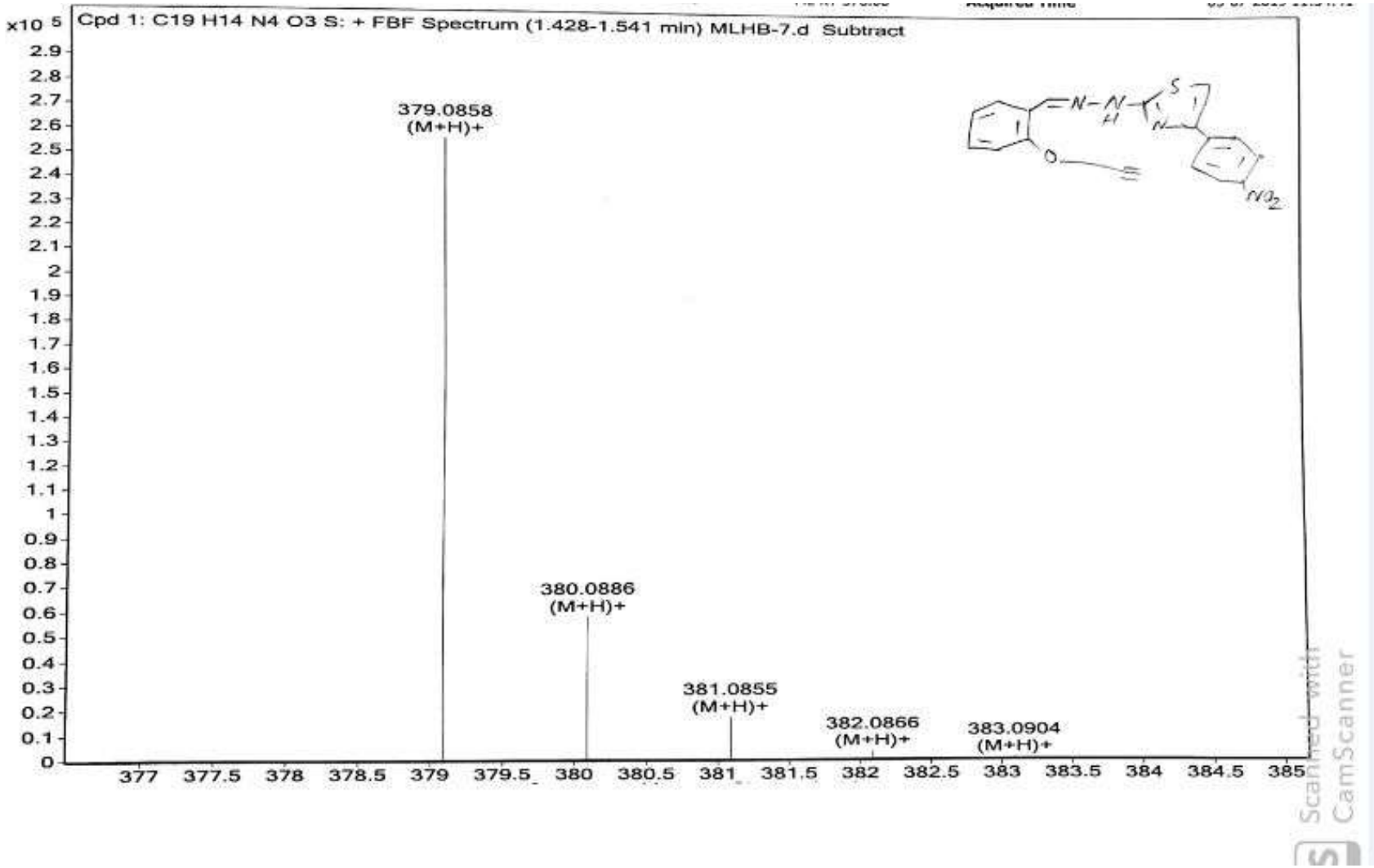
^{13}C NMR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (11)



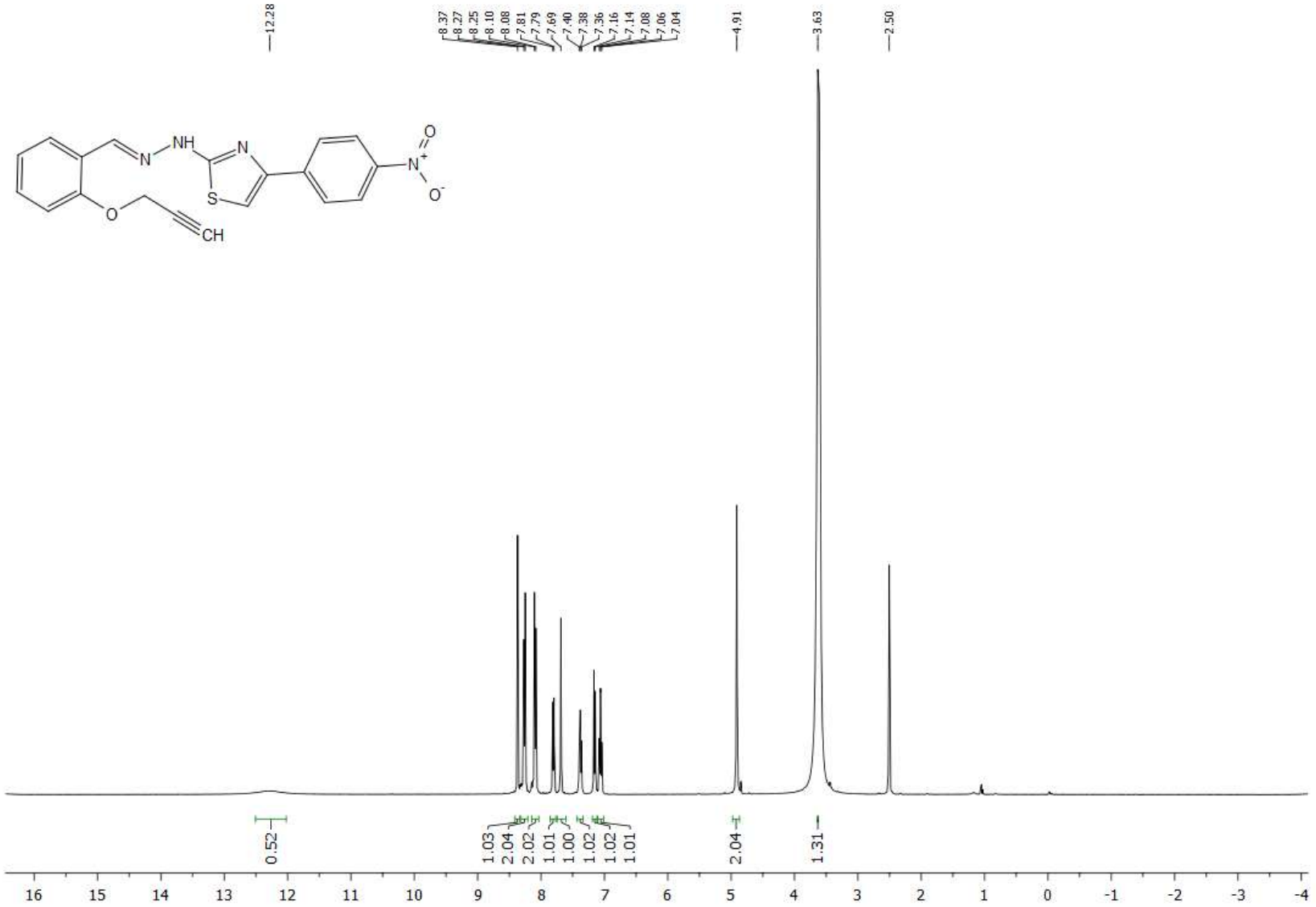
FT-IR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (11)



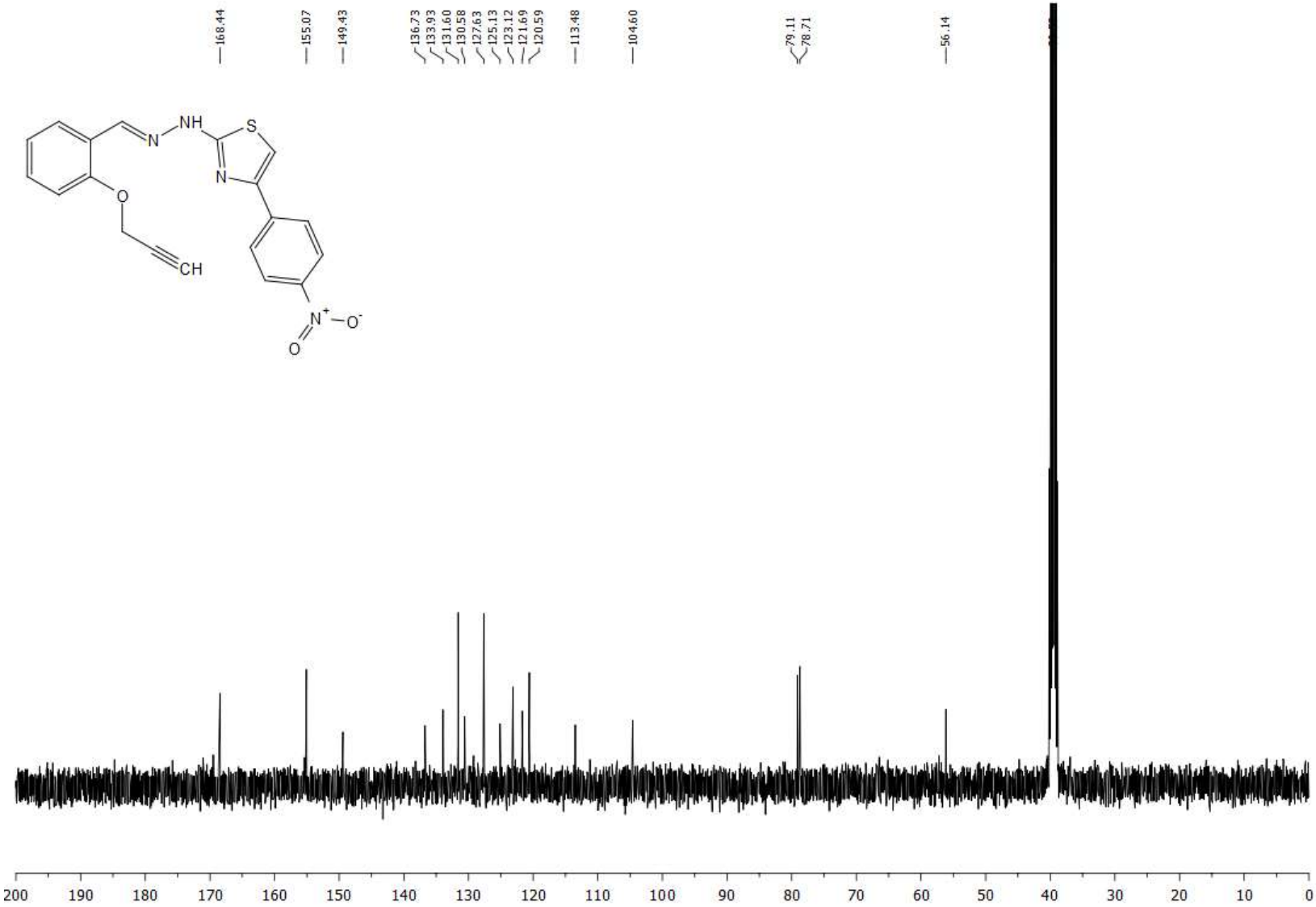
Mass spectrum of (*E*)-4-(4-Nitrophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (12)



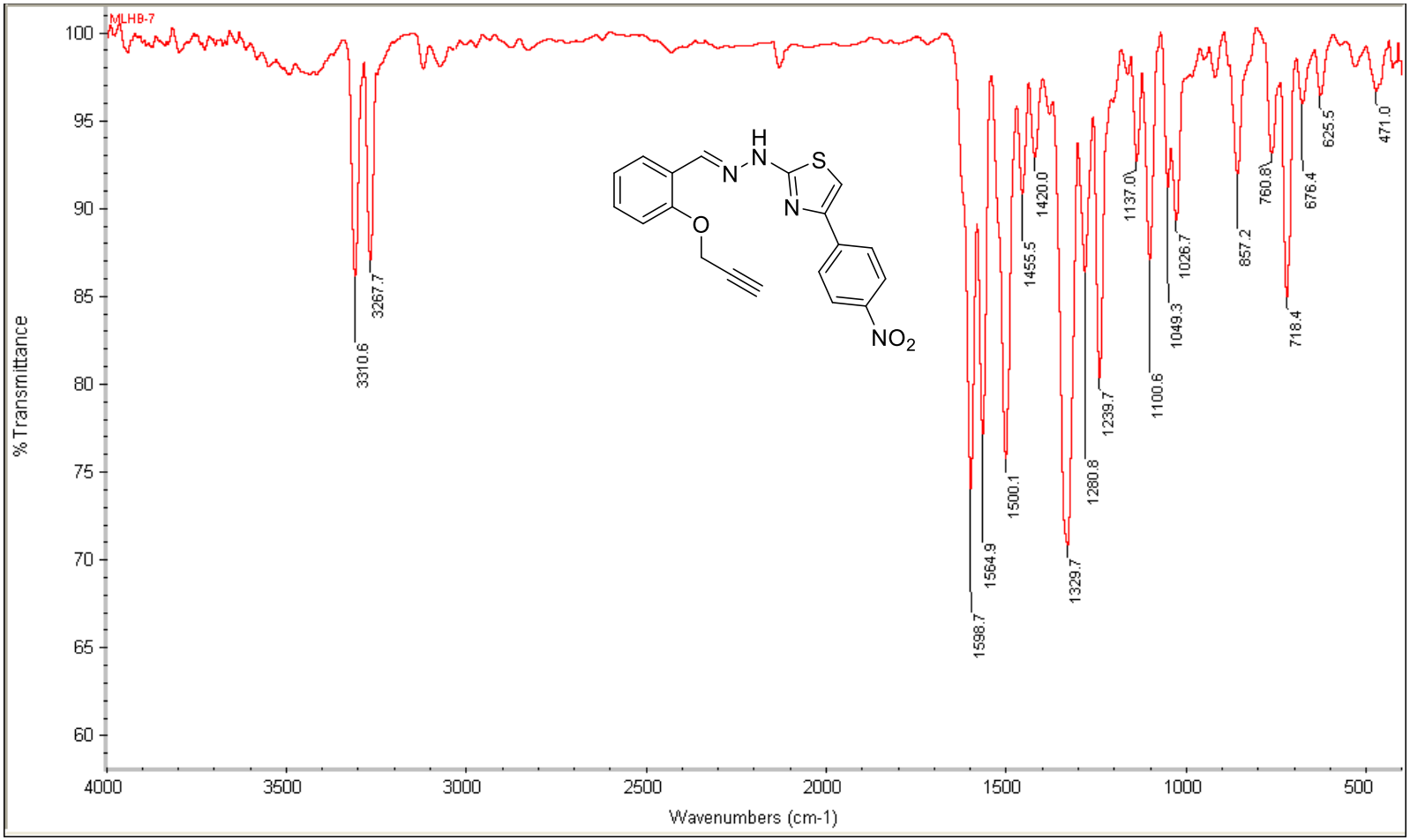
^{1}H NMR spectrum of (*E*)-4-(4-Nitrophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (12)



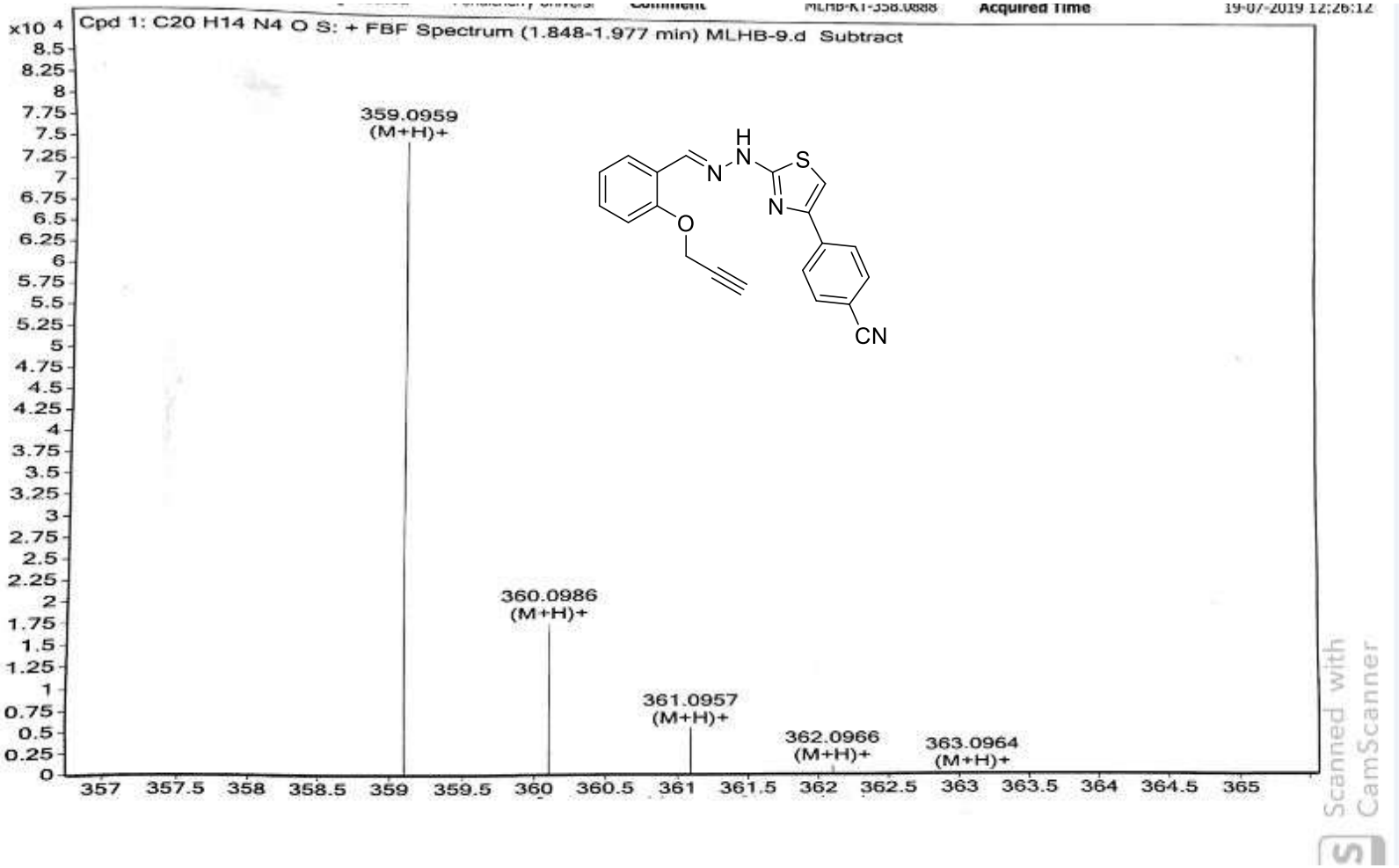
^{13}C NMR spectrum of (*E*)-4-(4-Nitrophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (12)



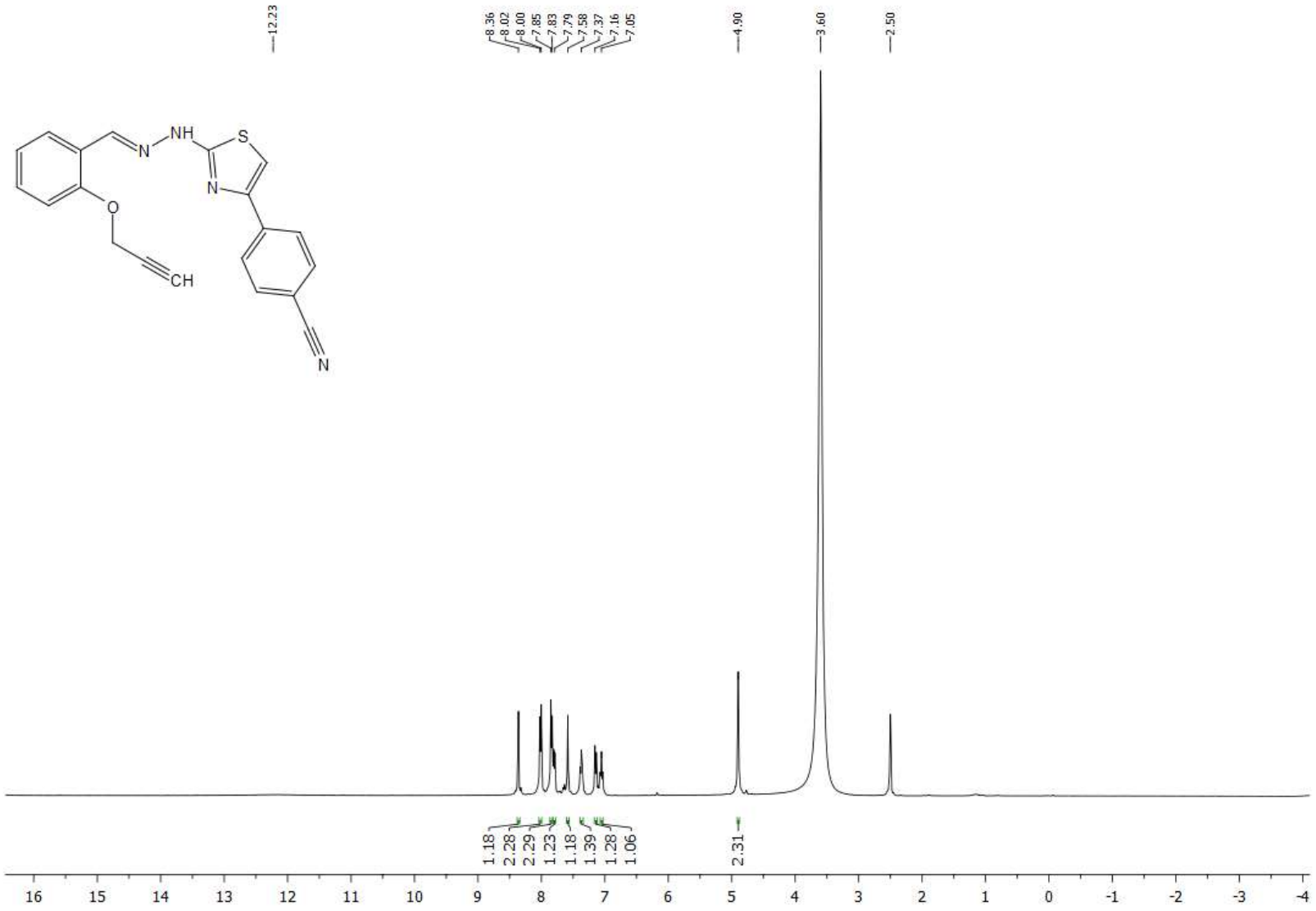
FT-IR spectrum of (*E*)-4-(4-Nitrophenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (12)



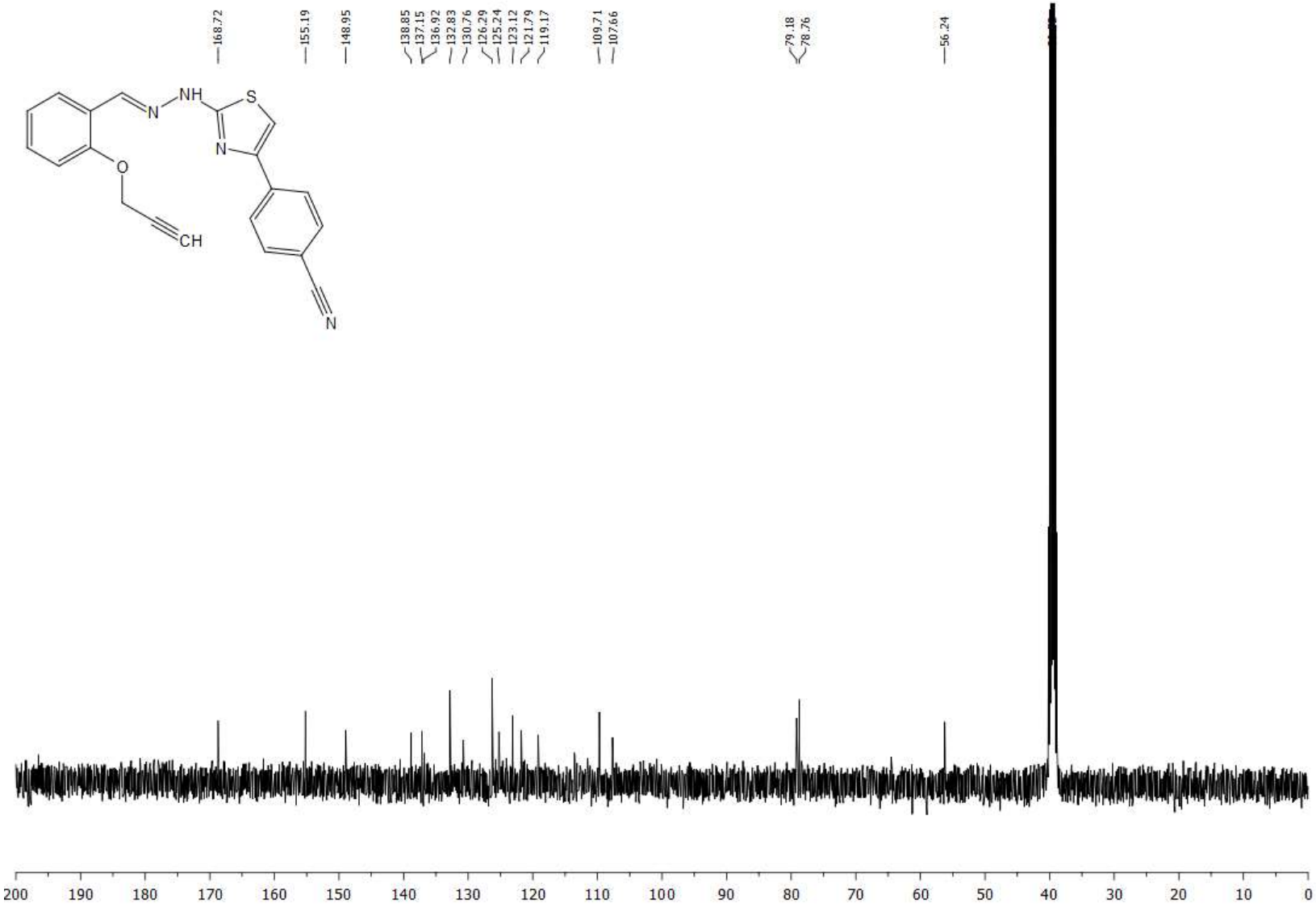
Mass spectrum of (*E*)-4-(2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (13)



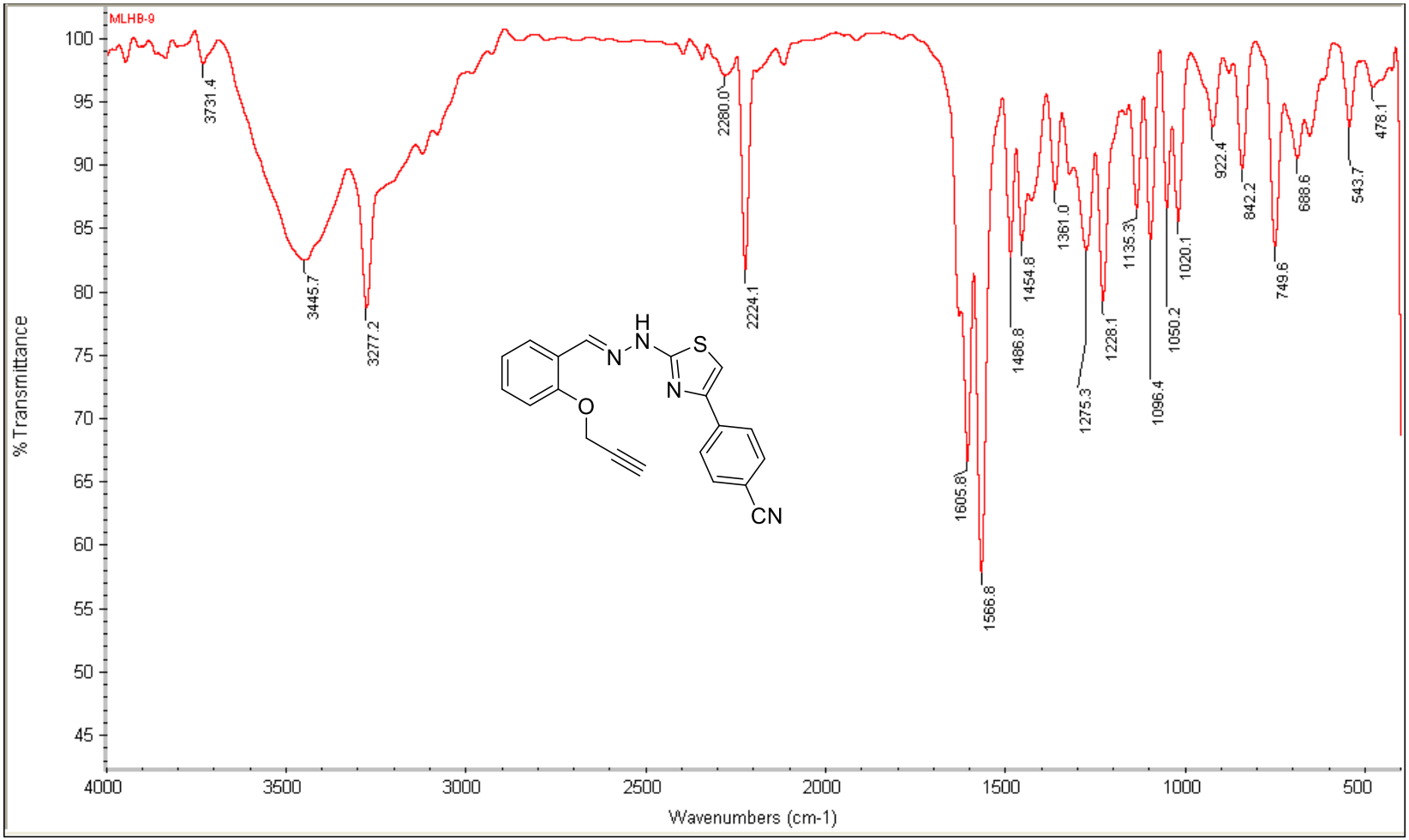
^{1}H NMR spectrum of (*E*)-4-(2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (13)



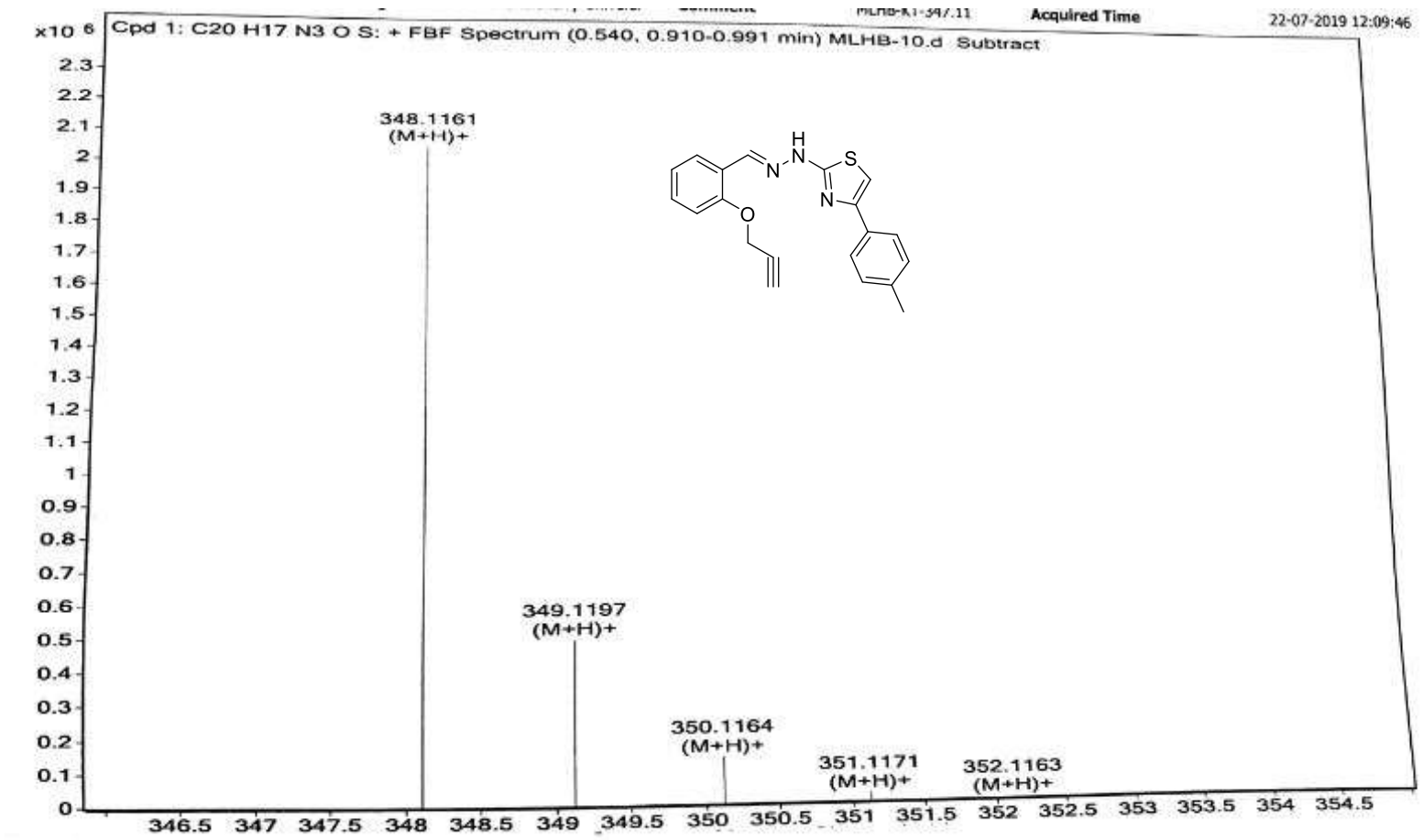
^{13}C NMR spectrum of (*E*)-4-(2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (13)



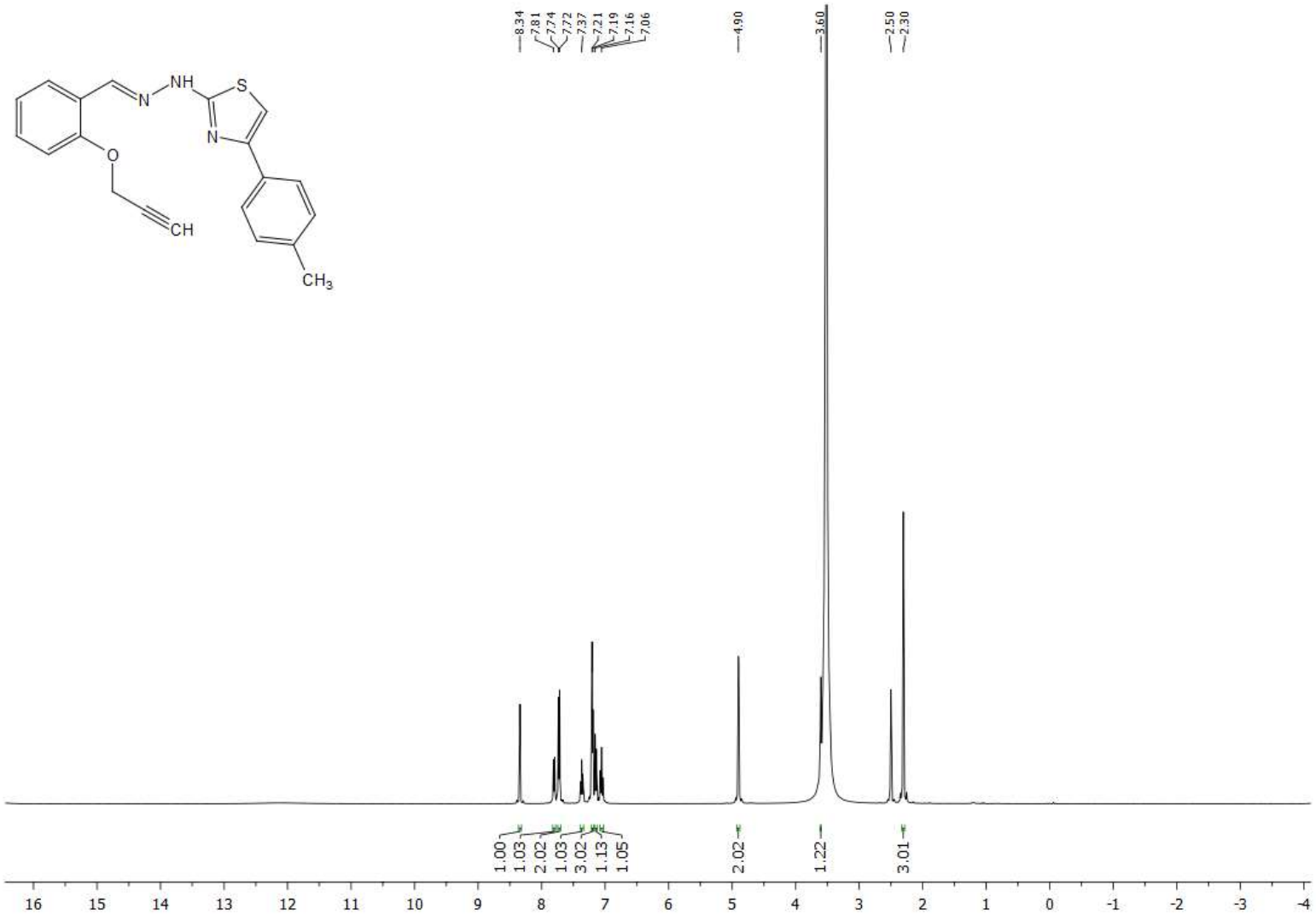
FT-IR spectrum of (*E*)-4-(2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (13)



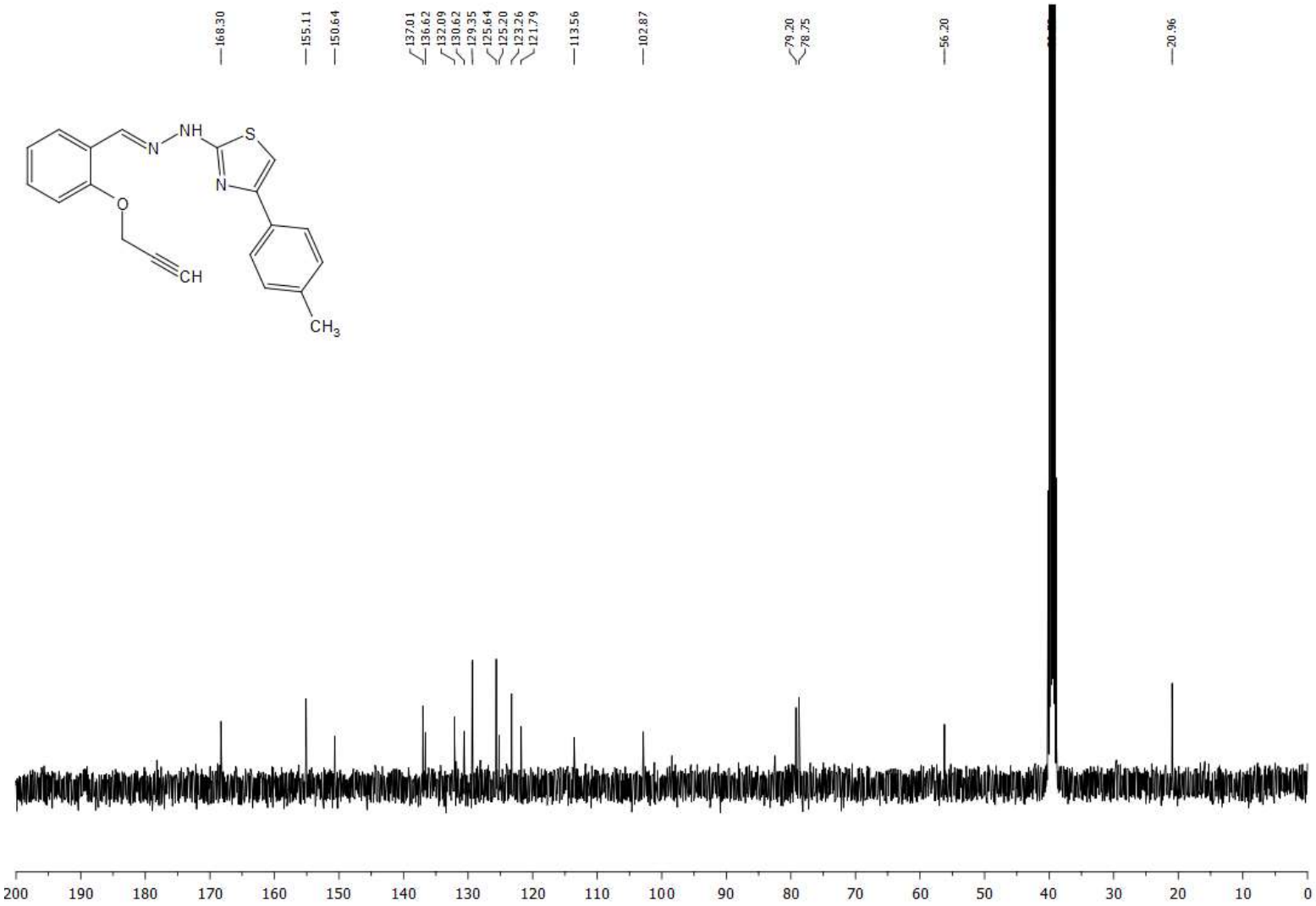
Mass spectrum of (*E*)-2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (14)



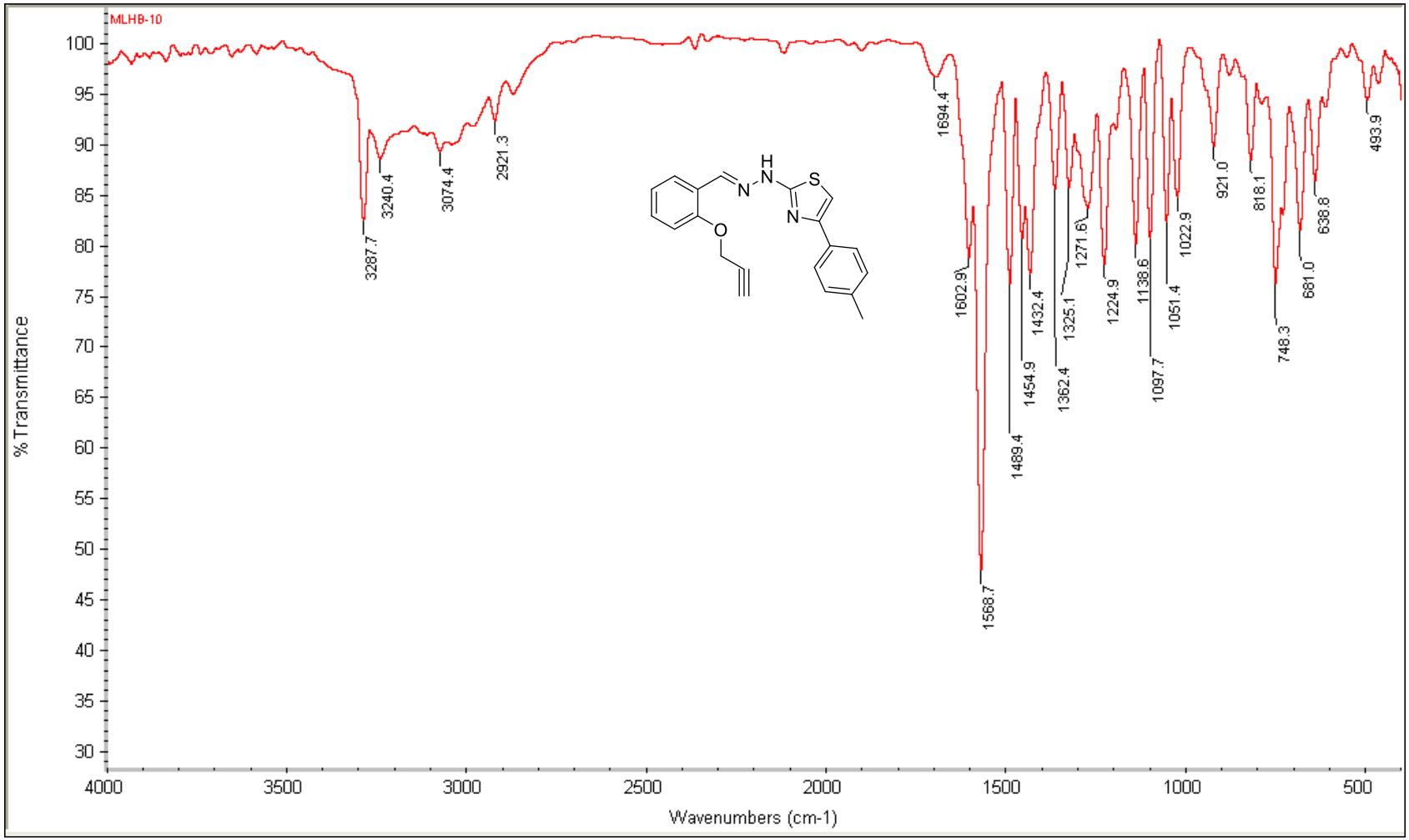
^{1}H NMR spectrum of (*E*)-2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (14)



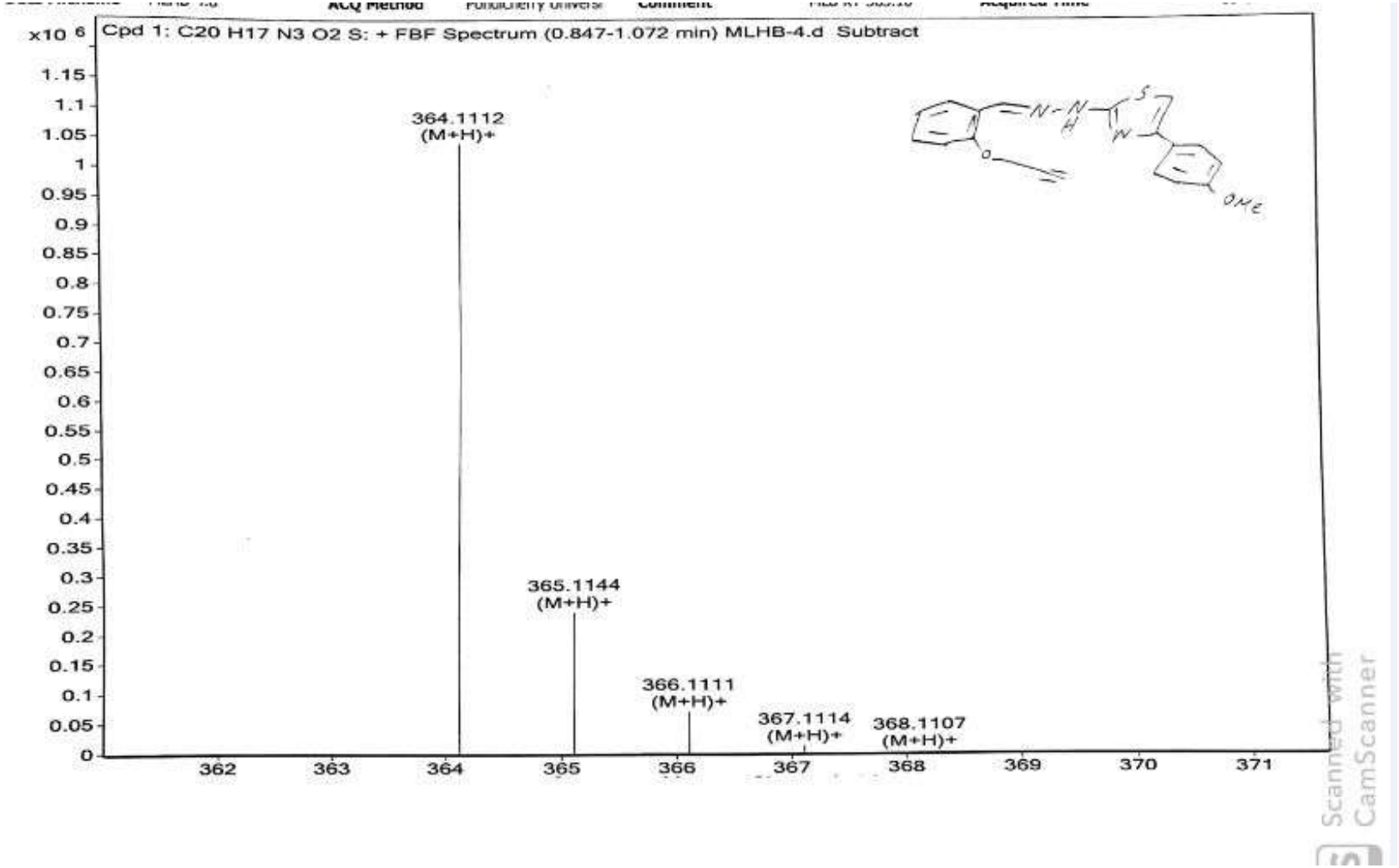
^{13}NMR spectrum of (*E*)-2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (14)



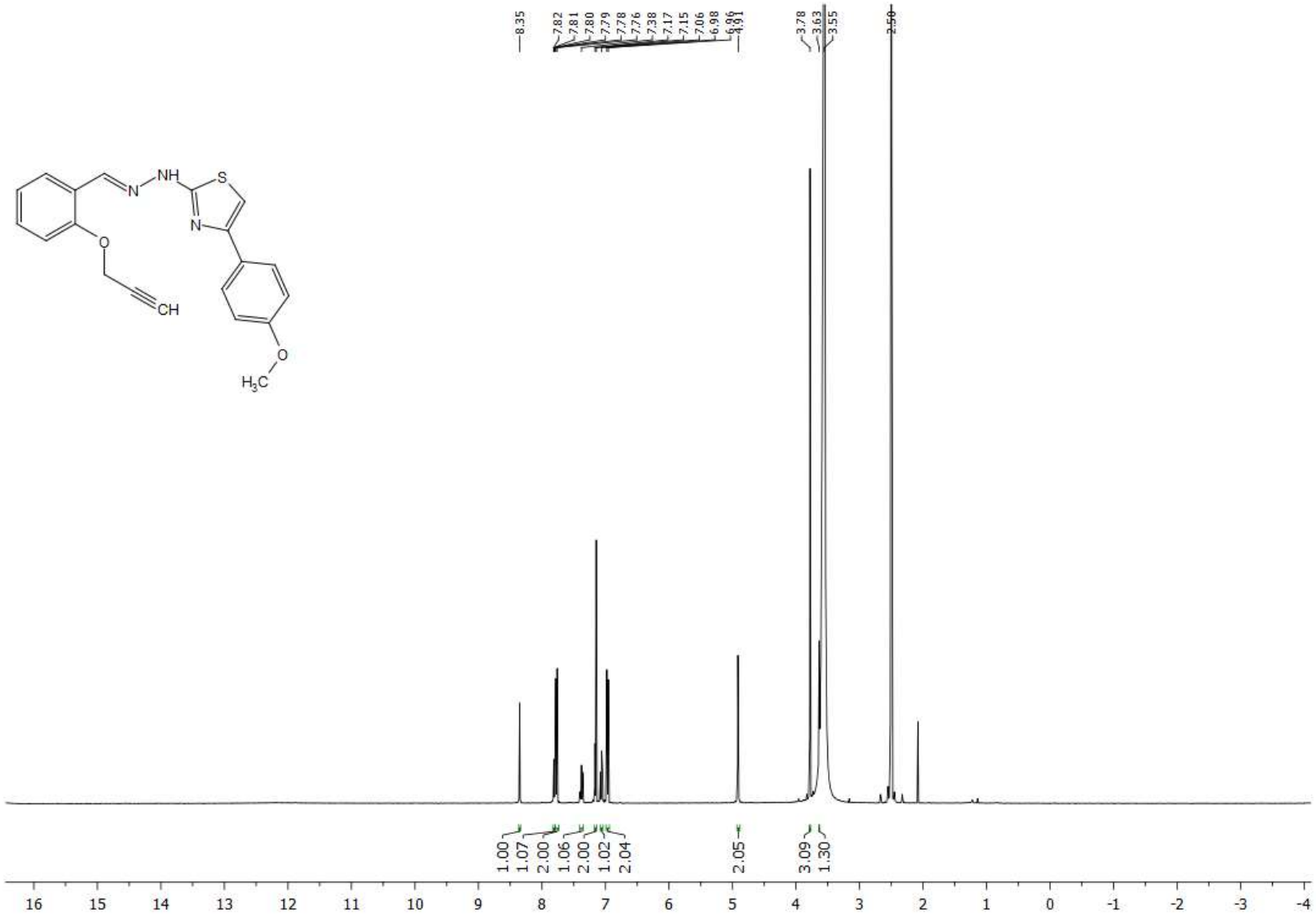
FT-IR spectrum of (*E*)-2-(2-(2-(Prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (14)



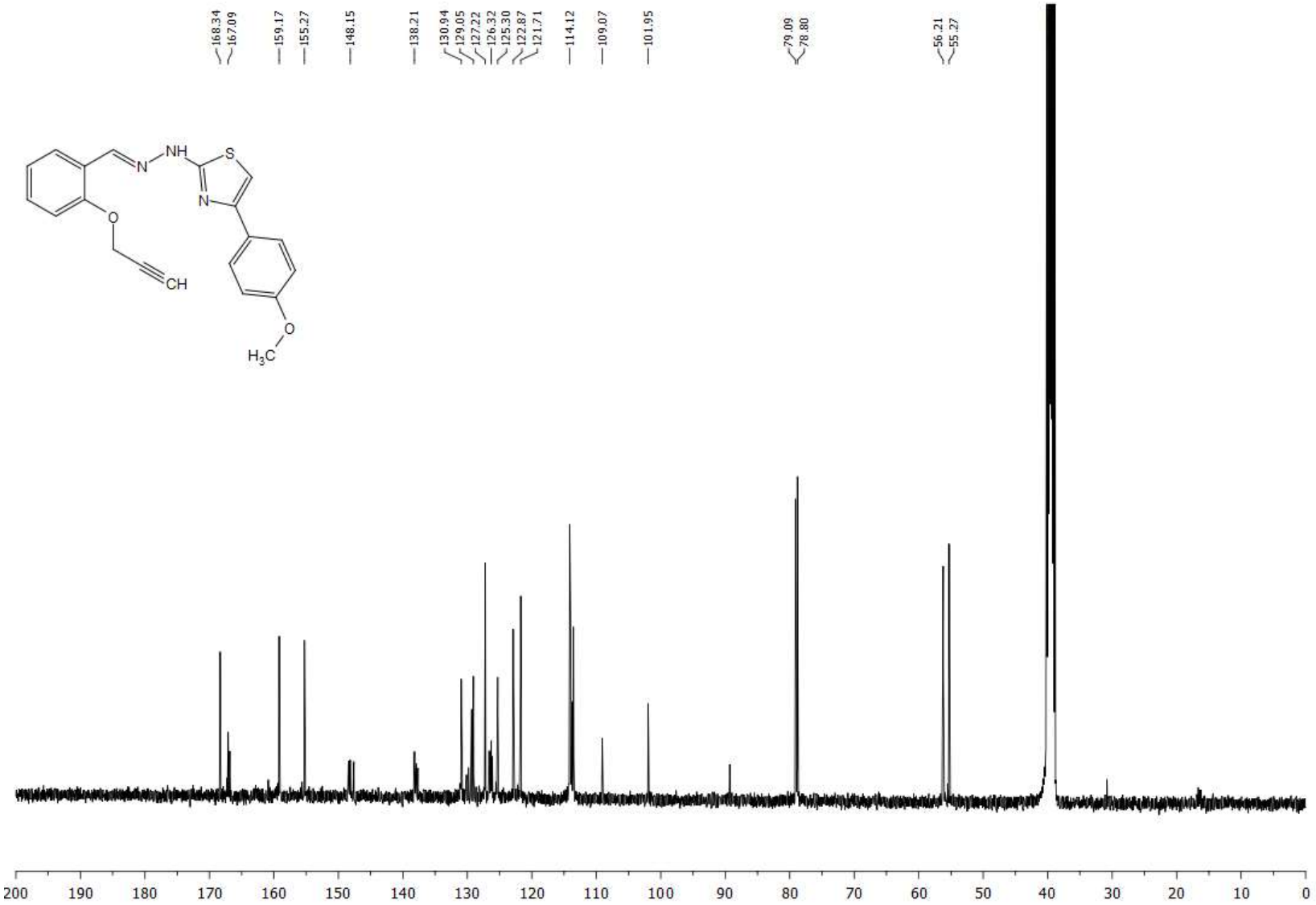
Mass spectrum of (*E*)-4-(4-Methoxyphenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (15)



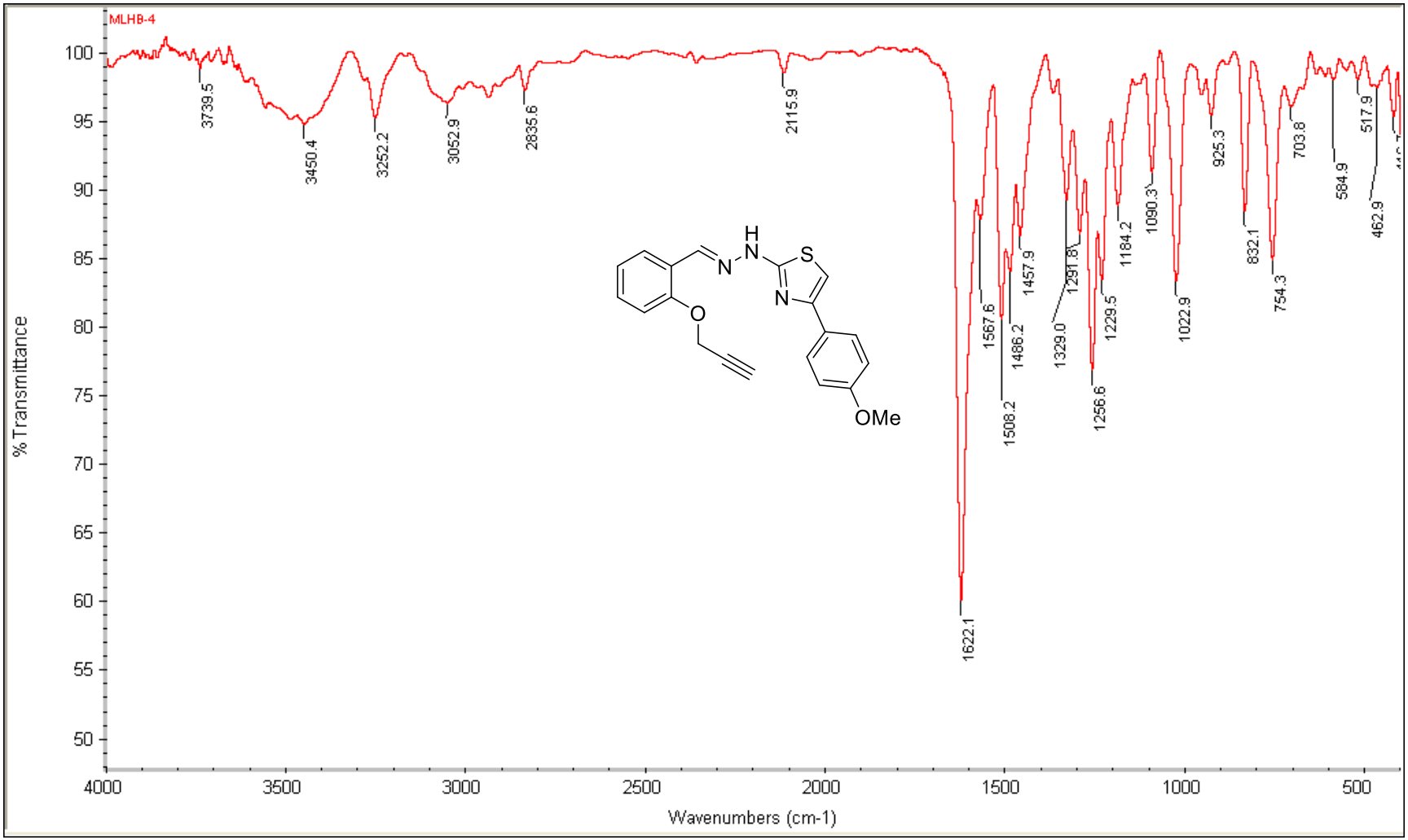
^{1}H NMR spectrum of (*E*)-4-(4-Methoxyphenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (15)



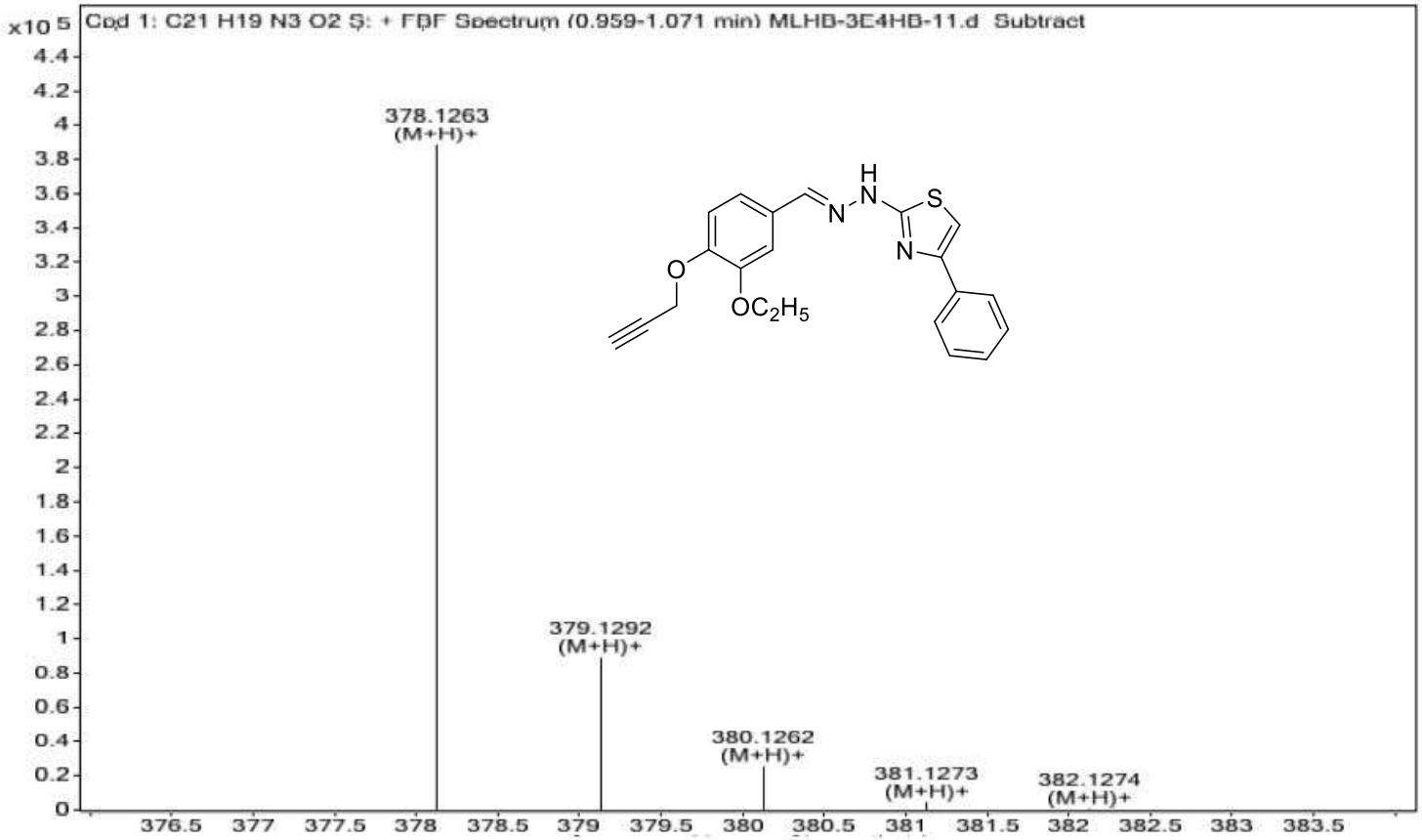
^{13}C NMR spectrum of (*E*)-4-(4-Methoxyphenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (15)



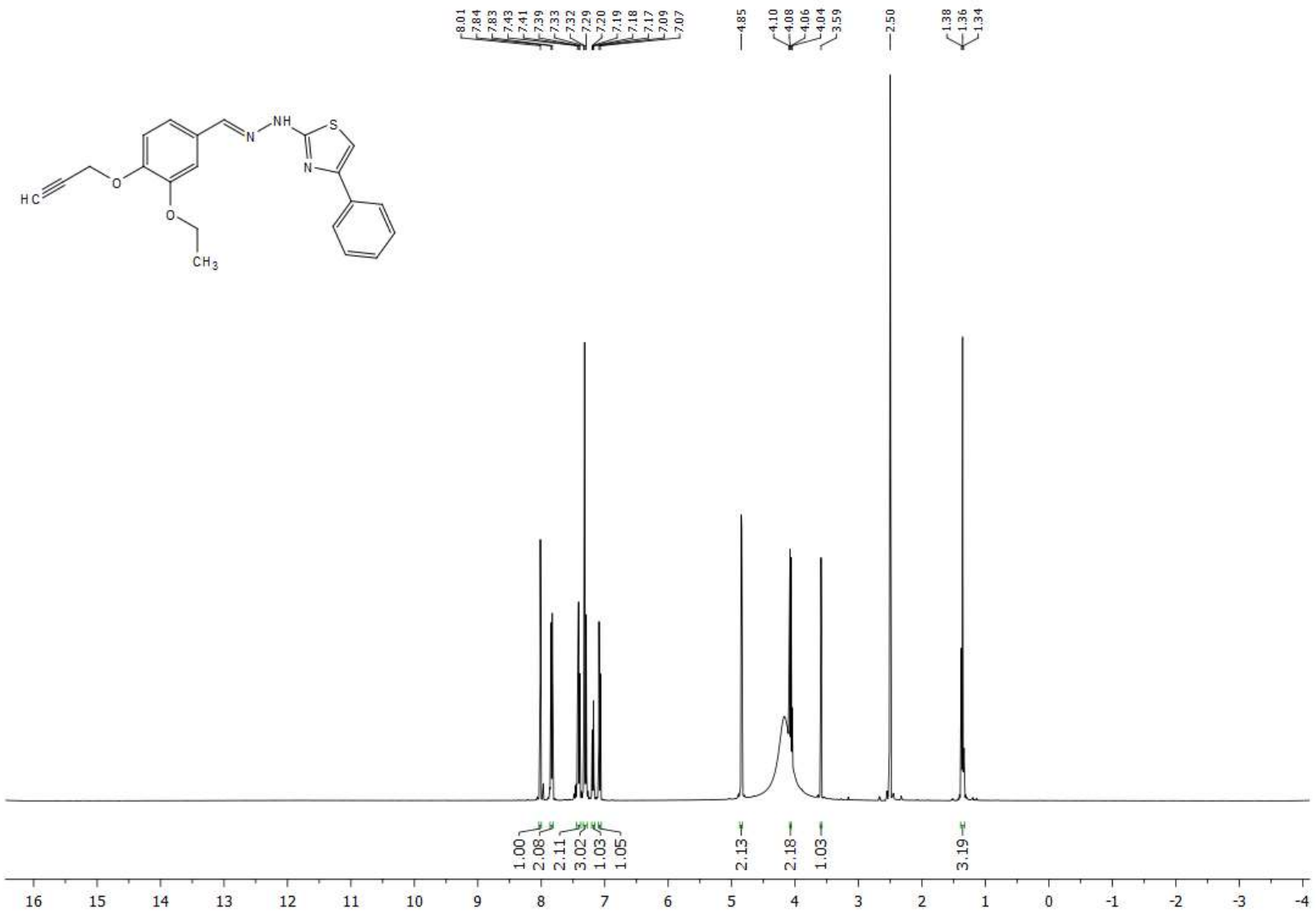
FT-IR spectrum of (*E*)-4-(4-Methoxyphenyl)-2-(2-(2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (15)



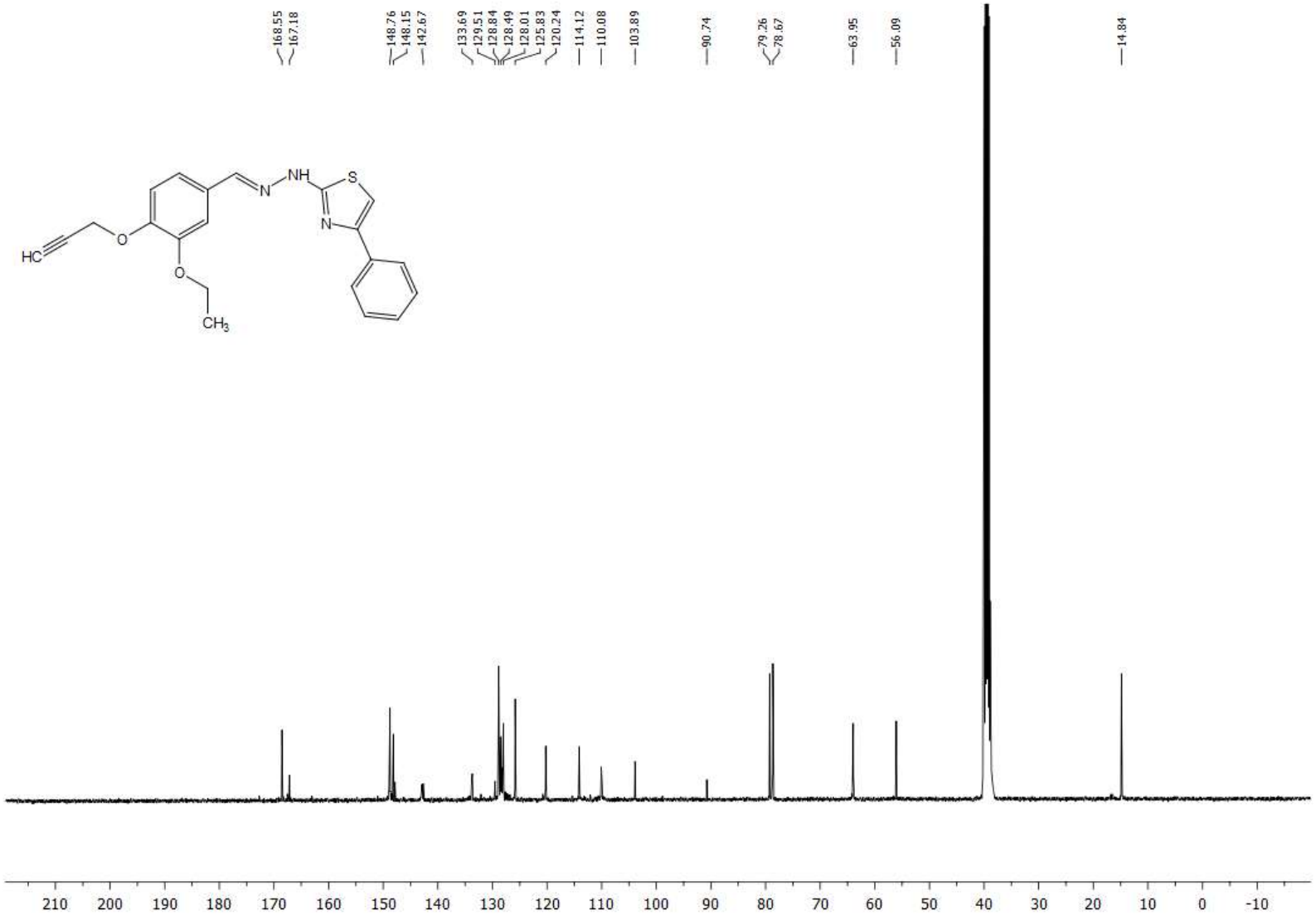
Mass spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (16)



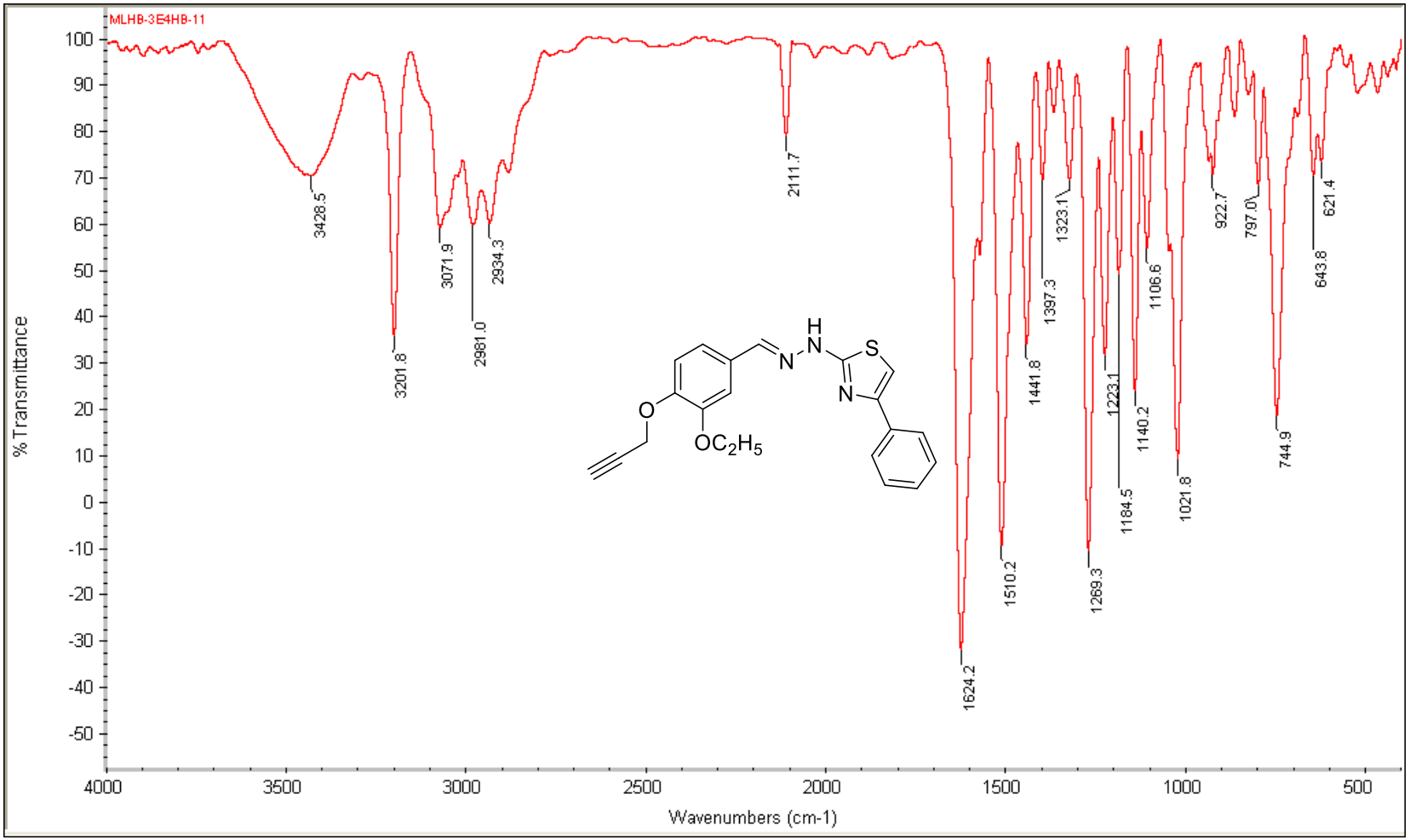
^{1}H NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (16)



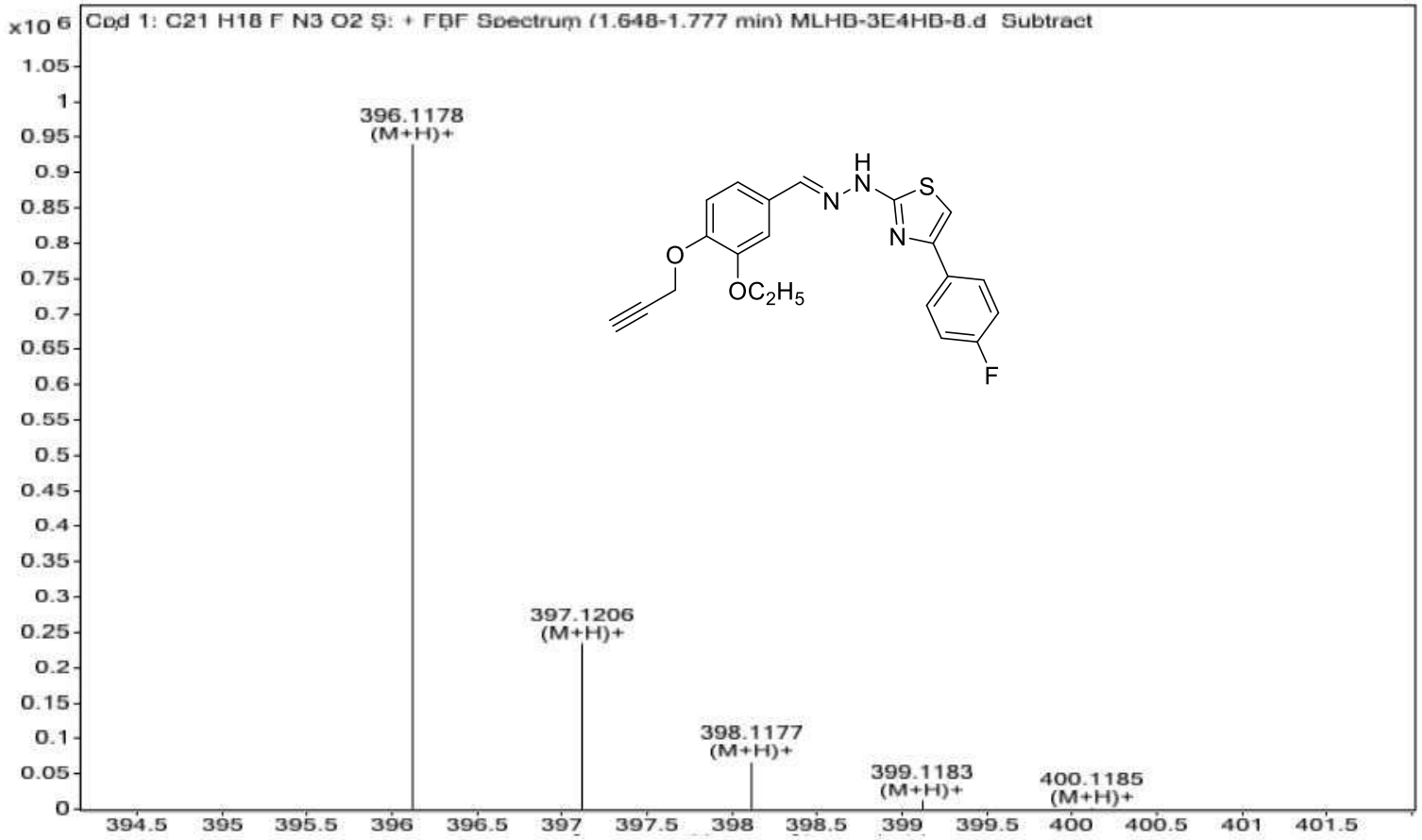
^{13}NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (16)



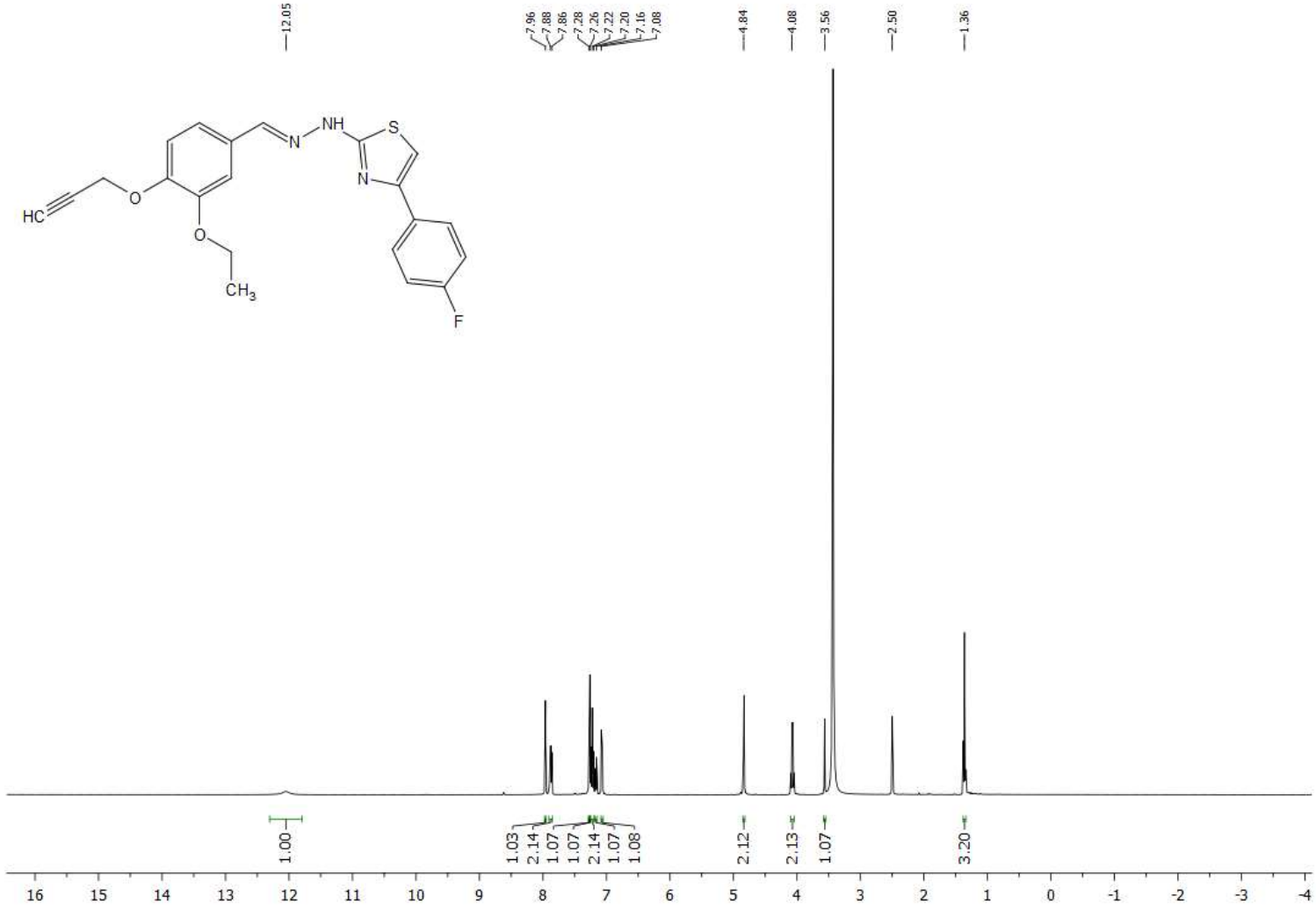
FT-IR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (16)



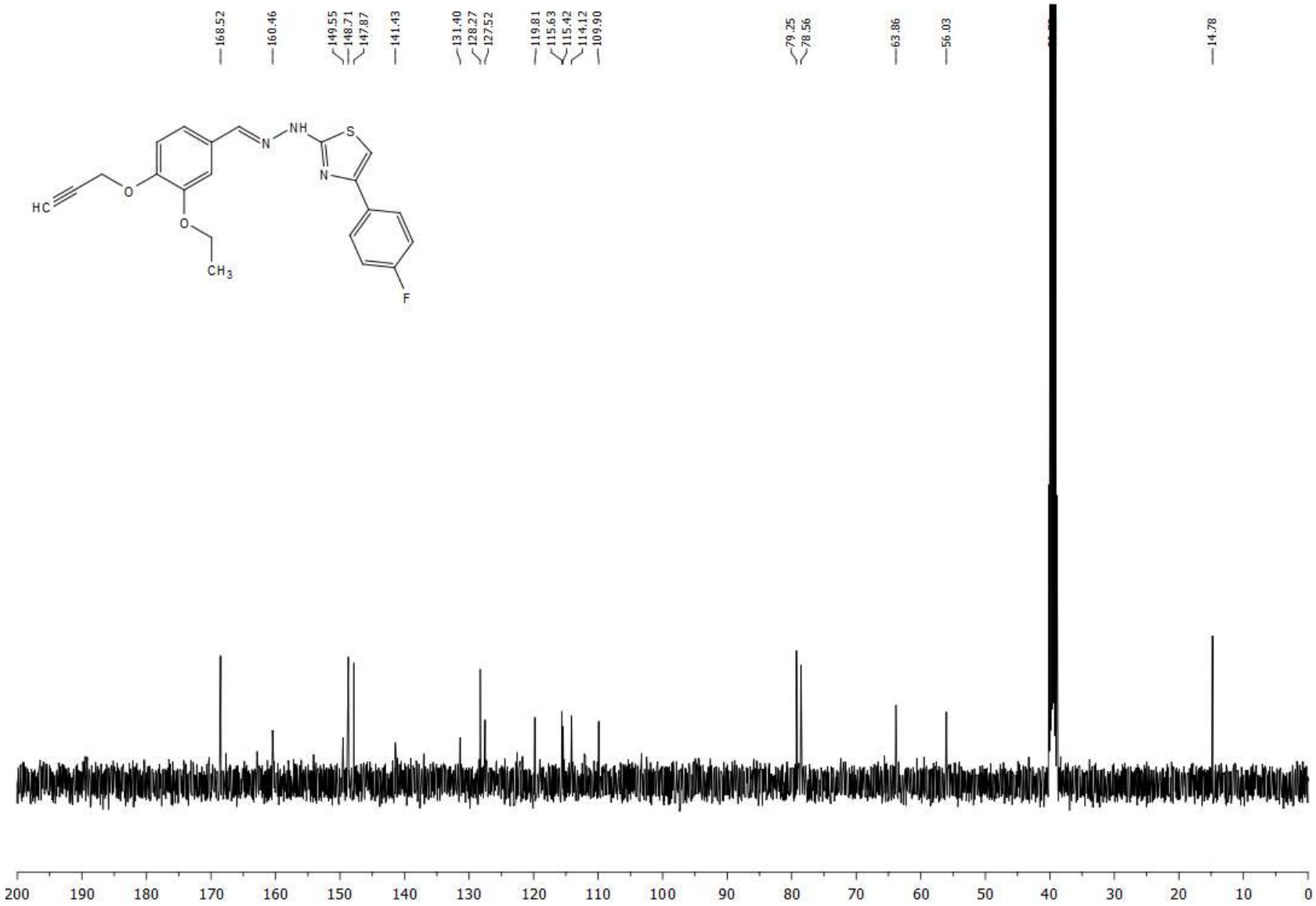
Mass spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (17)



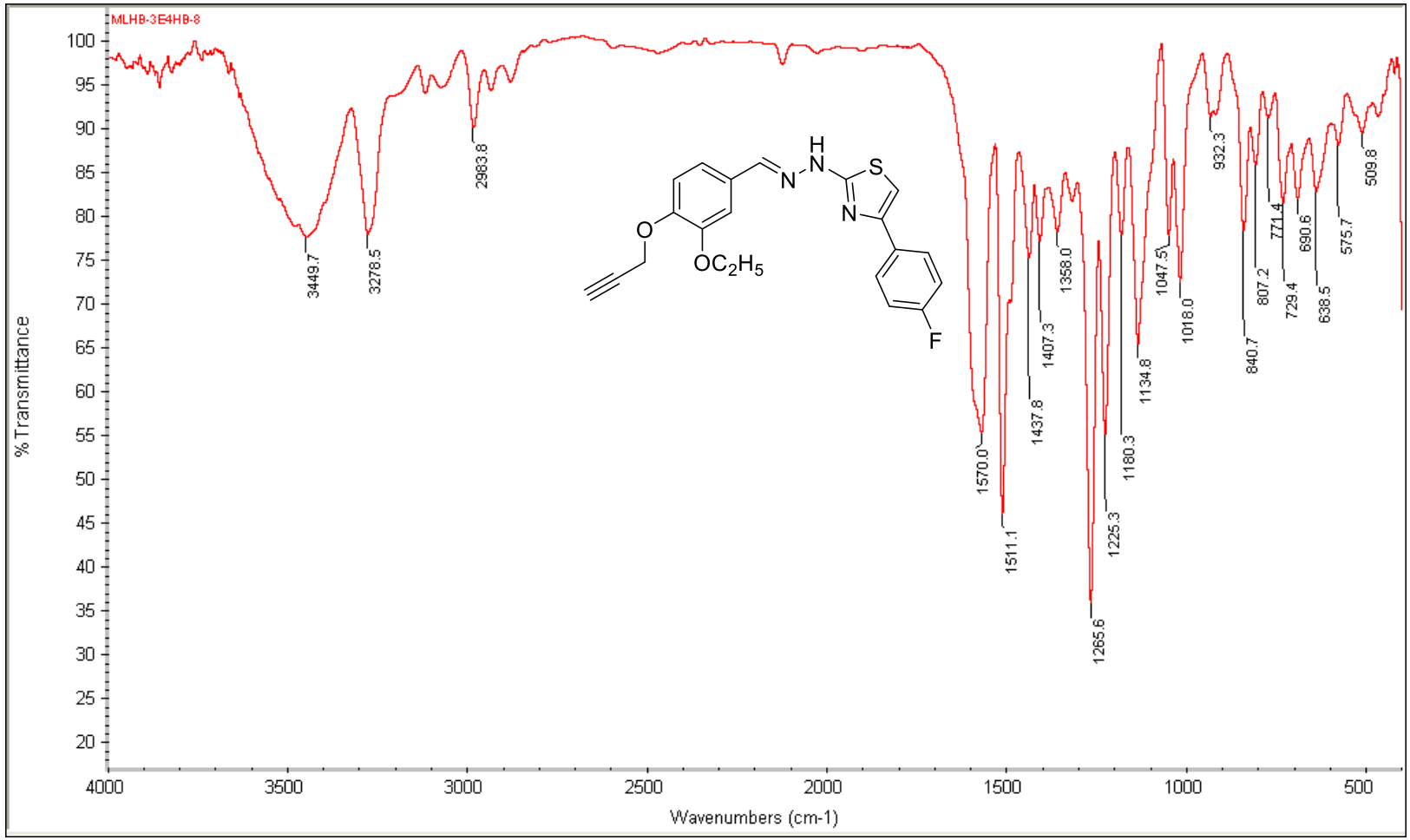
^{1}H NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (17)



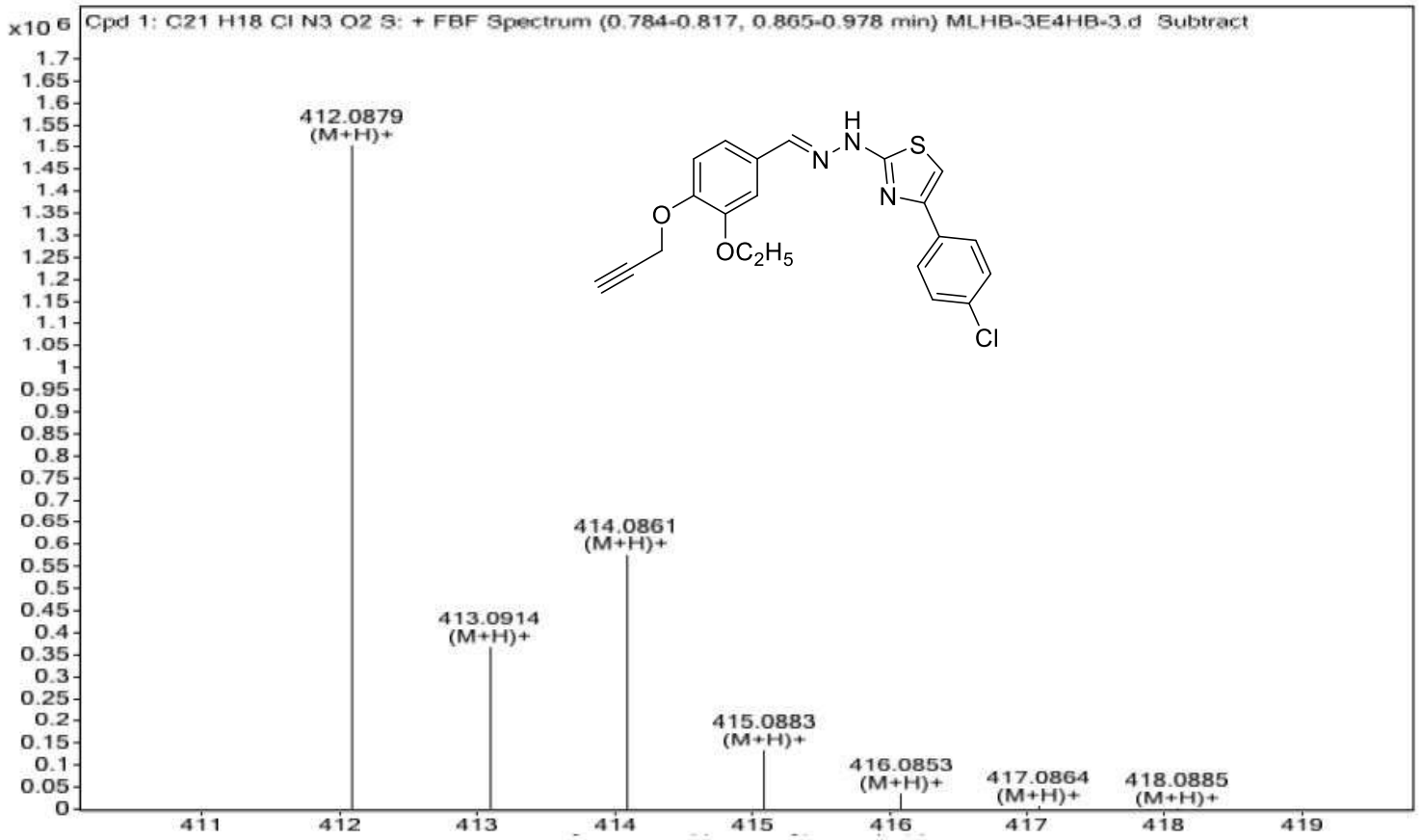
^{13}C NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (17)



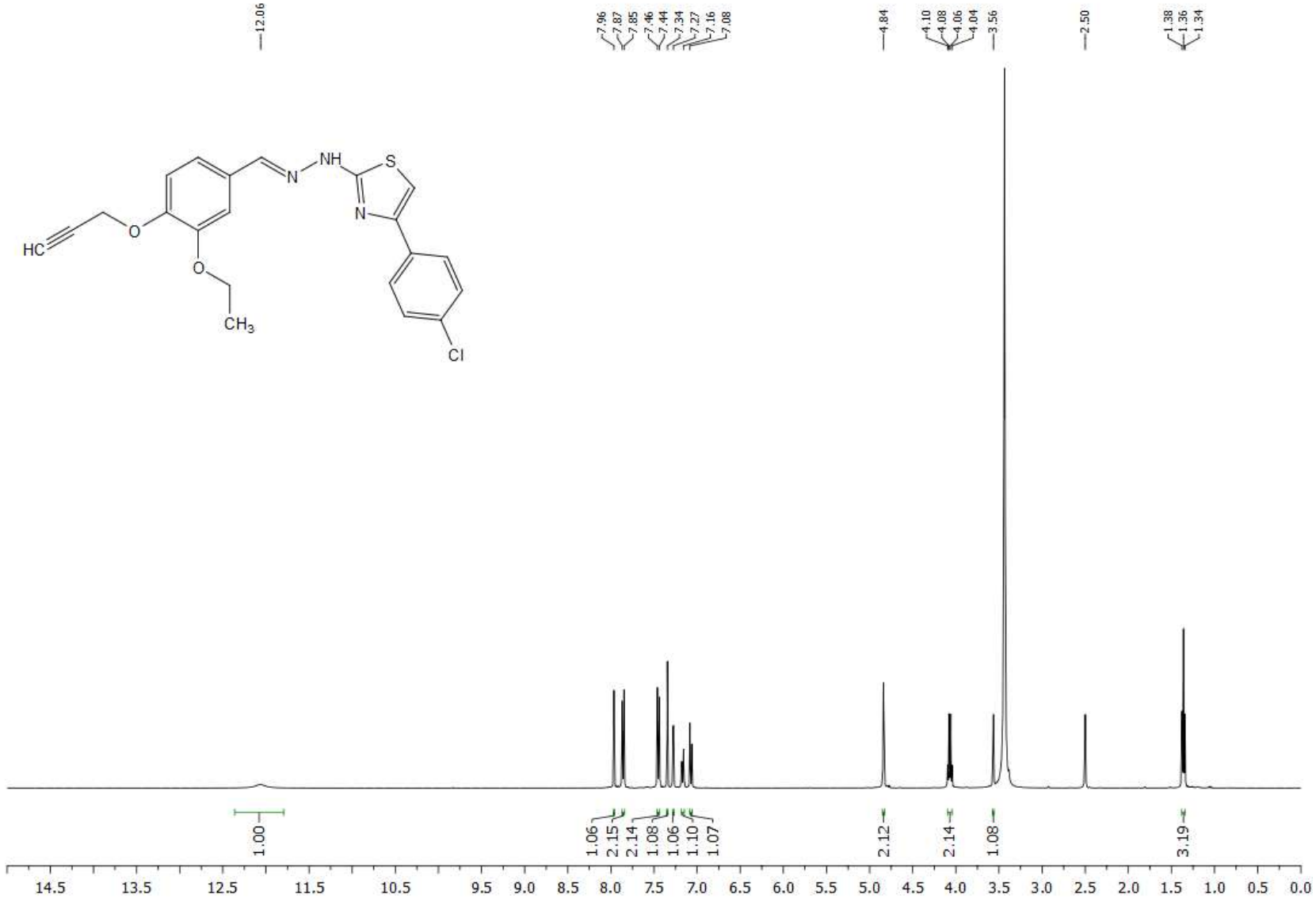
FT-IR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (17)



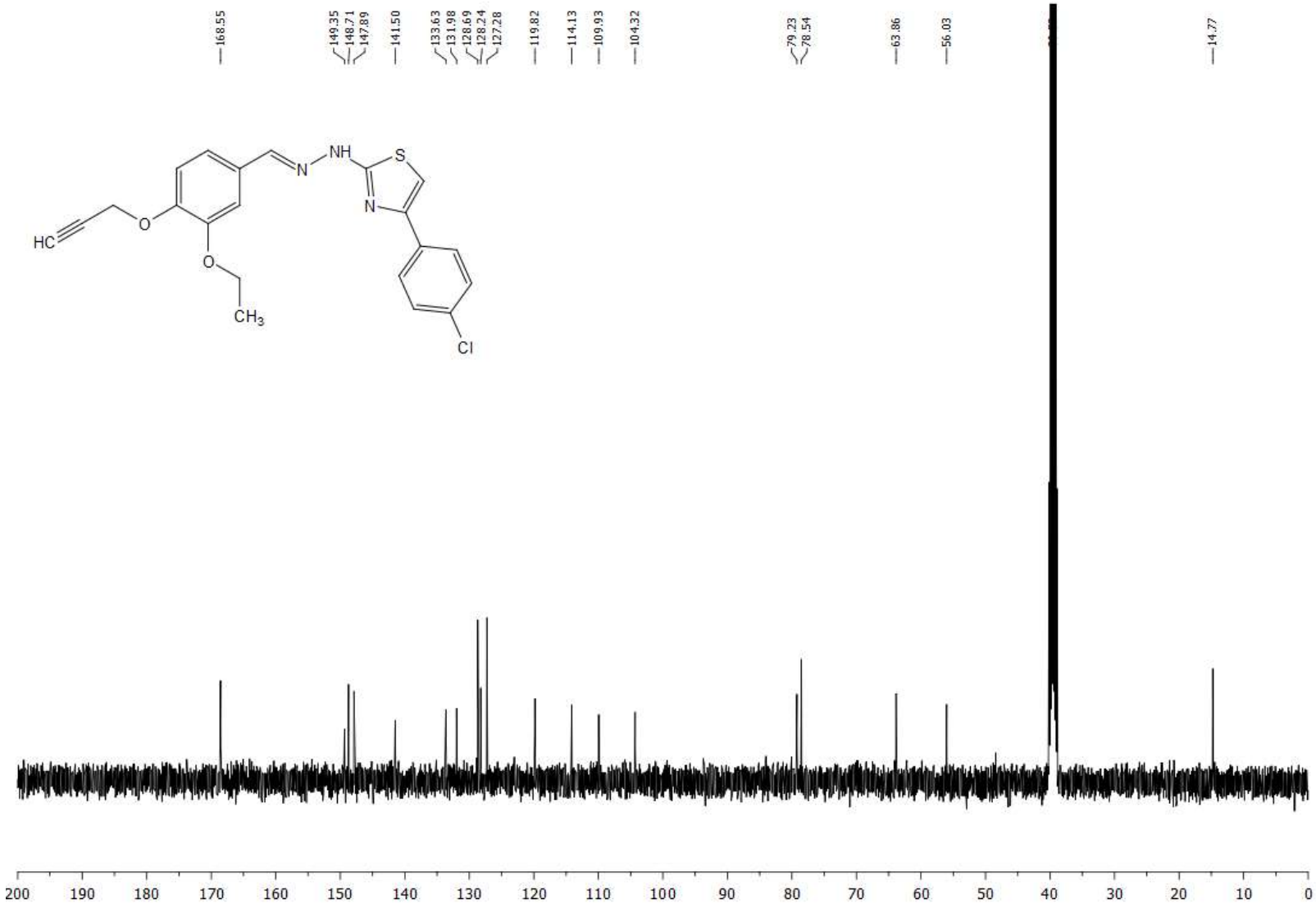
Mass spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (18)



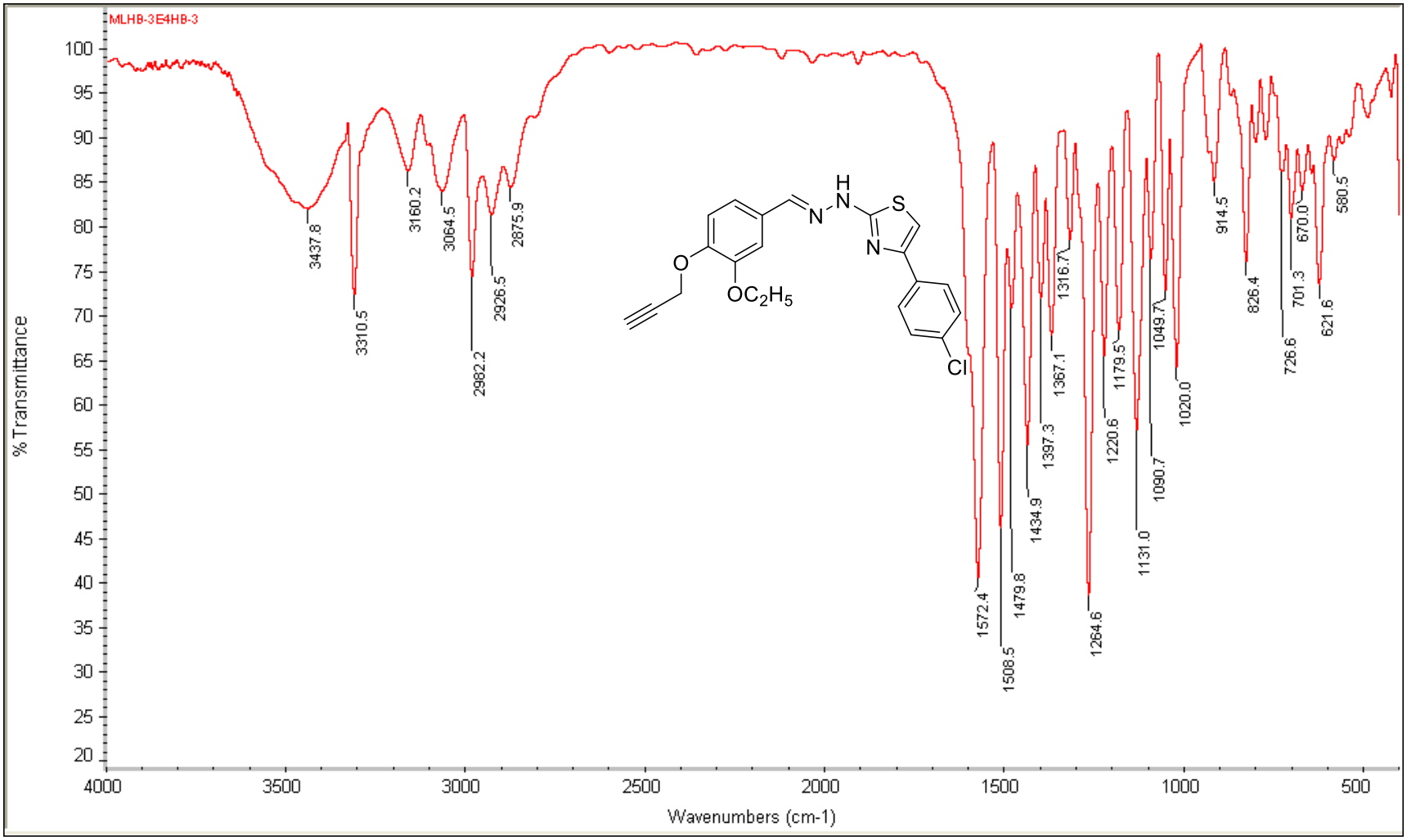
^{1}H NMR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (18)



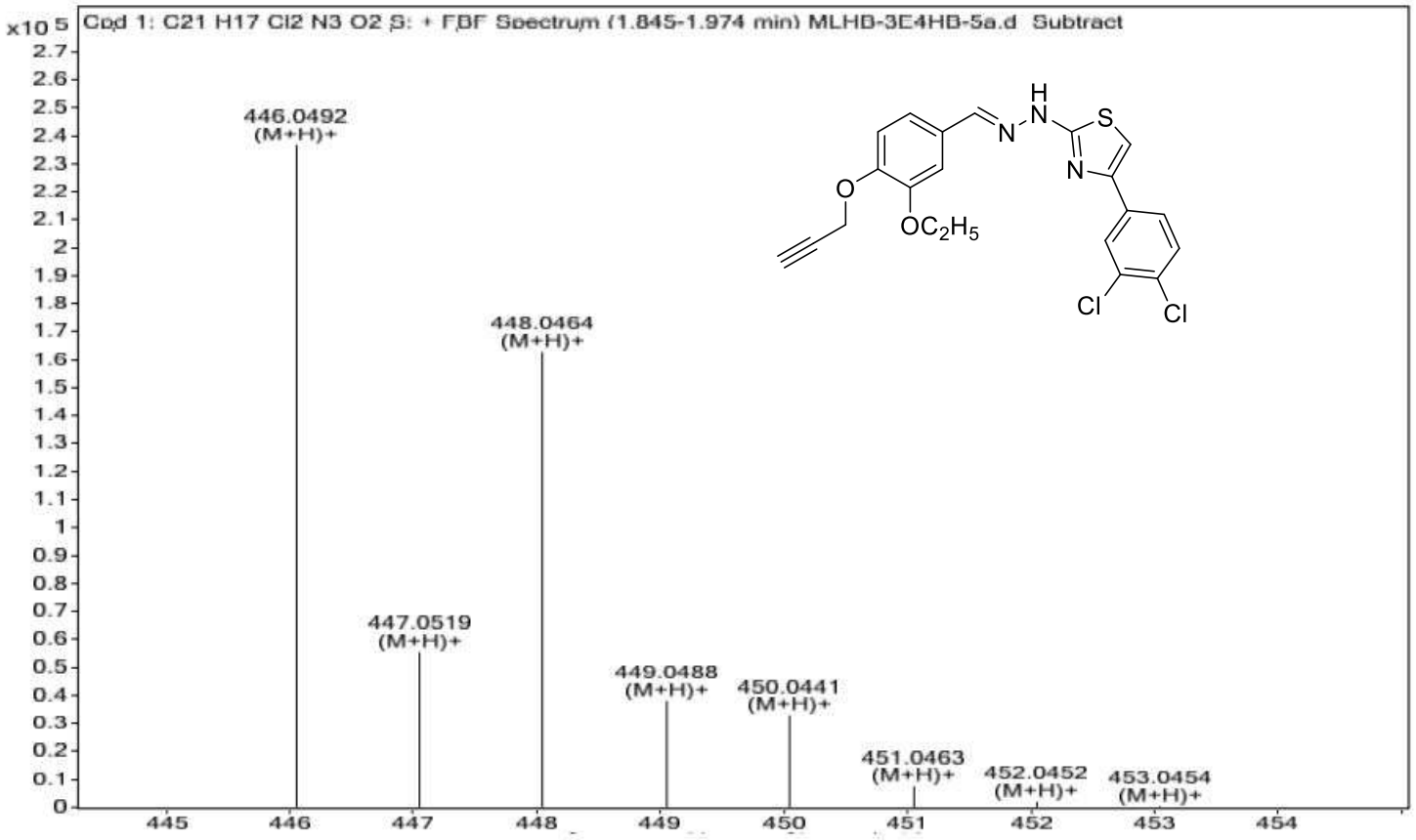
^{13}C NMR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (18)



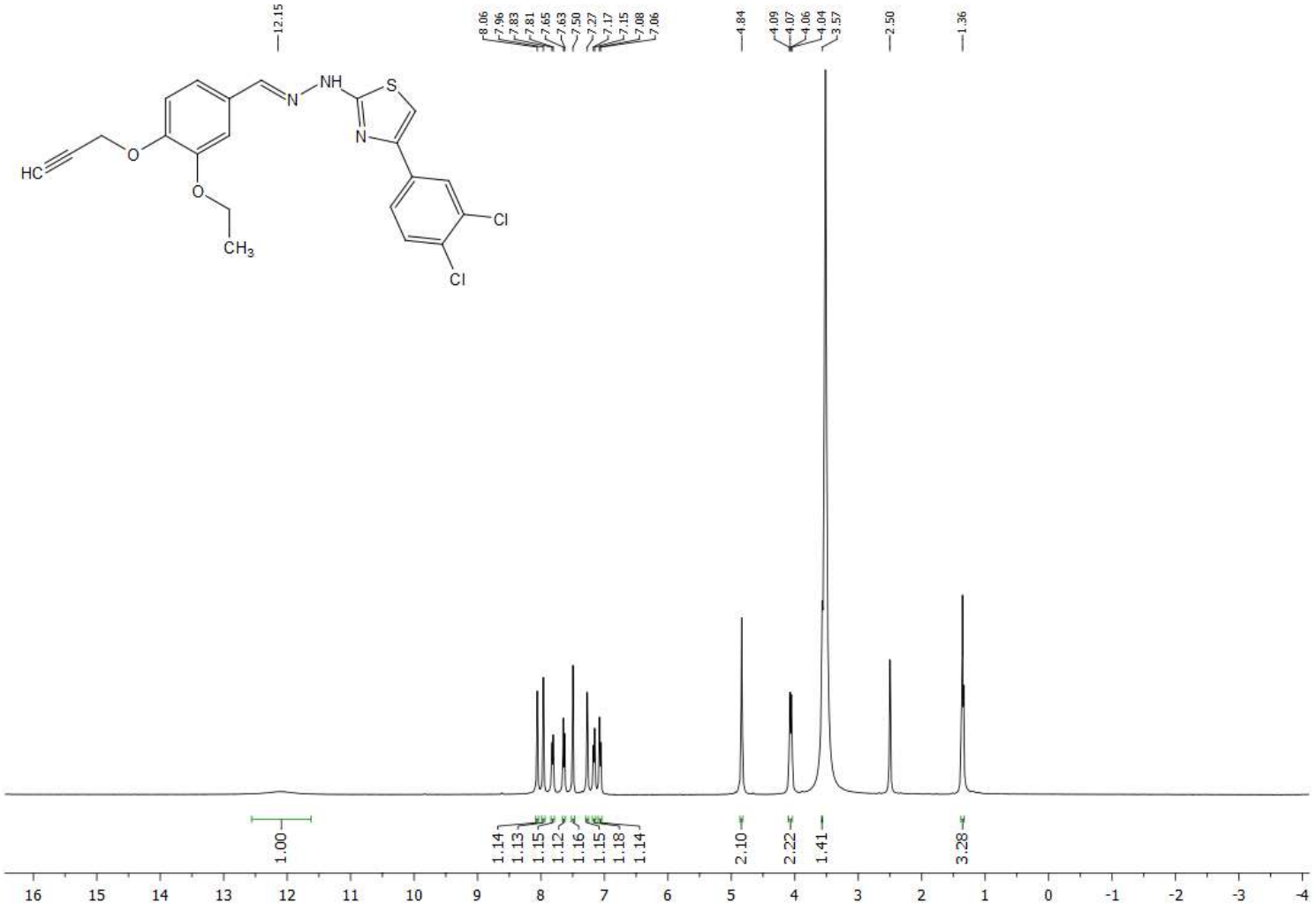
FT-IR spectrum of (*E*)-4-(4-Chlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (18)



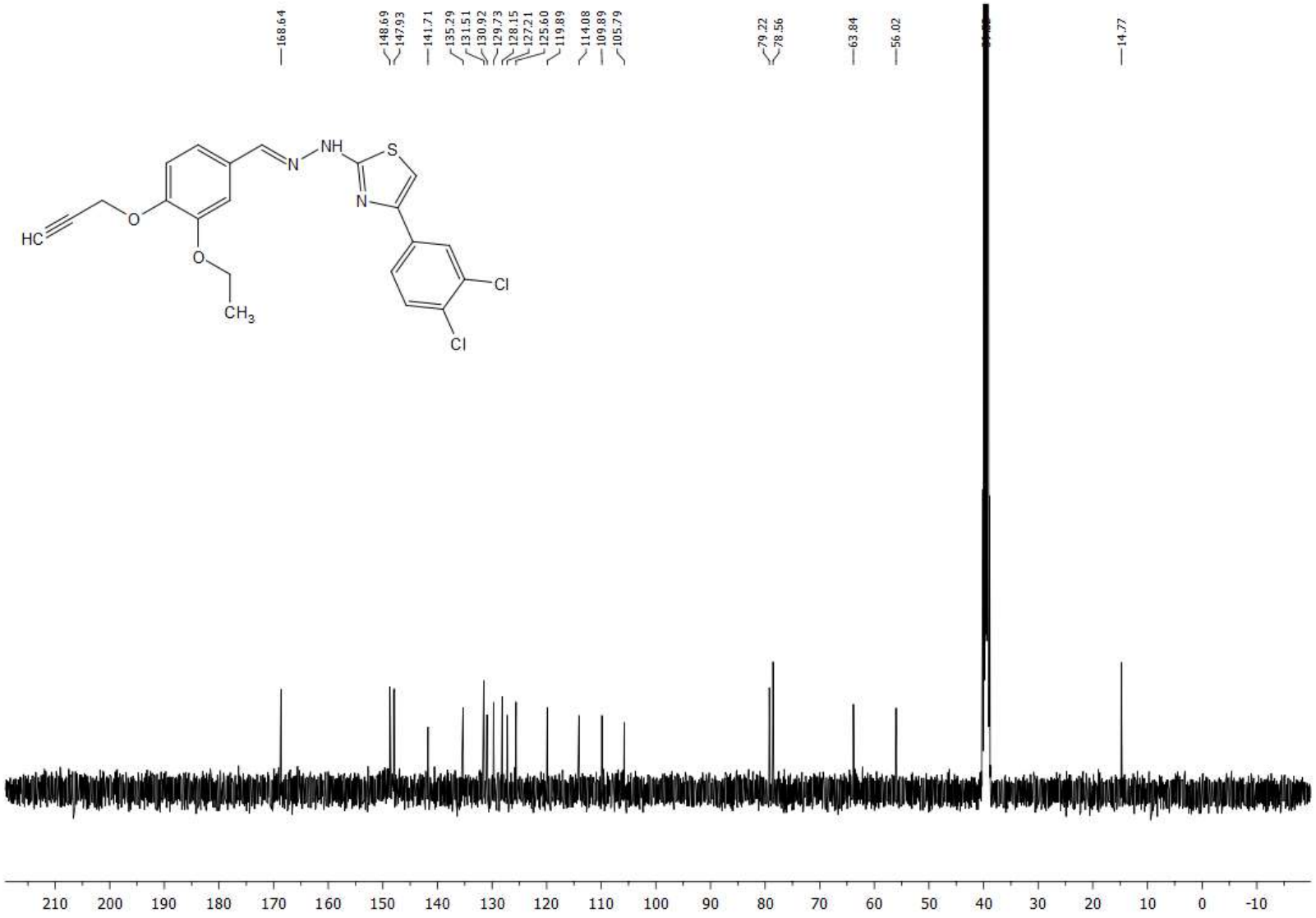
Mass spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (19)



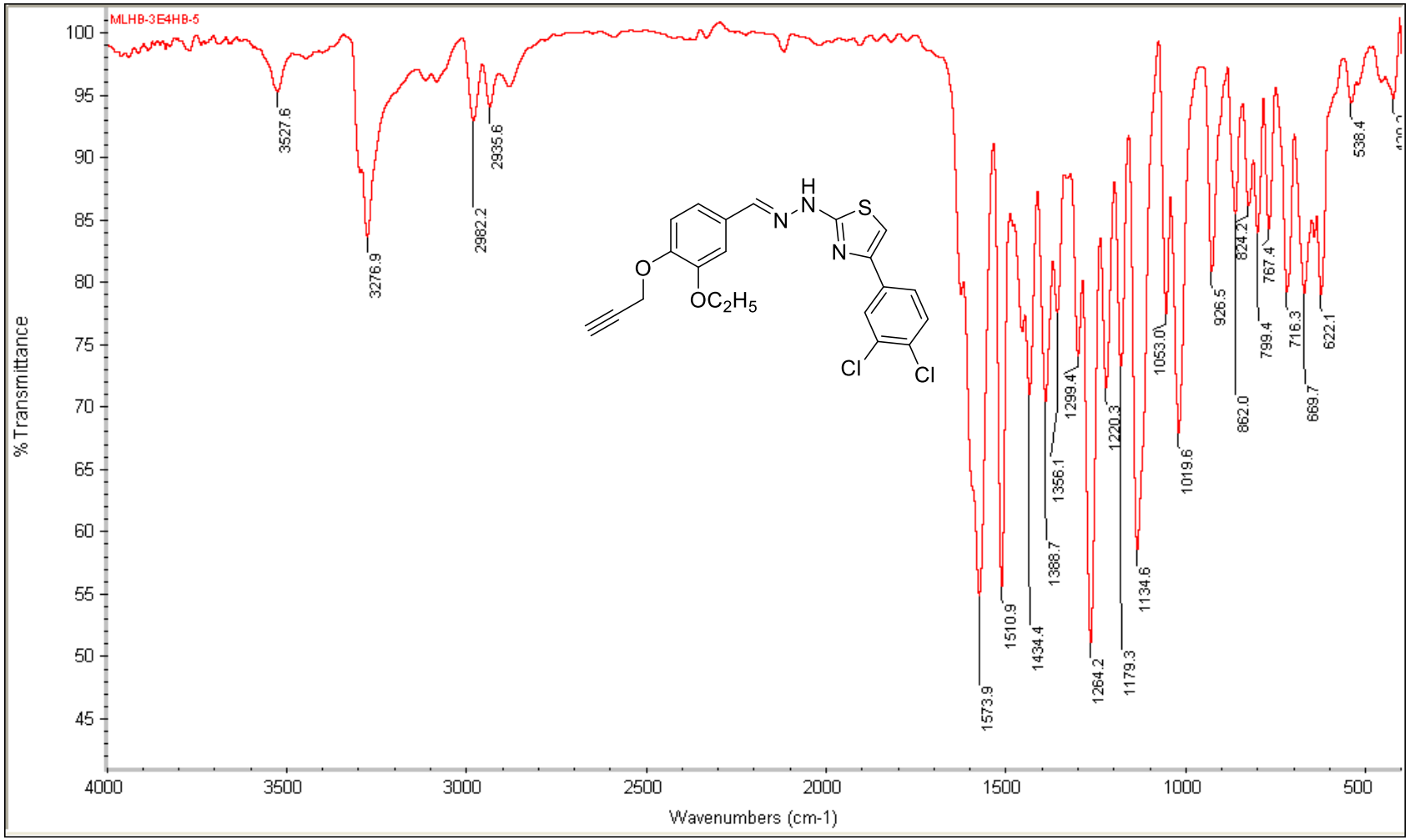
^{1}H NMR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (19)



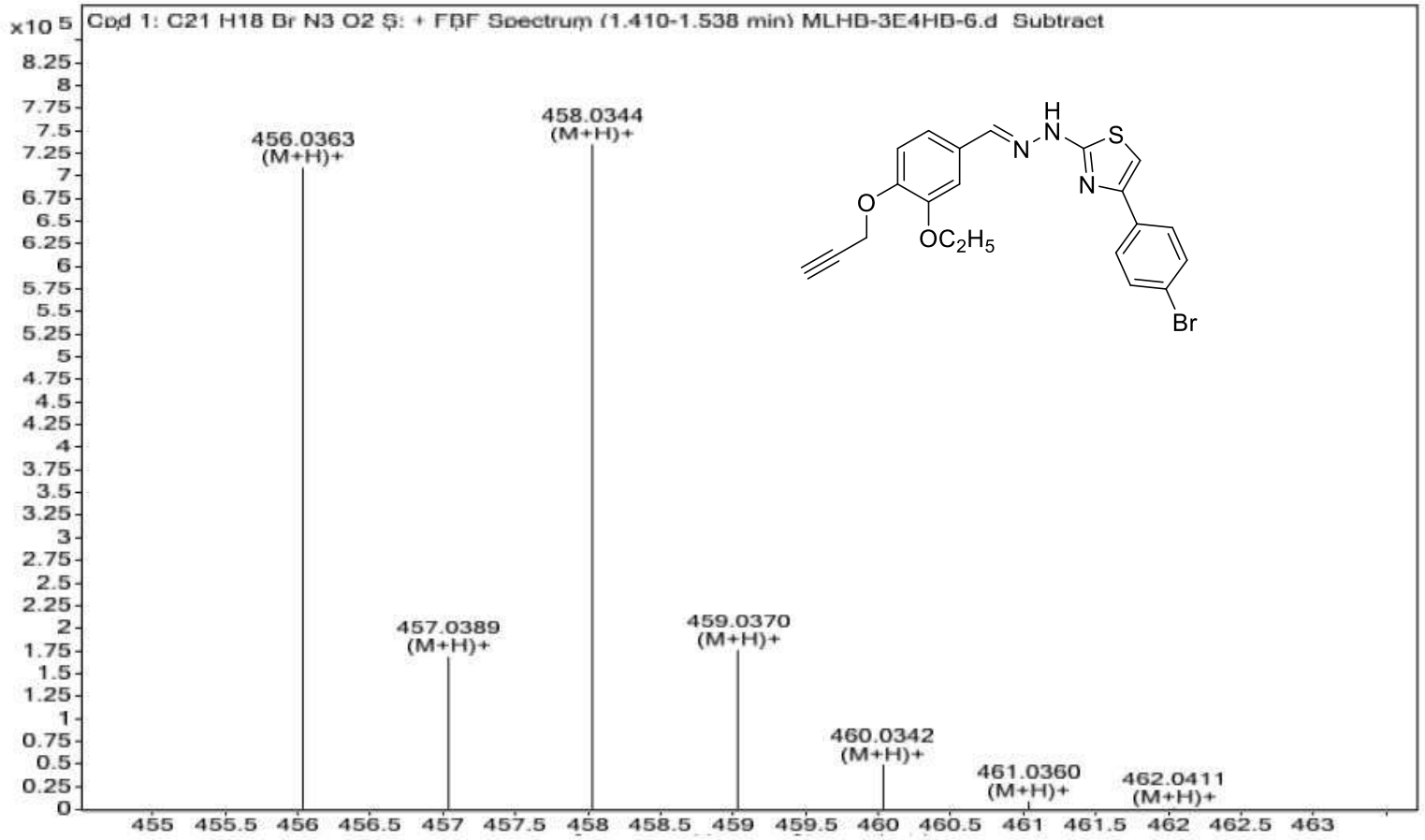
^{13}C NMR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (19)



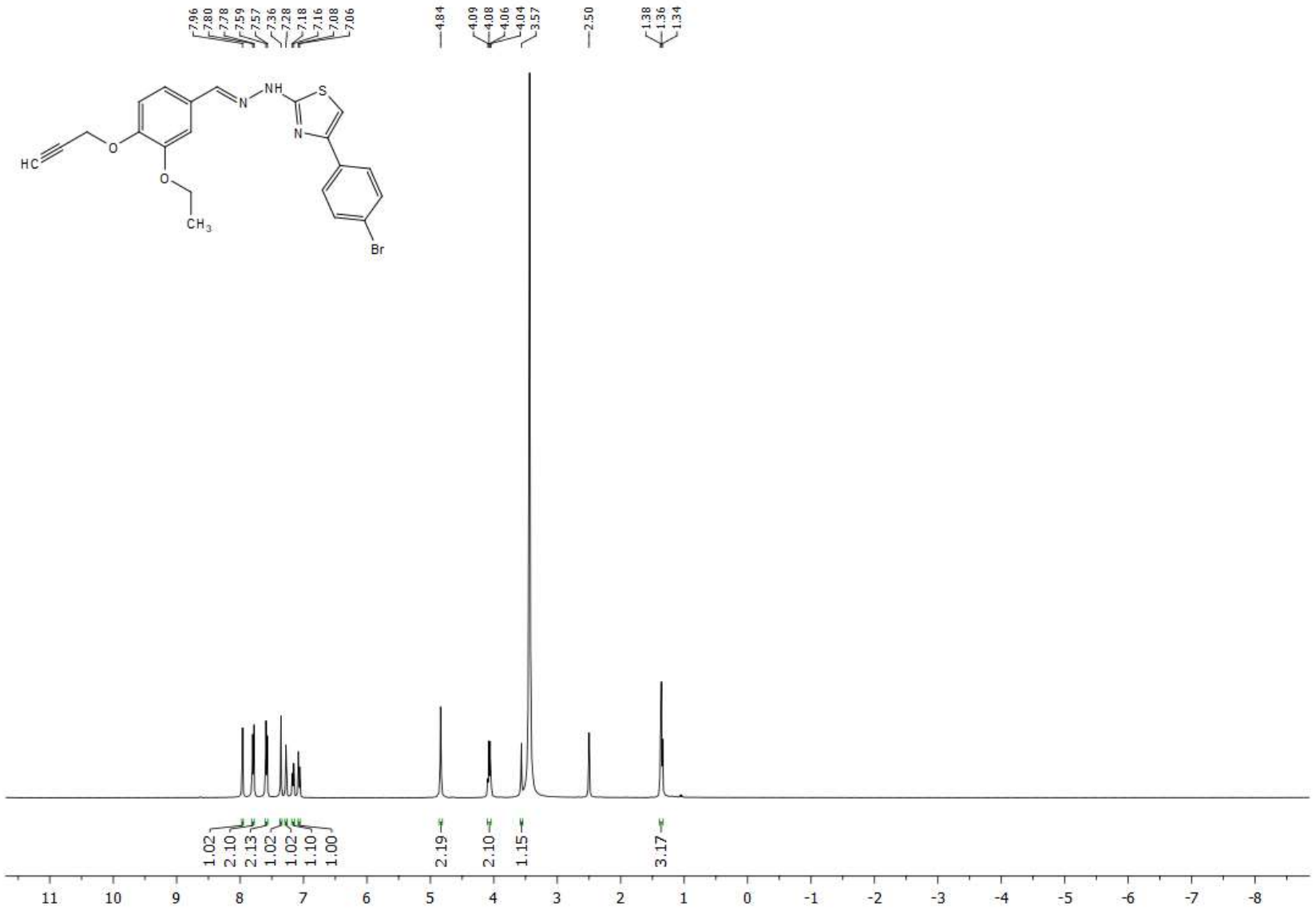
FT-IR spectrum of (*E*)-4-(3,4-Dichlorophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (19)



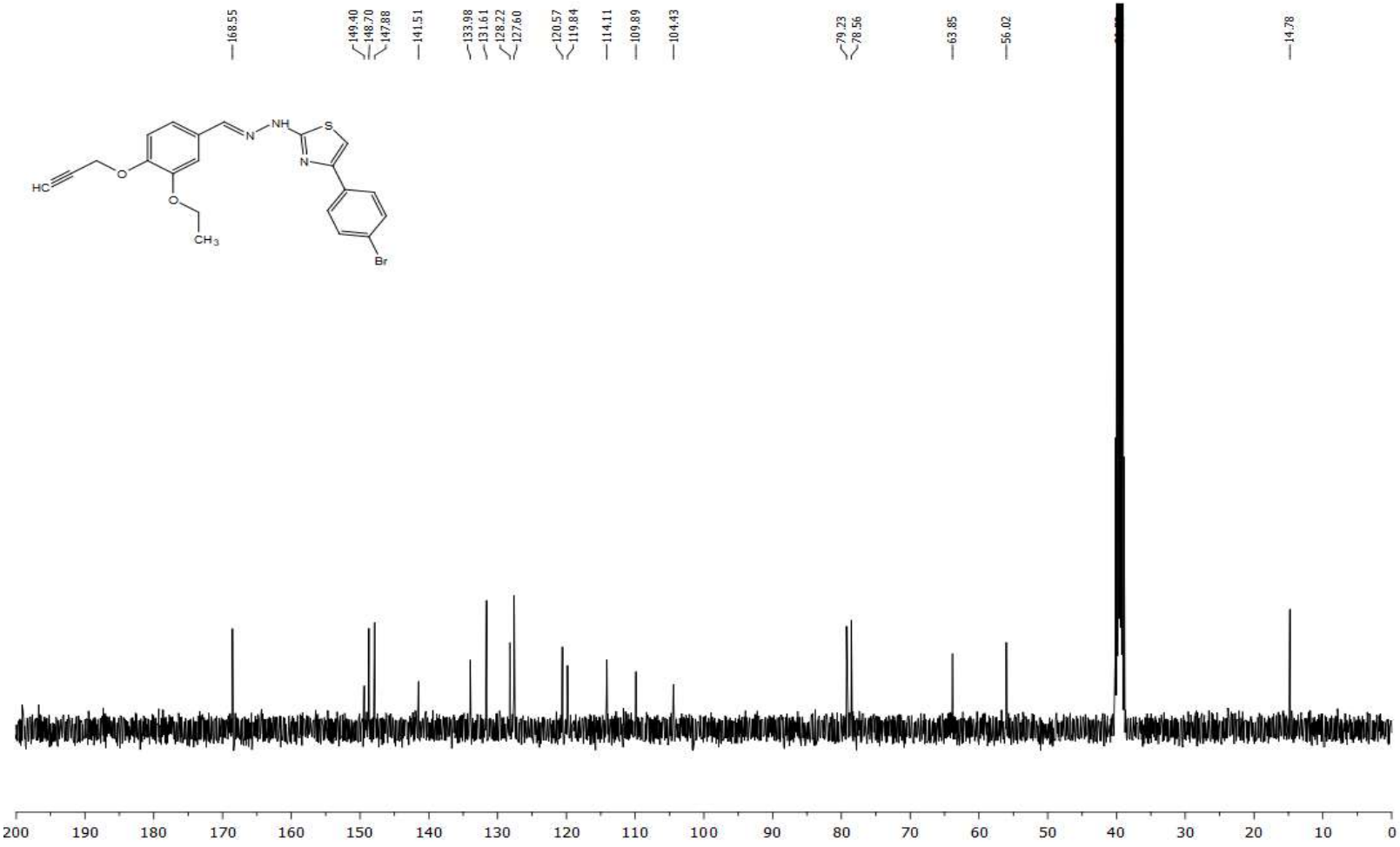
Mass spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (20)



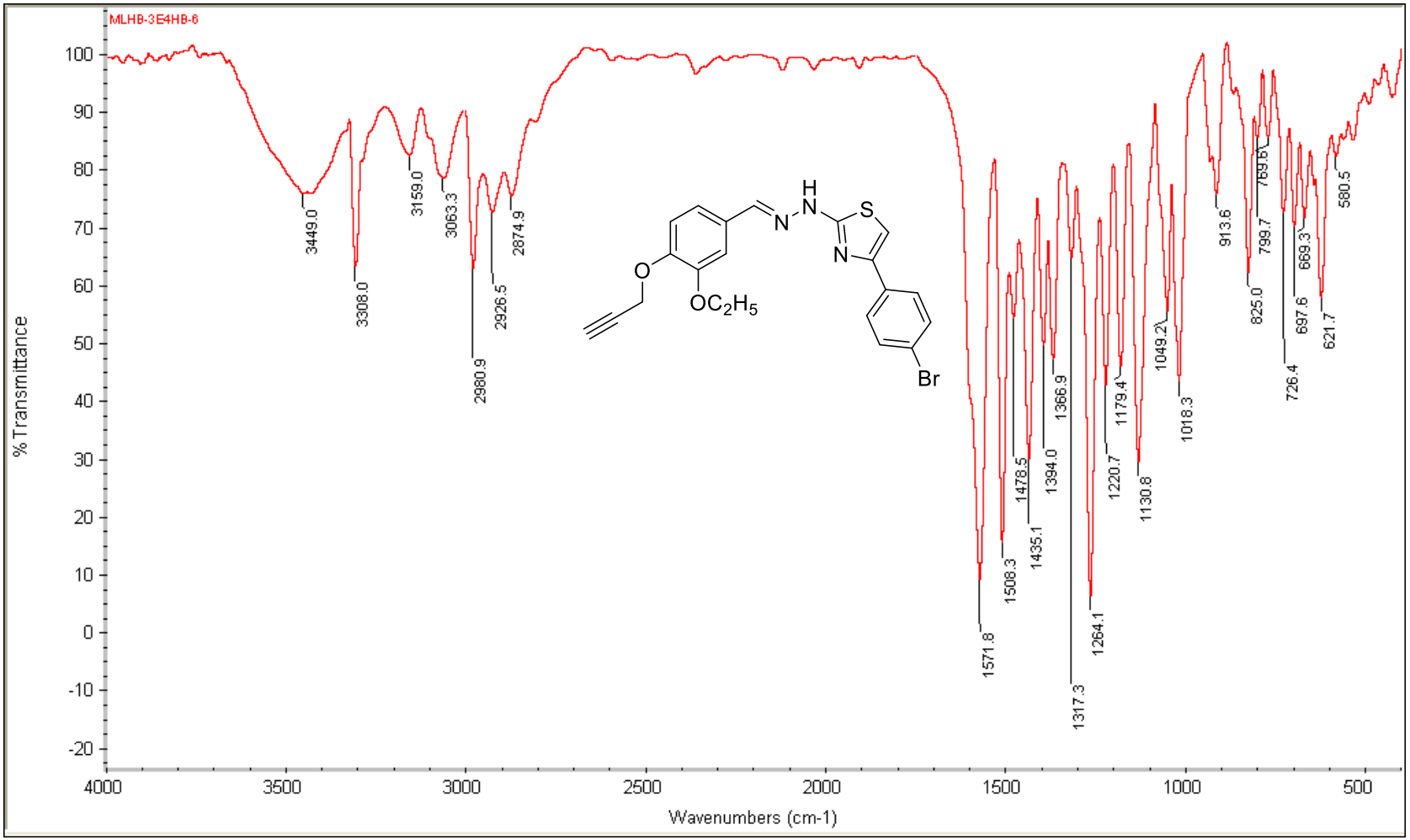
^{1}H NMR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (20)



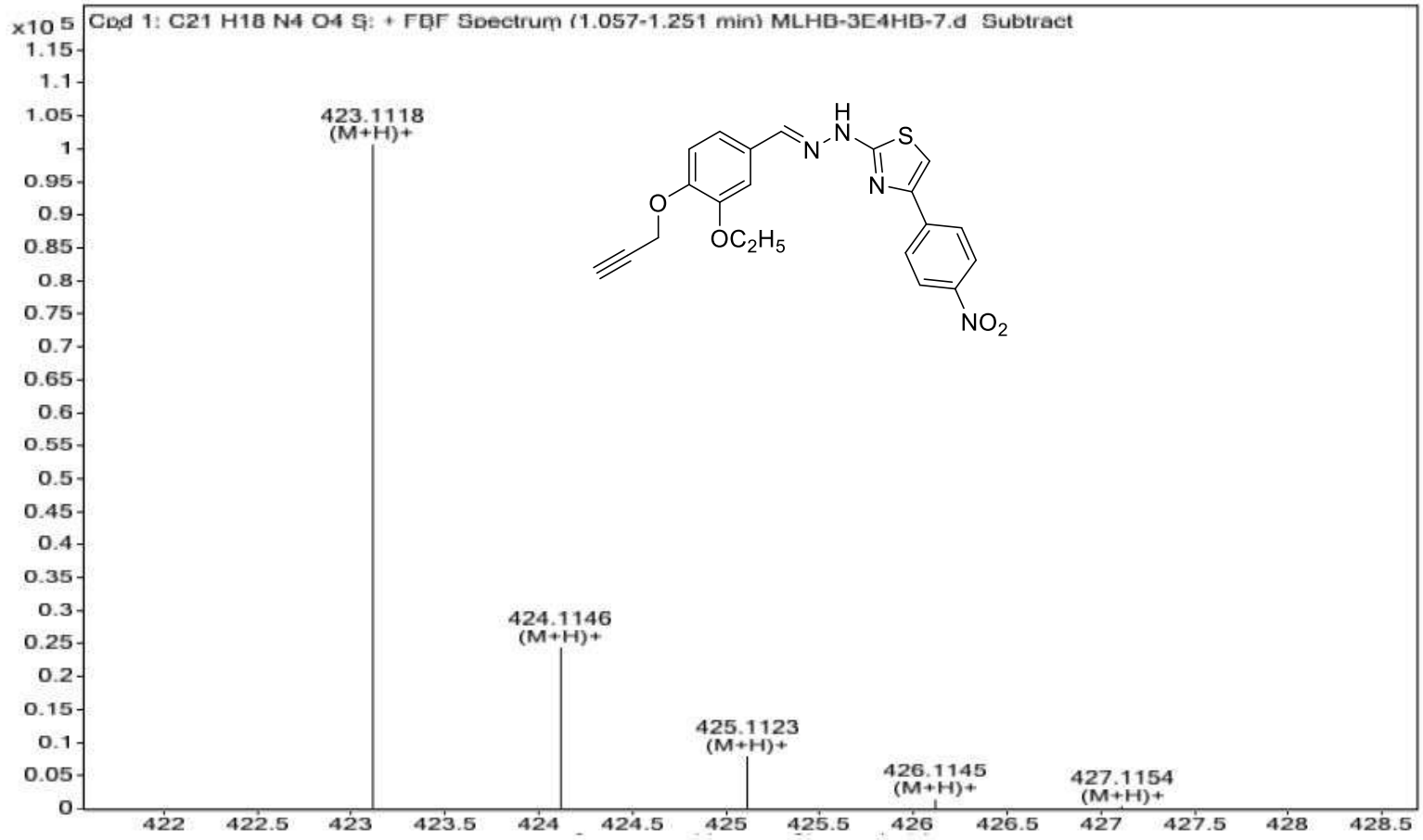
^{13}C NMR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (20)



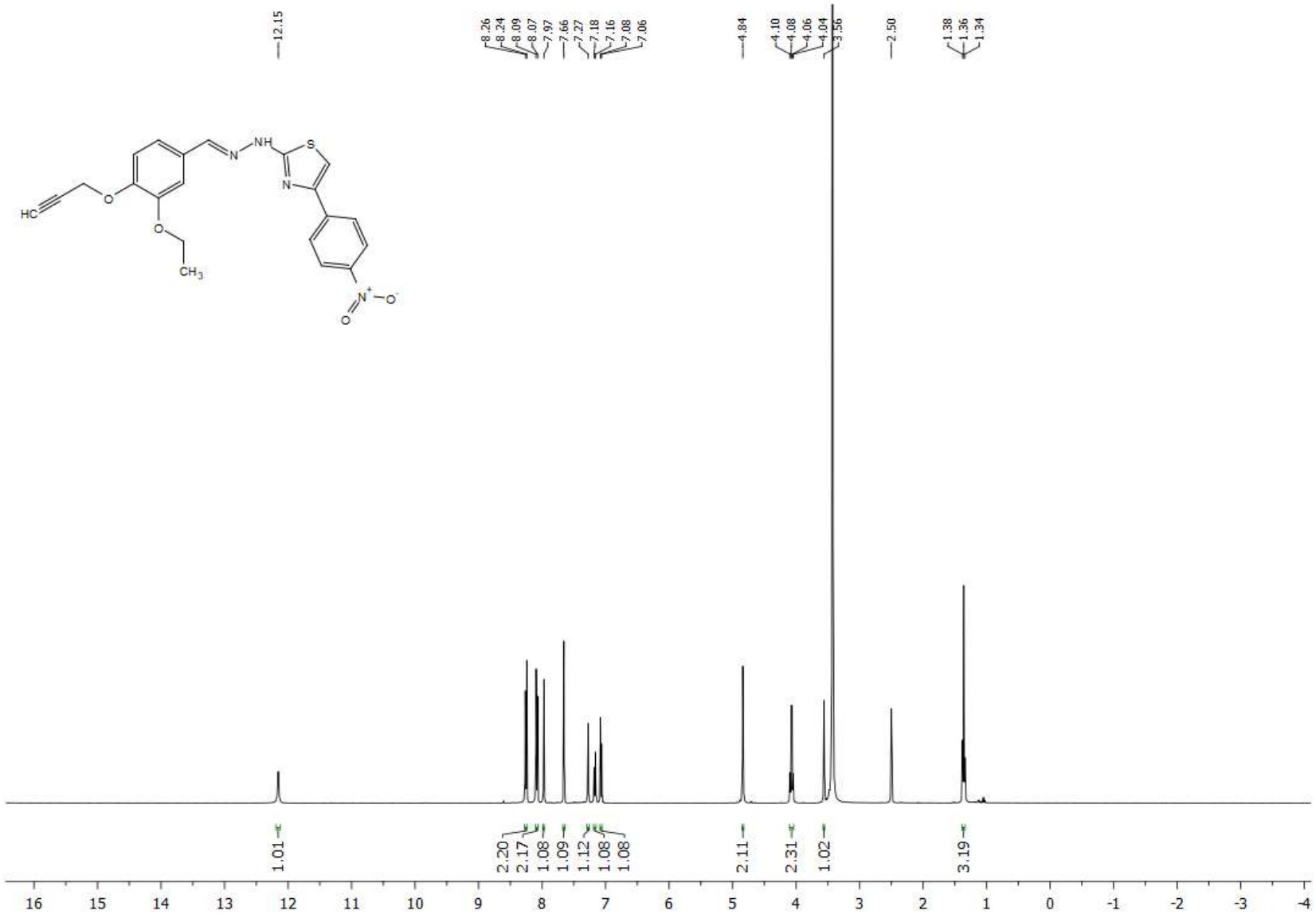
FT-IR spectrum of (*E*)-4-(4-Bromophenyl)-2-(2-(3-ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazole (20)



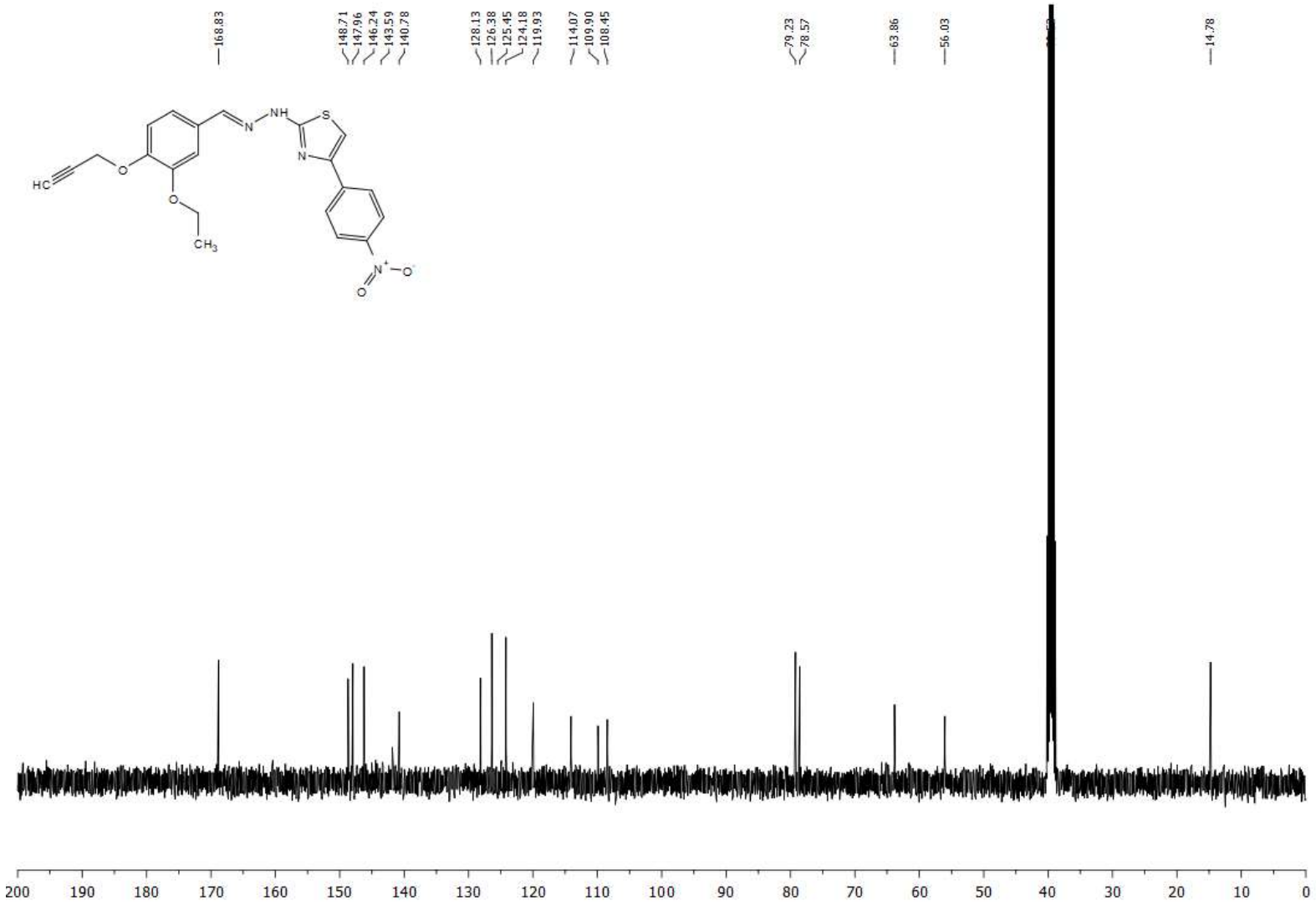
Mass spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-nitrophenyl)thiazole (21)



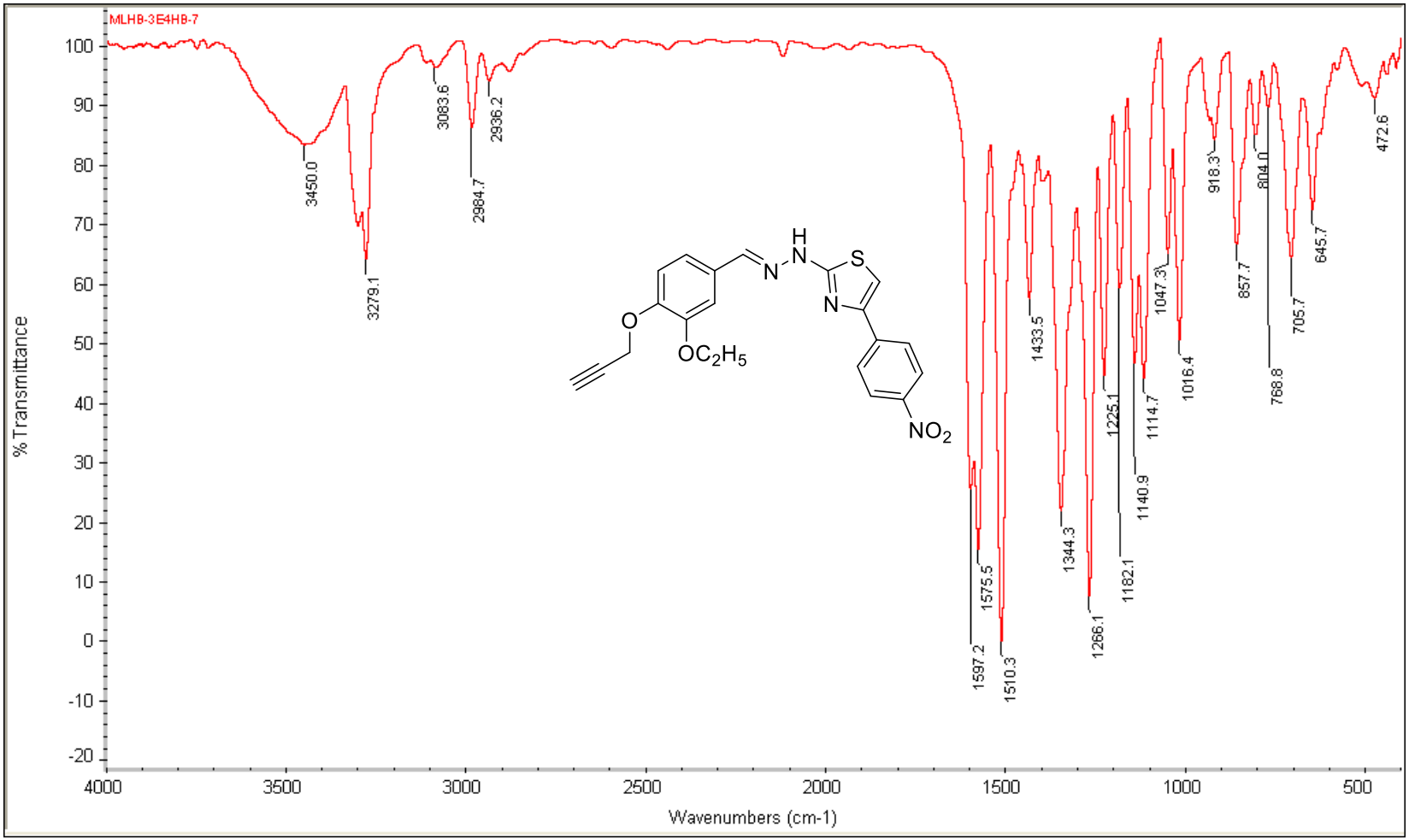
^{1}H NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-nitrophenyl)thiazole (21)



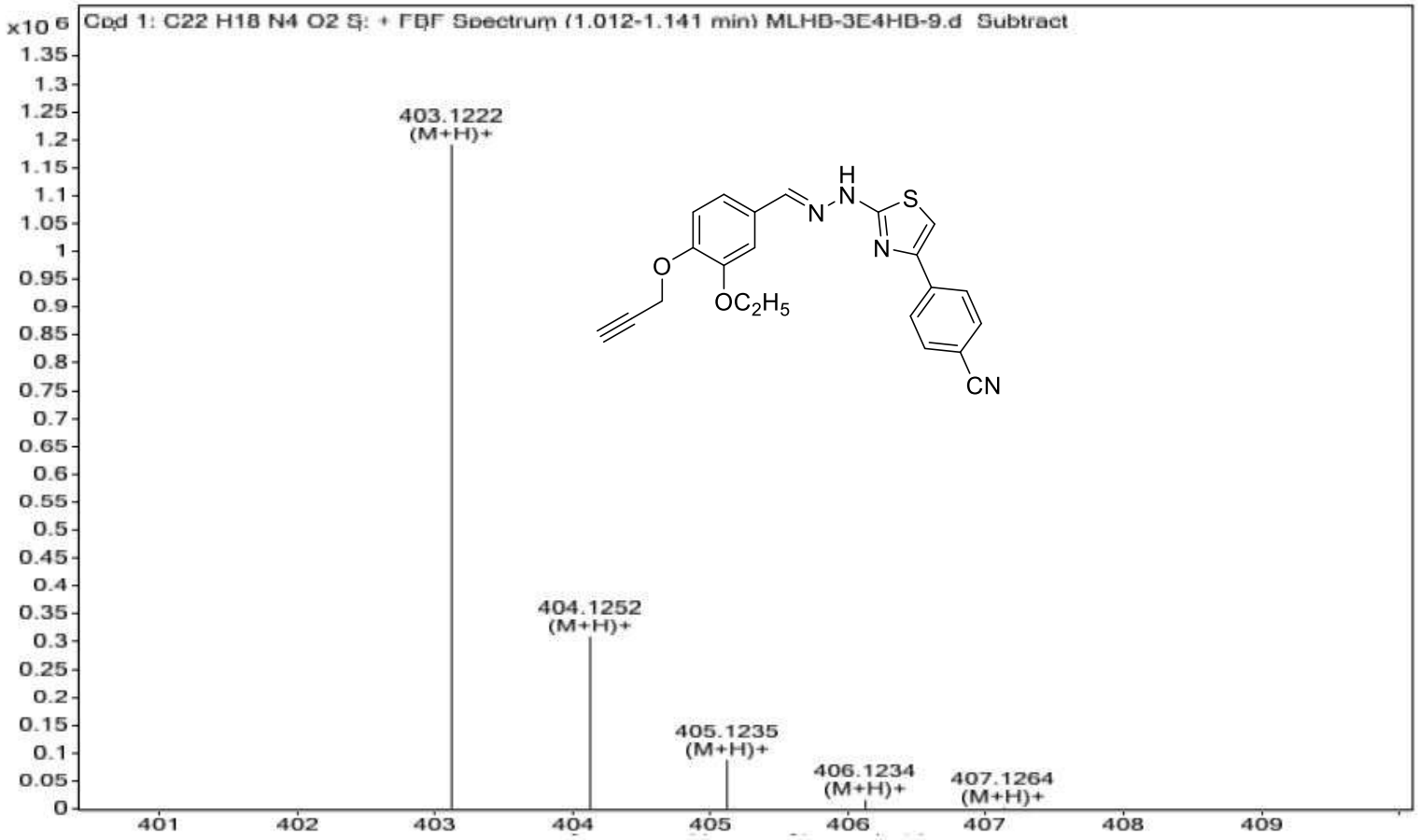
^{13}C NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-nitrophenyl)thiazole (21)



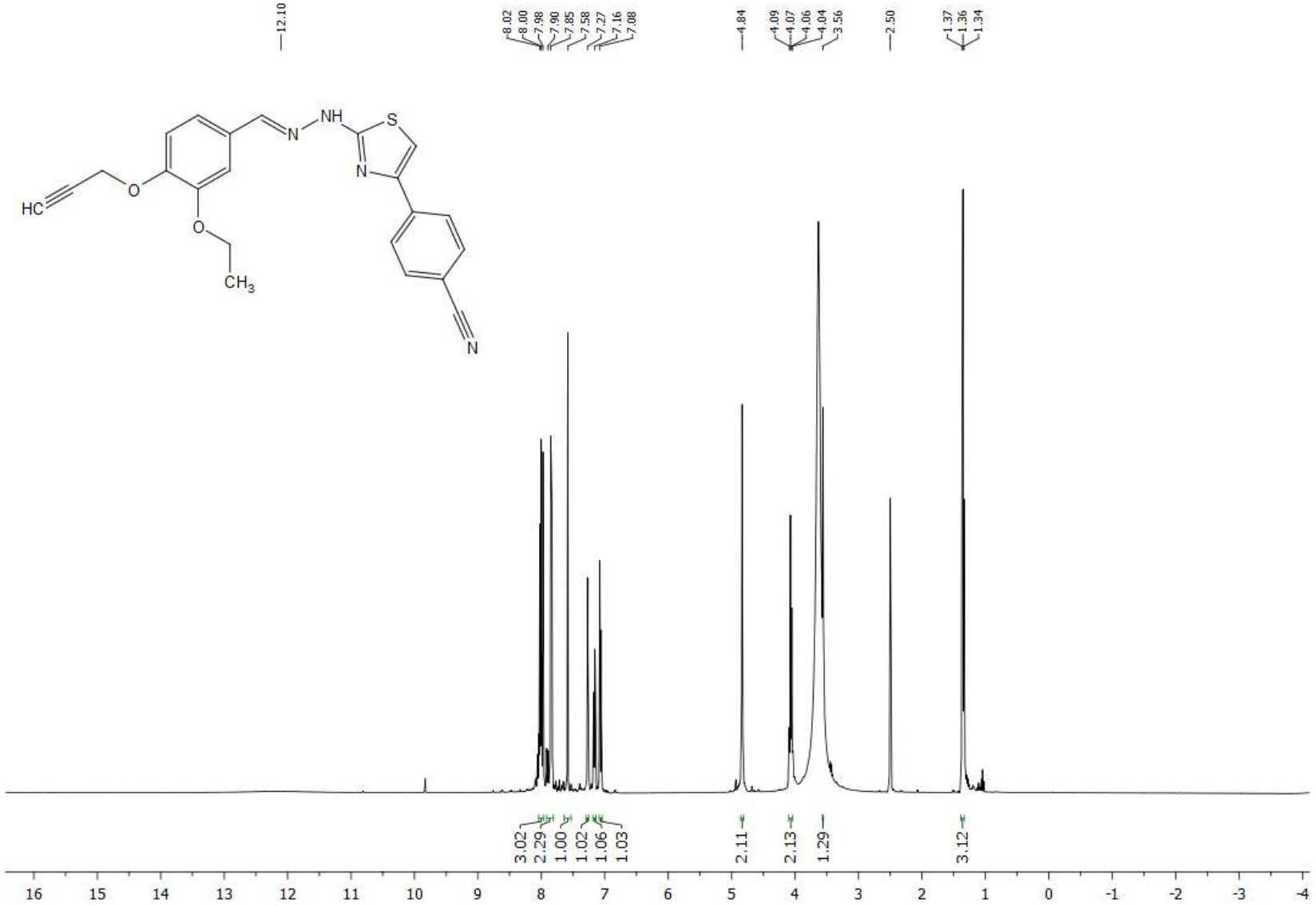
FT-IR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-nitrophenyl)thiazole (21)



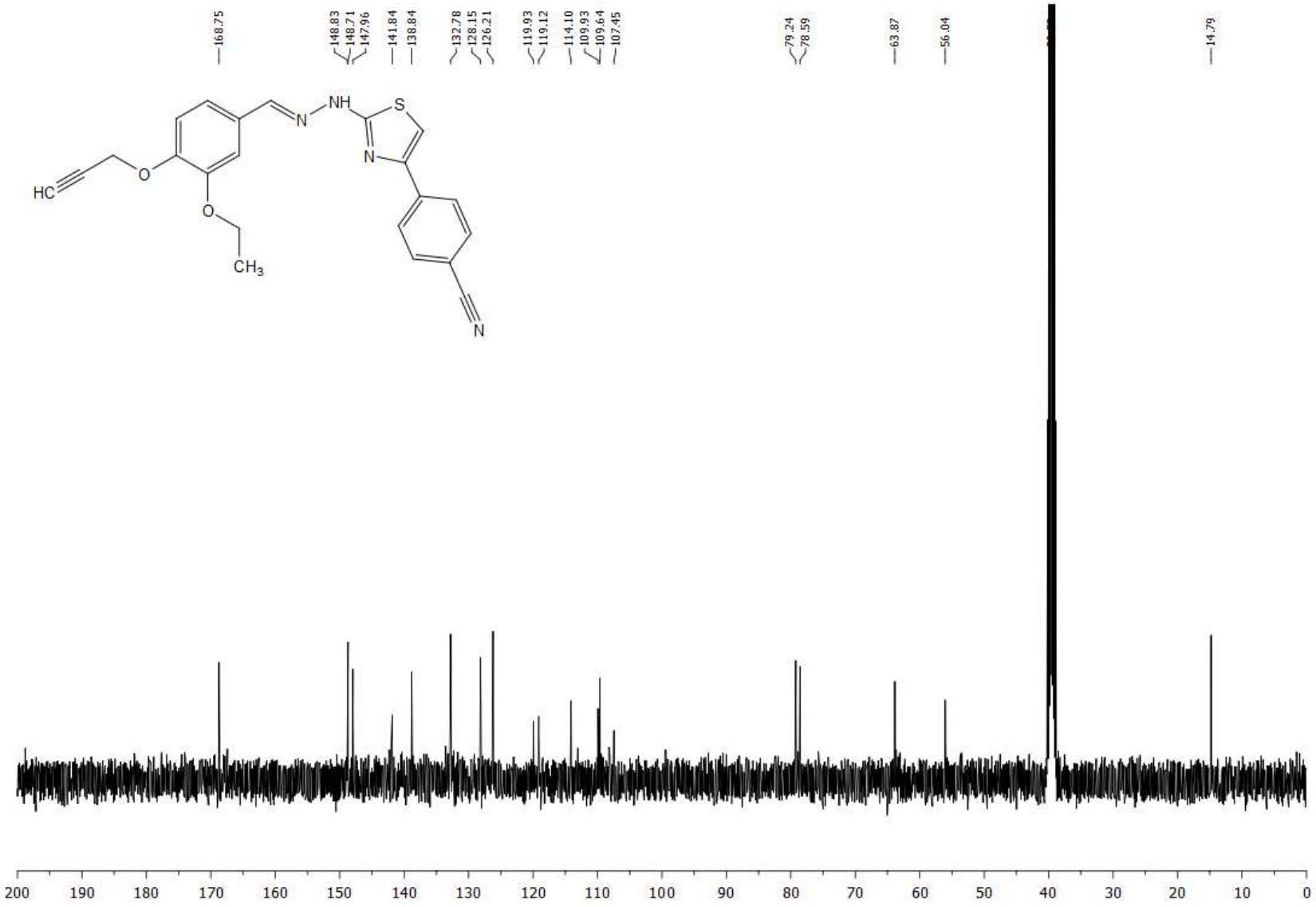
Mass spectrum of (*E*)-4-(2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (22)



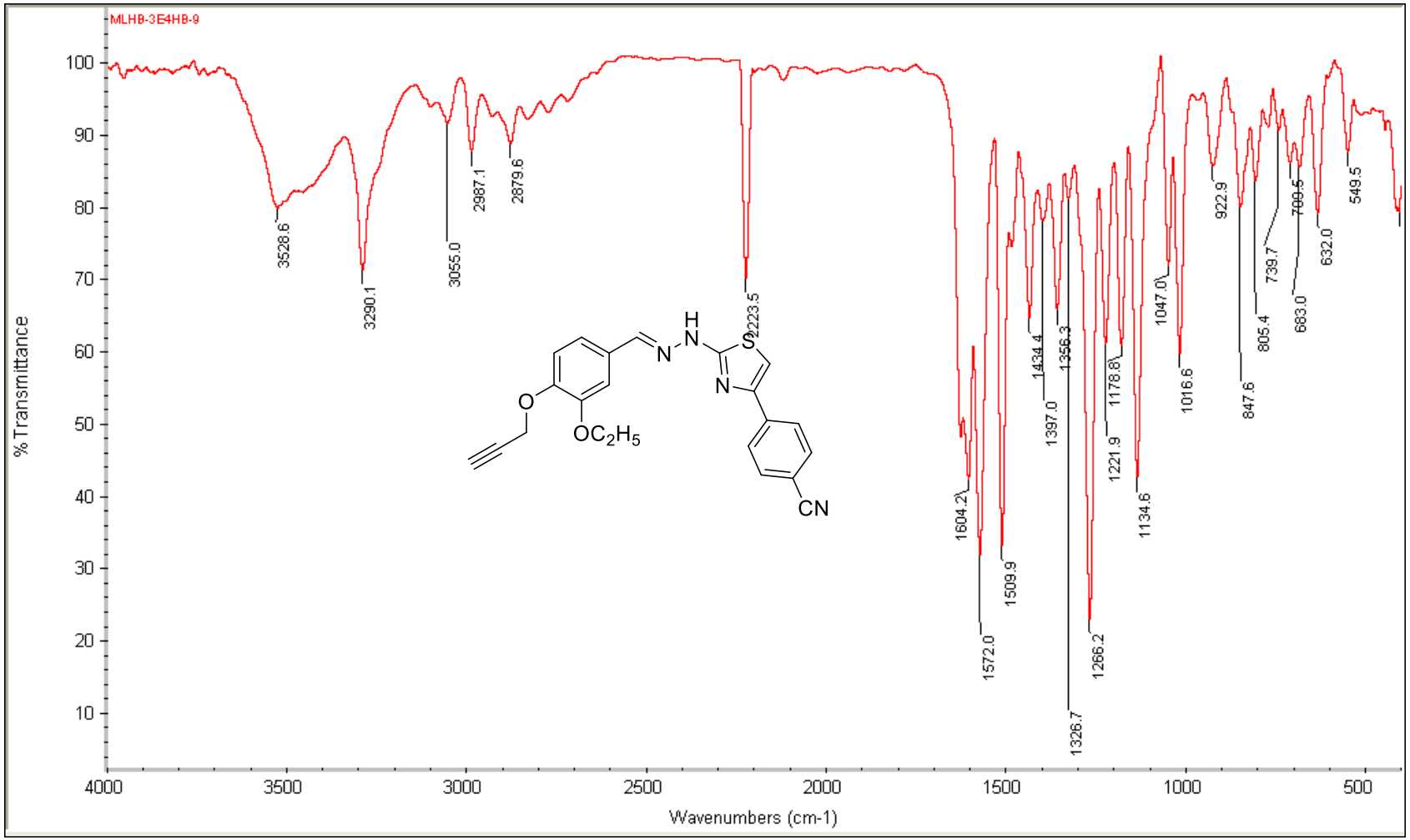
^{1}H NMR spectrum of (*E*)-4-(2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (22)



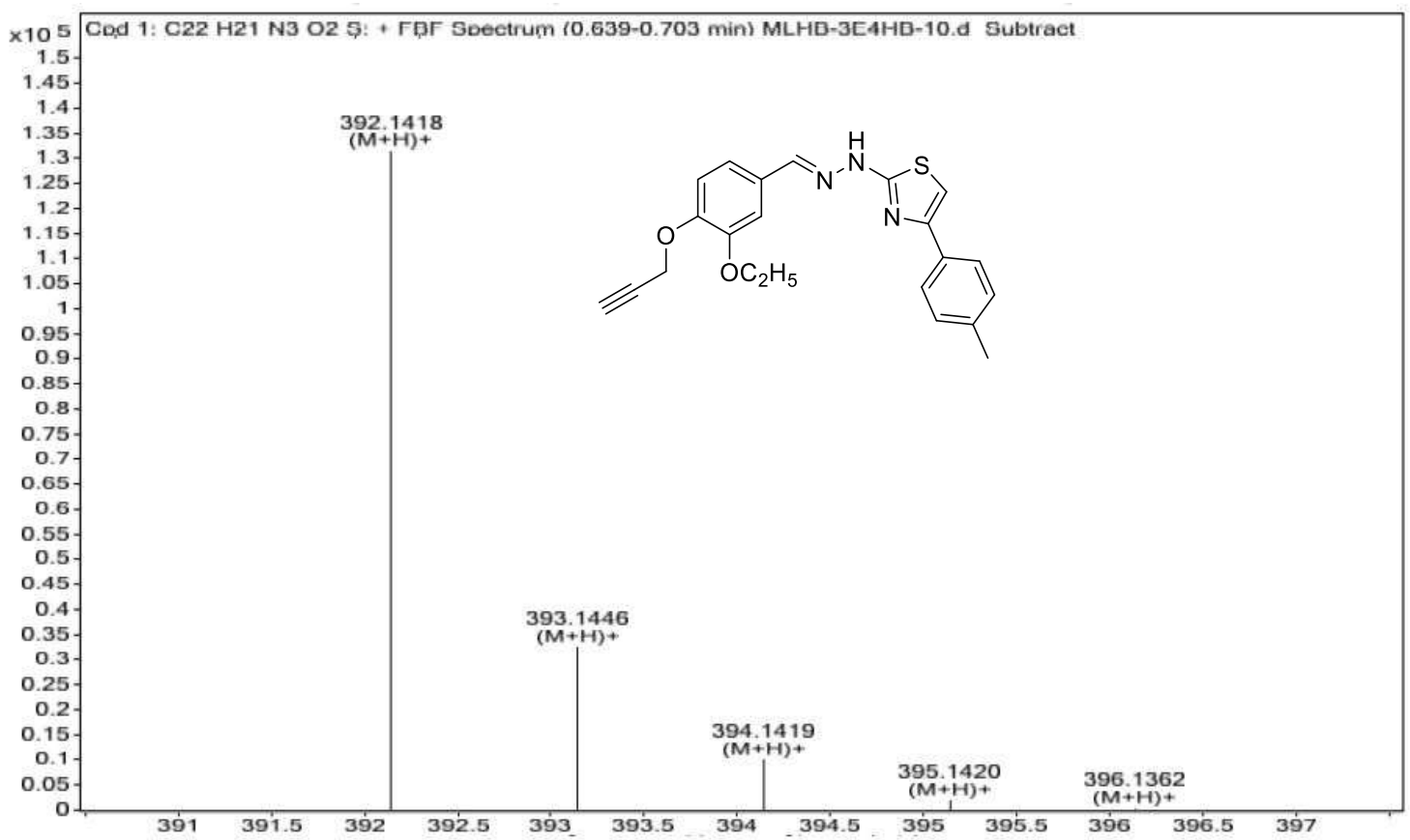
^{13}C NMR spectrum of (*E*)-4-(2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (22)



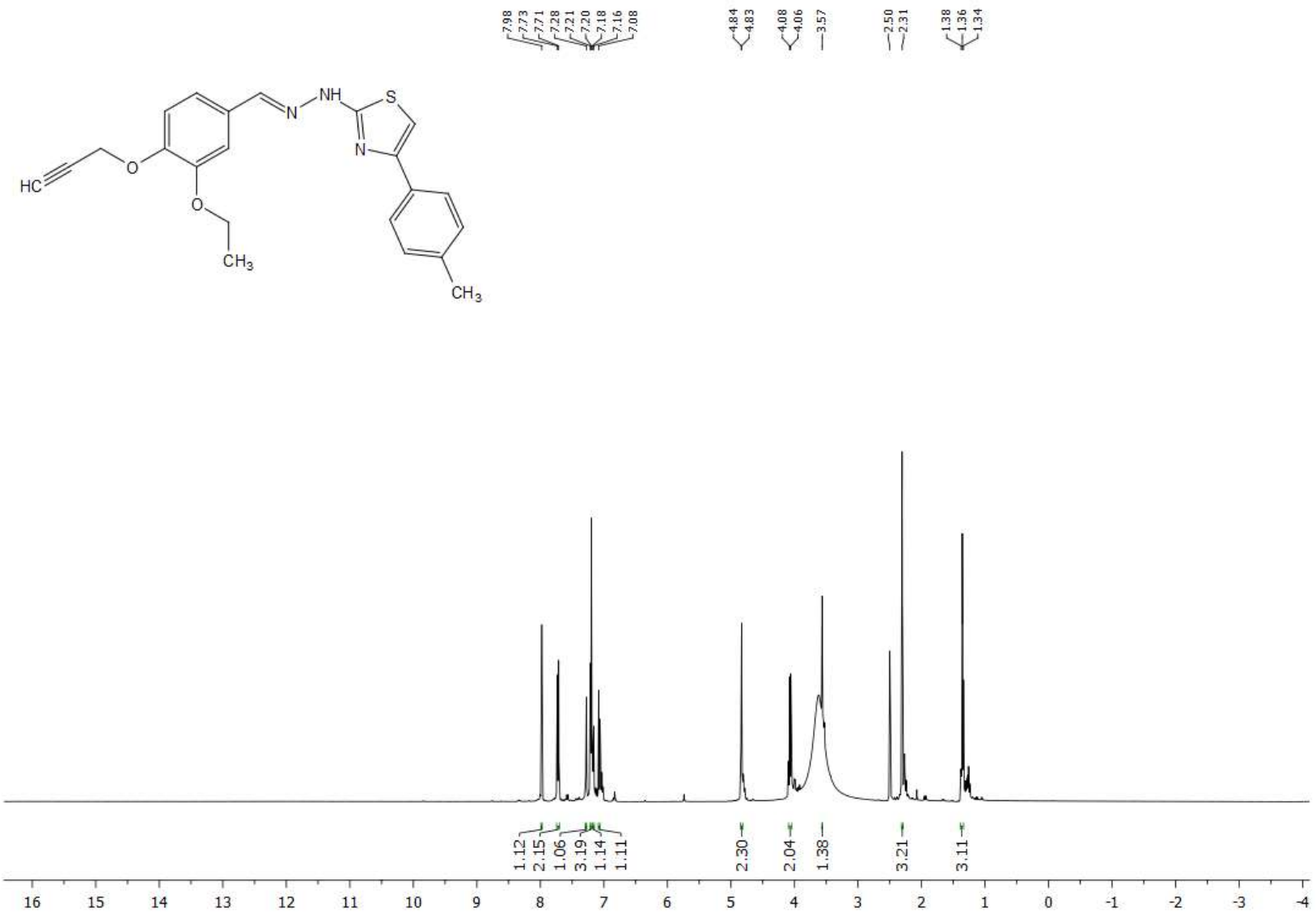
FT-IR spectrum of (*E*)-4-(2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (22)



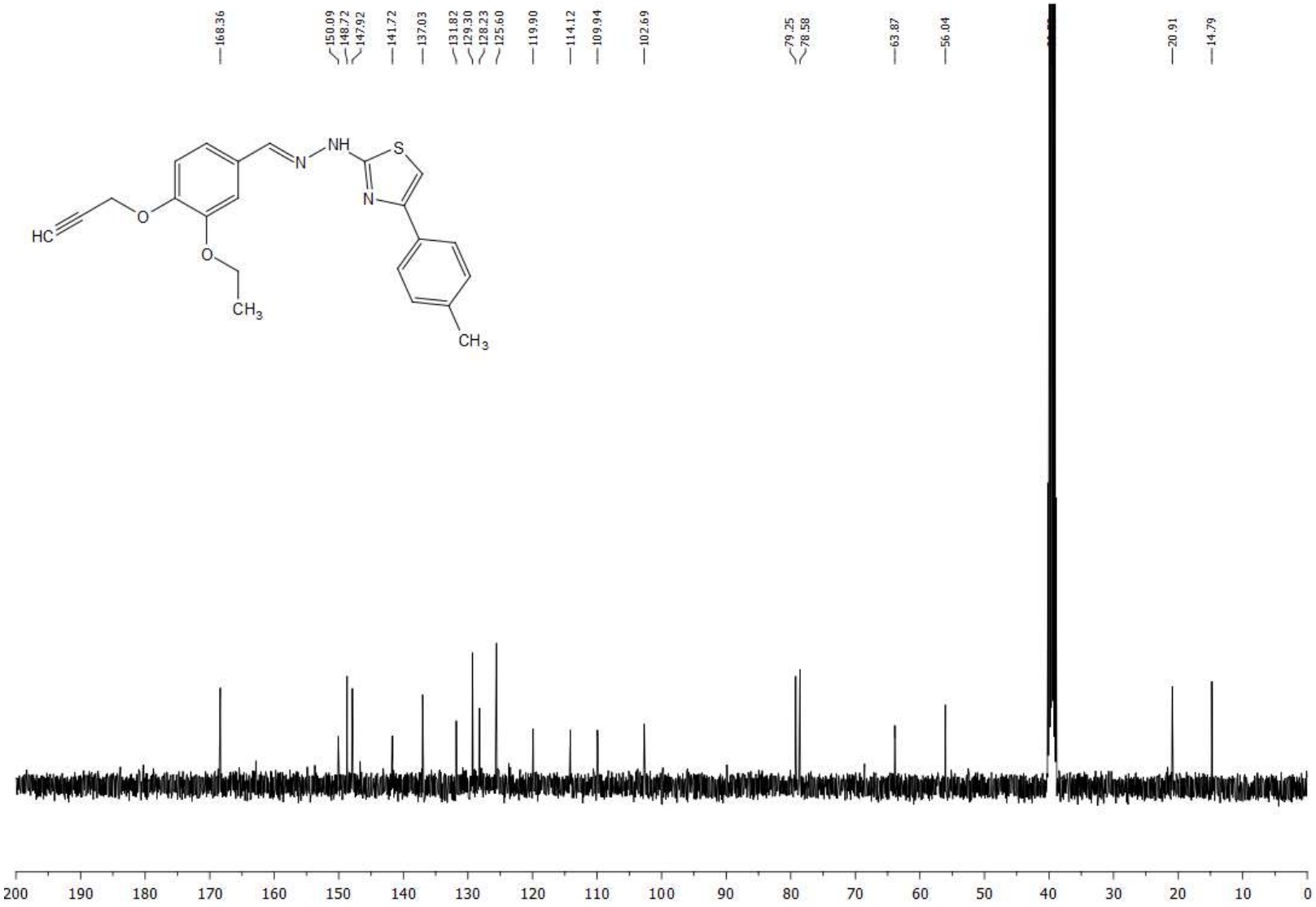
Mass spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (23)



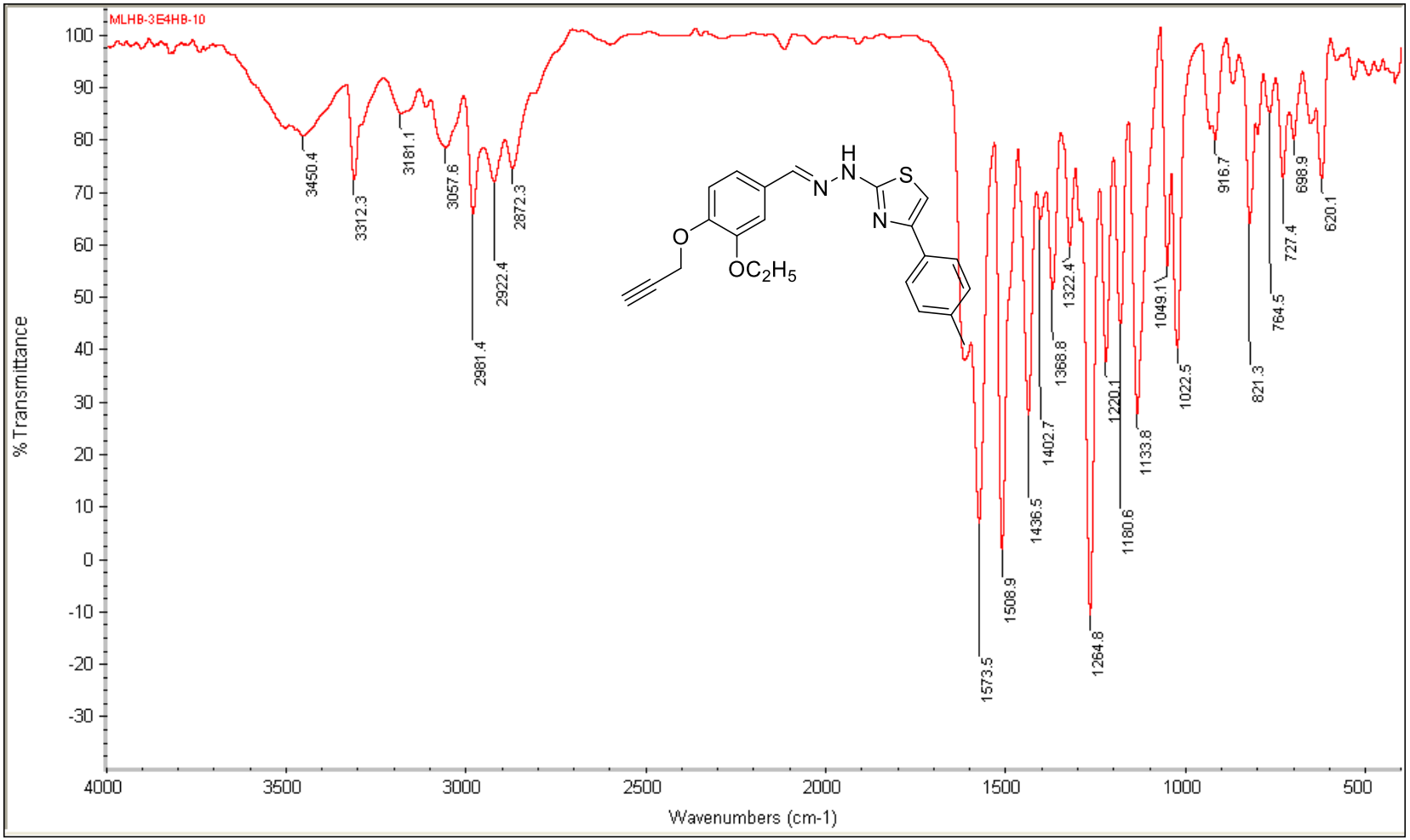
^{1}H NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (23)



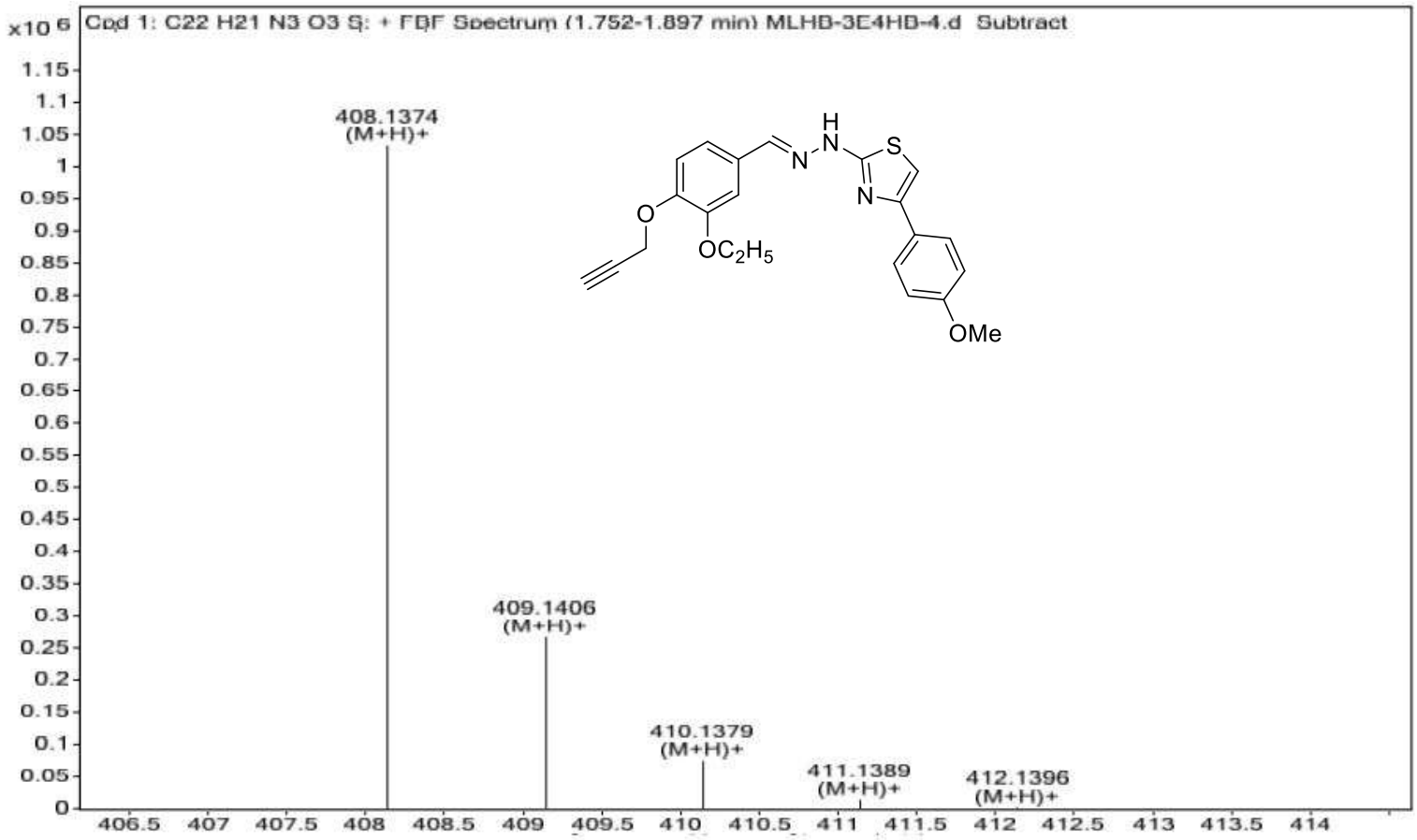
^{13}C NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (23)



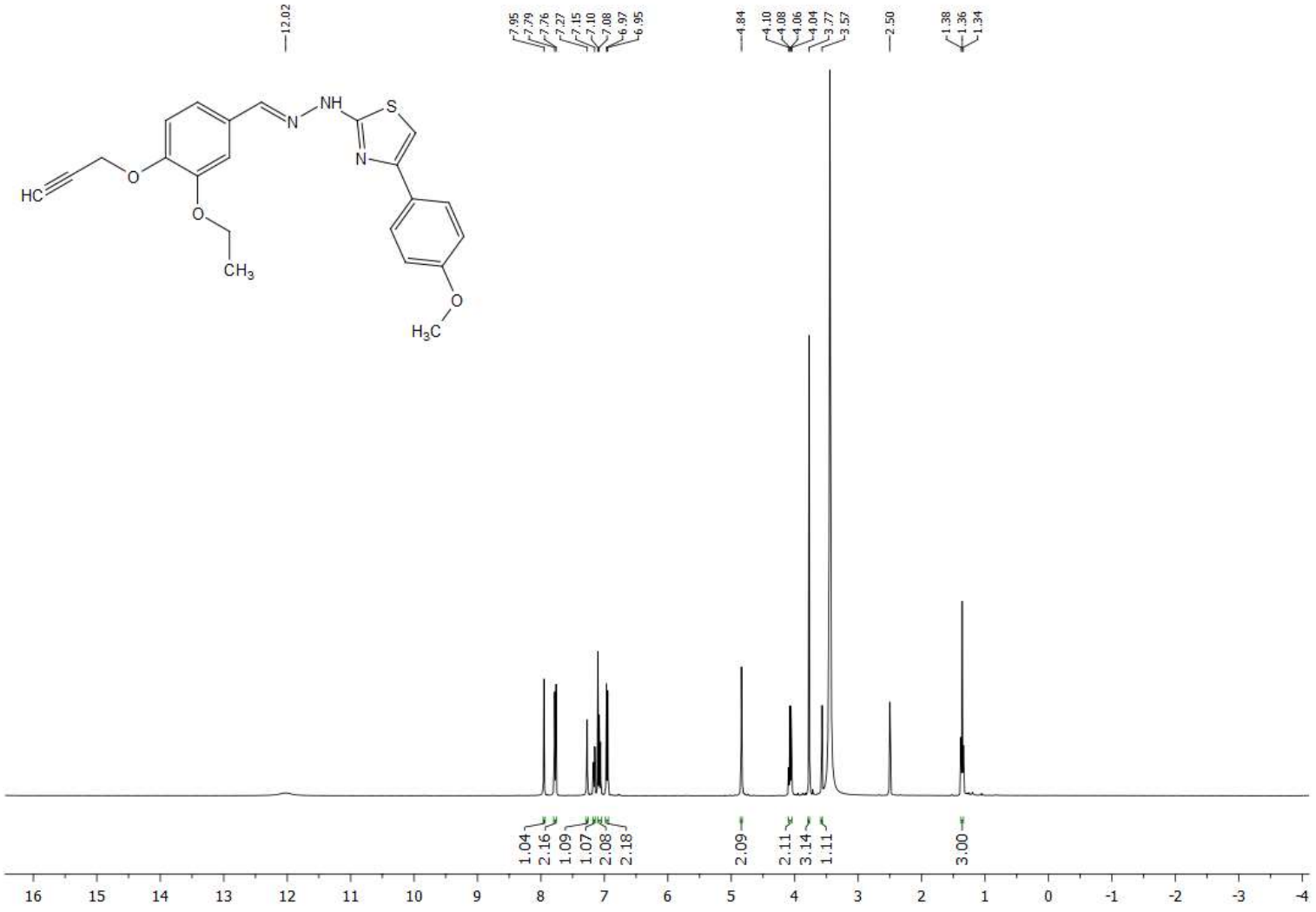
FT-IR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (23)



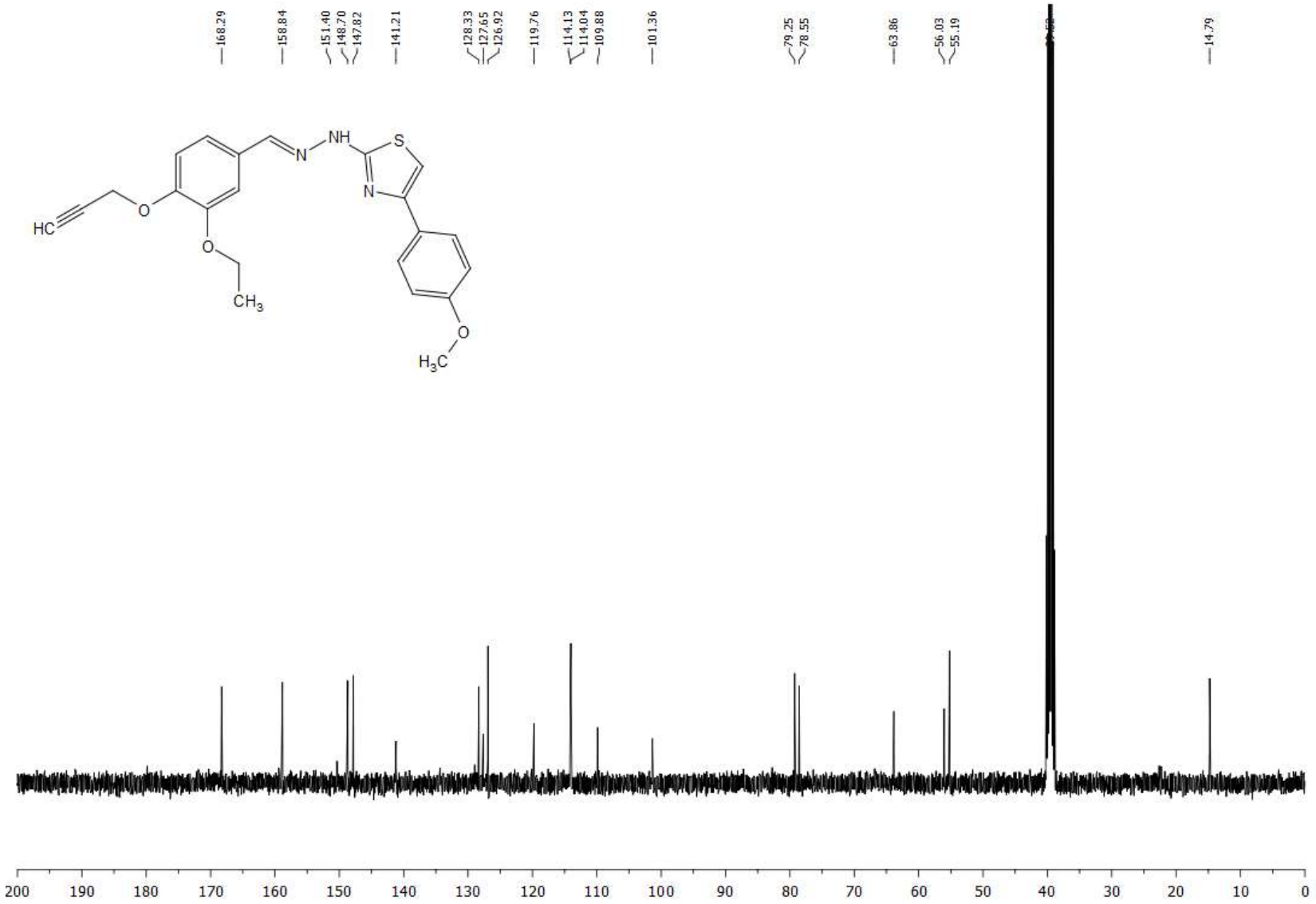
Mass spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (24)



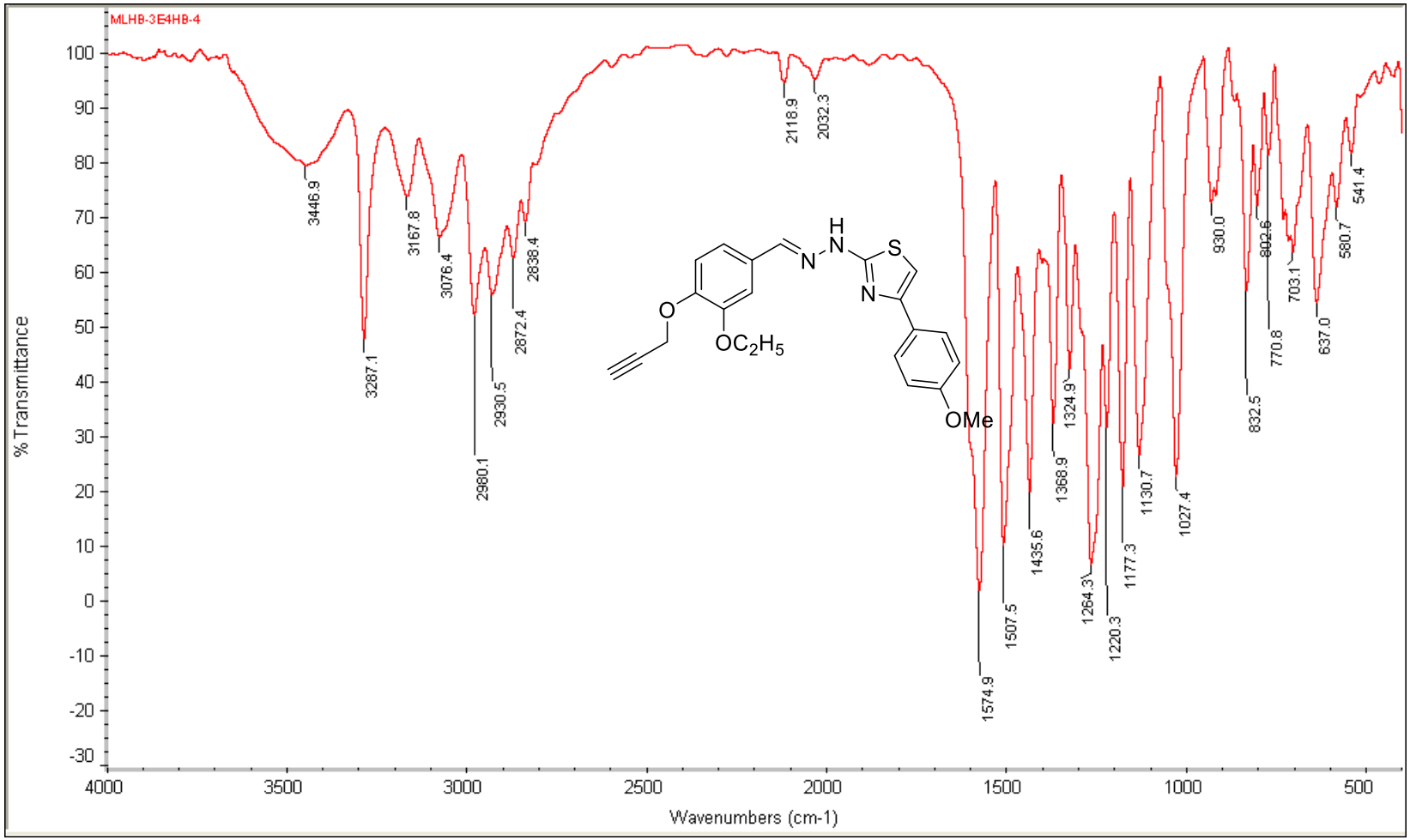
^{1}H NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (24)



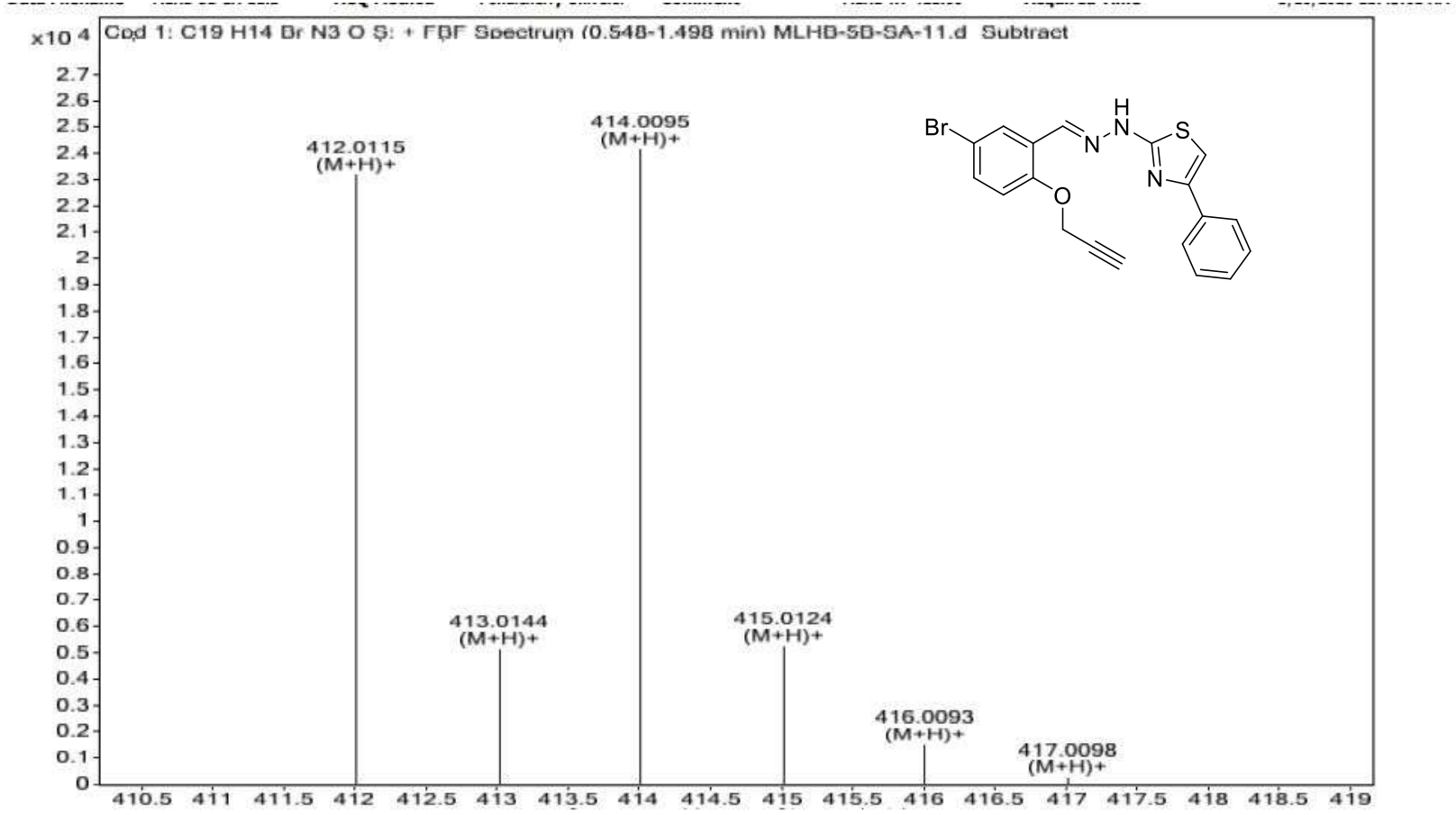
^{13}C NMR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (24)



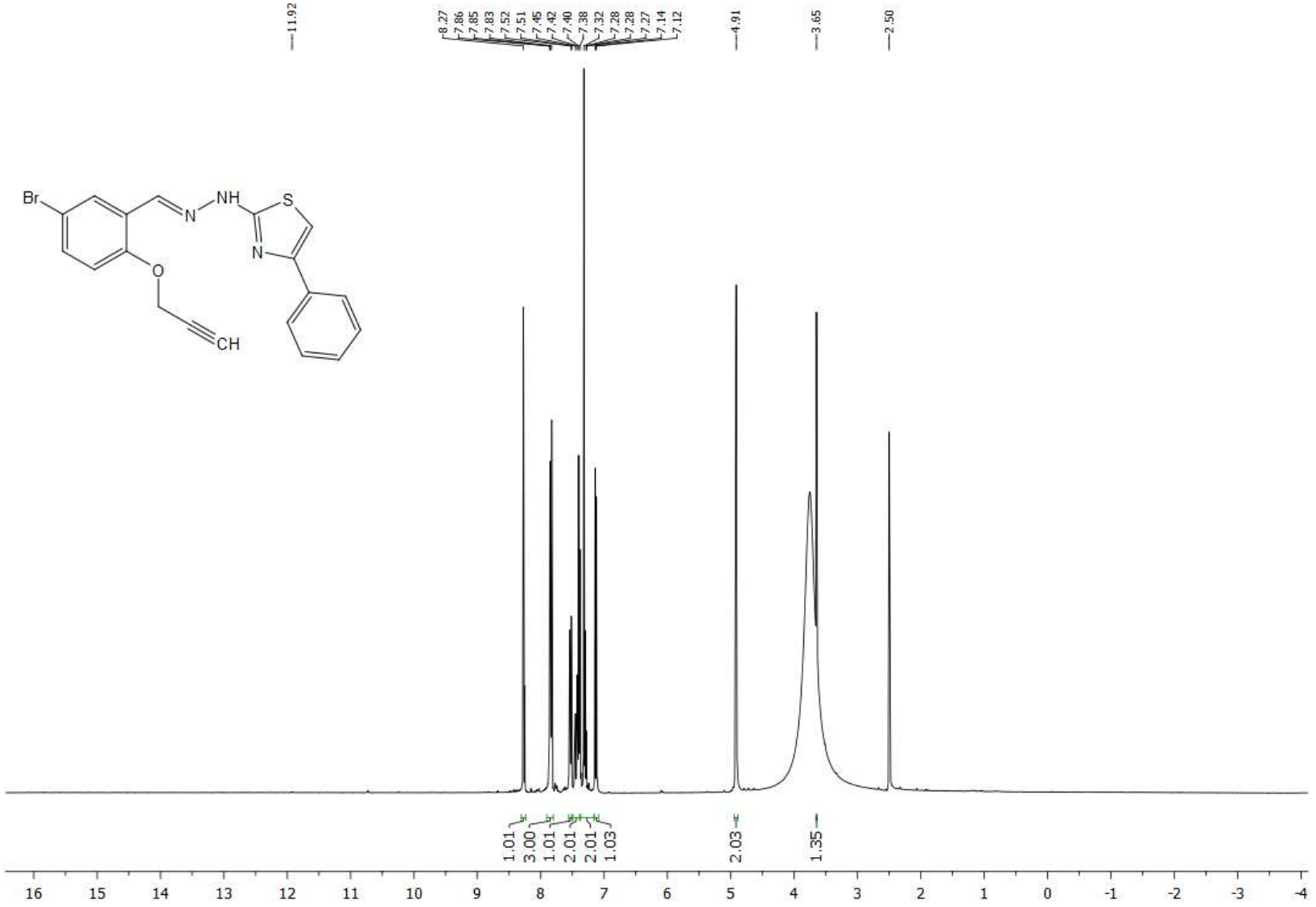
FT-IR spectrum of (*E*)-2-(2-(3-Ethoxy-4-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (24)



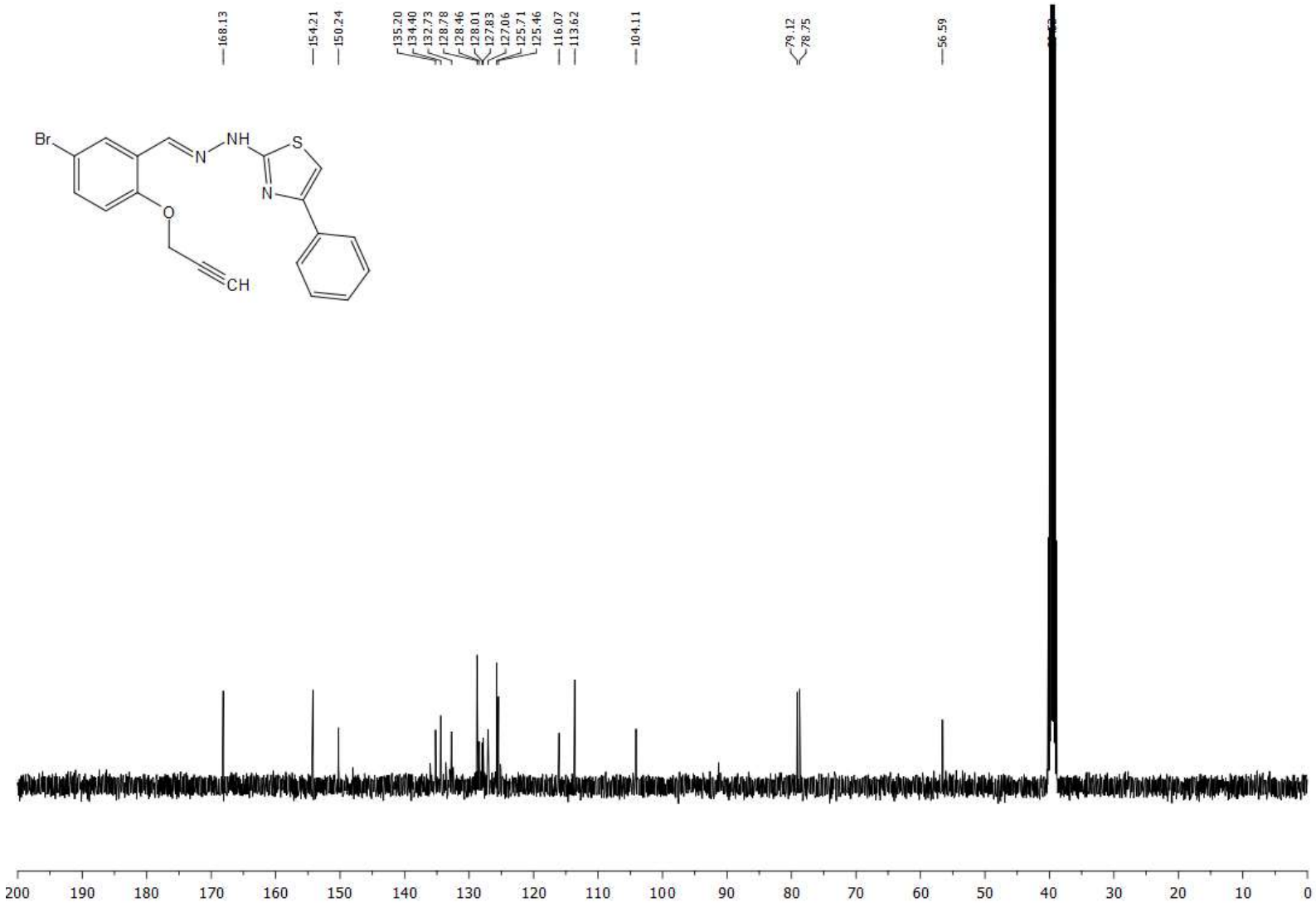
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (25)



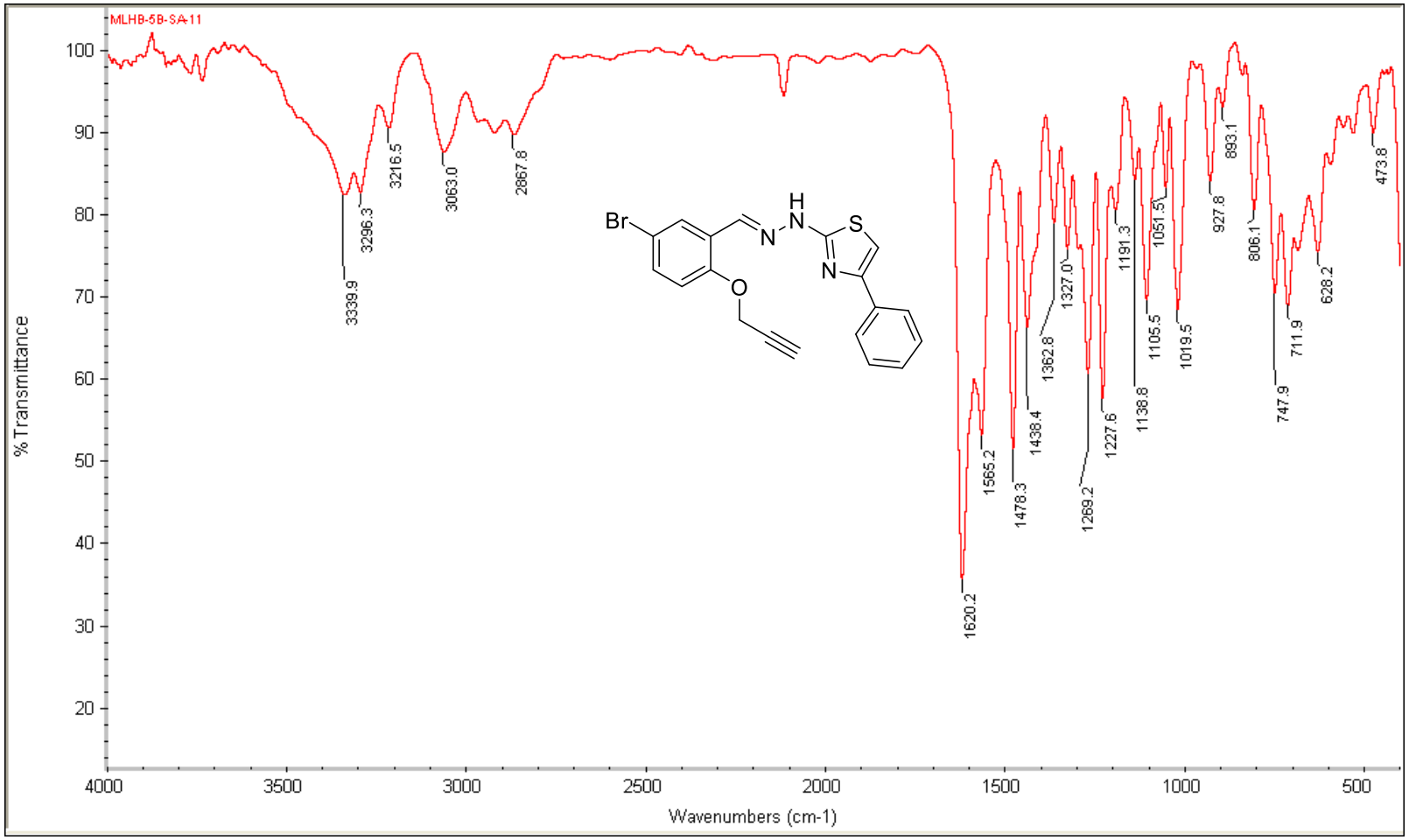
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (25)



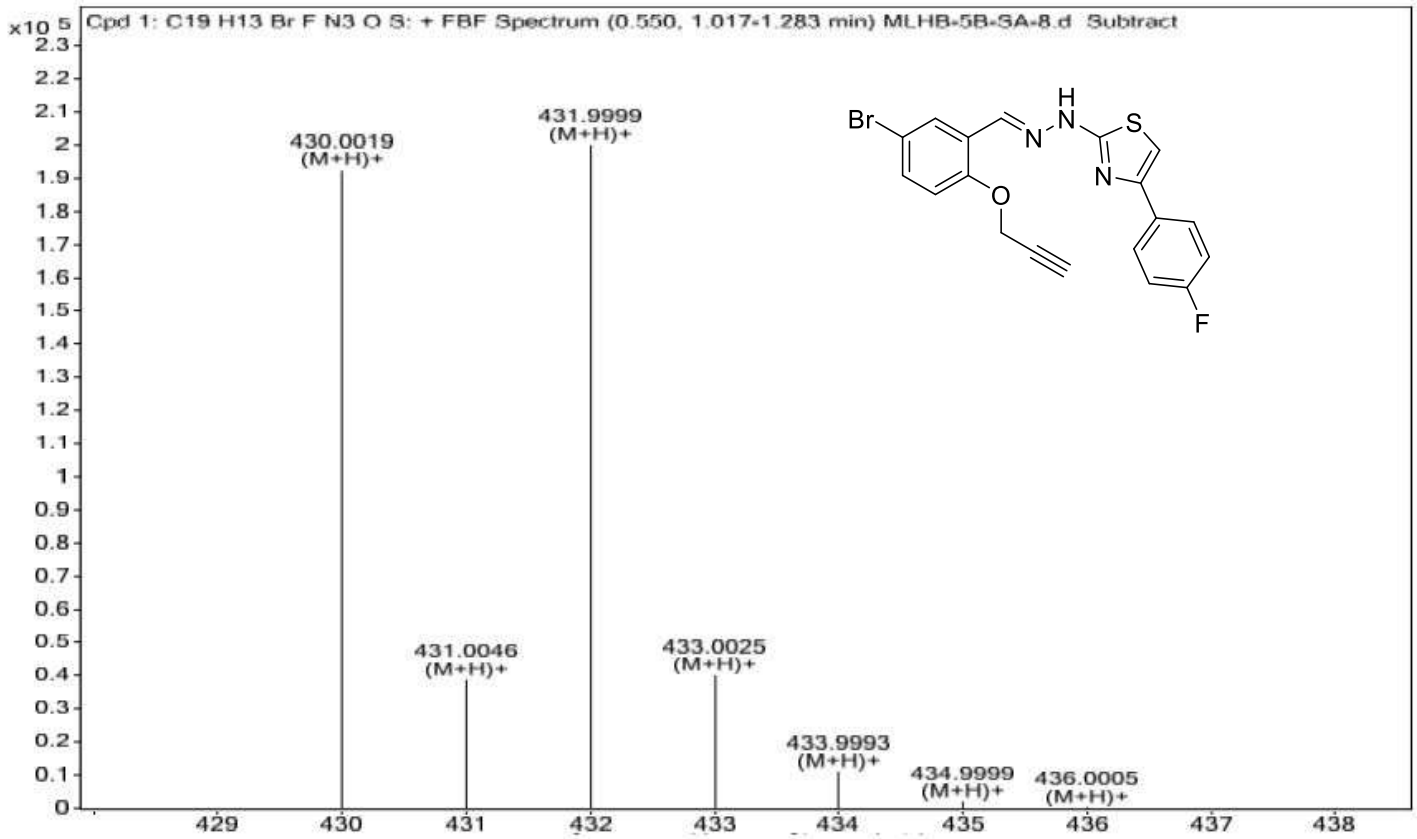
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (25)



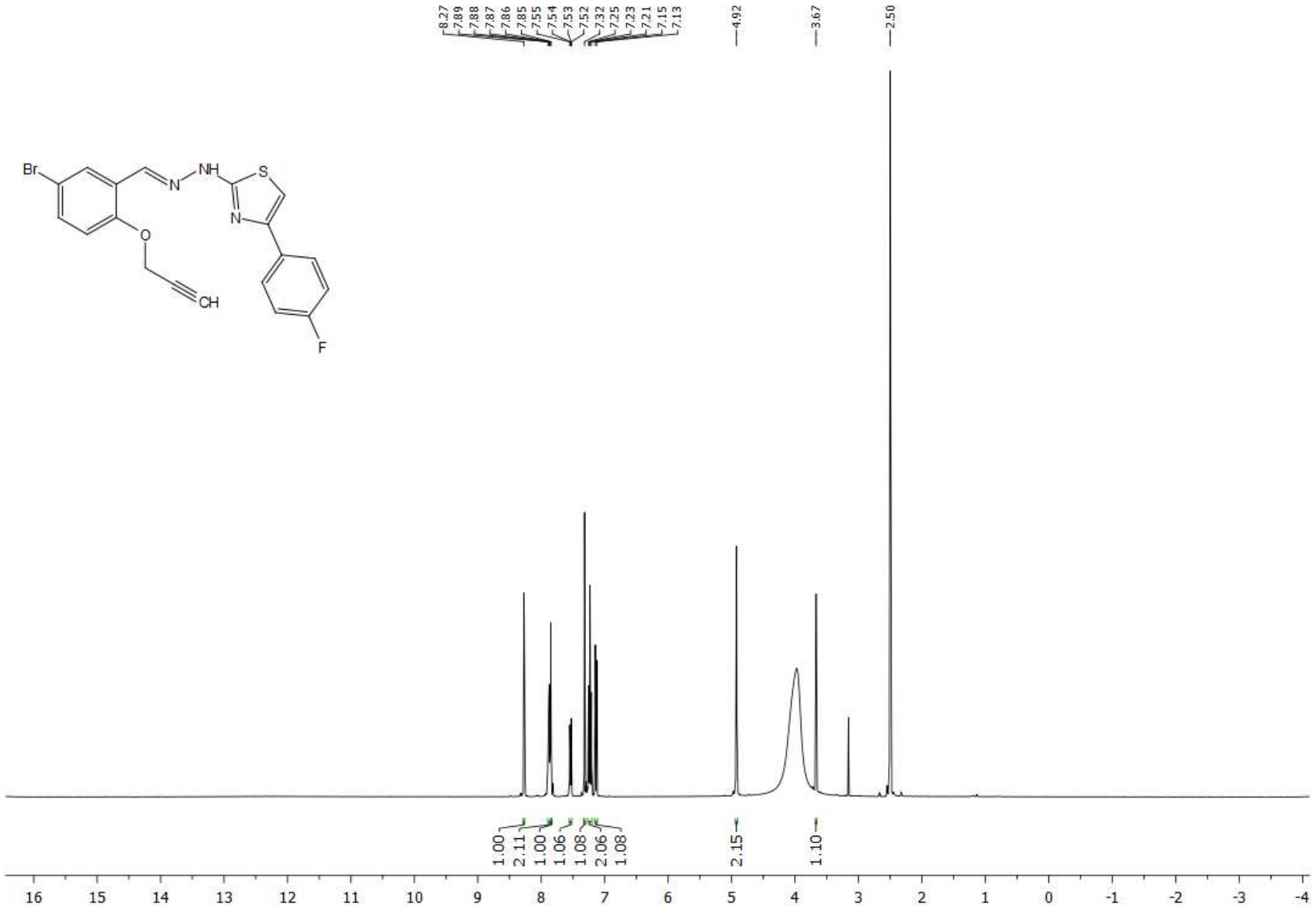
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-phenylthiazole (25)



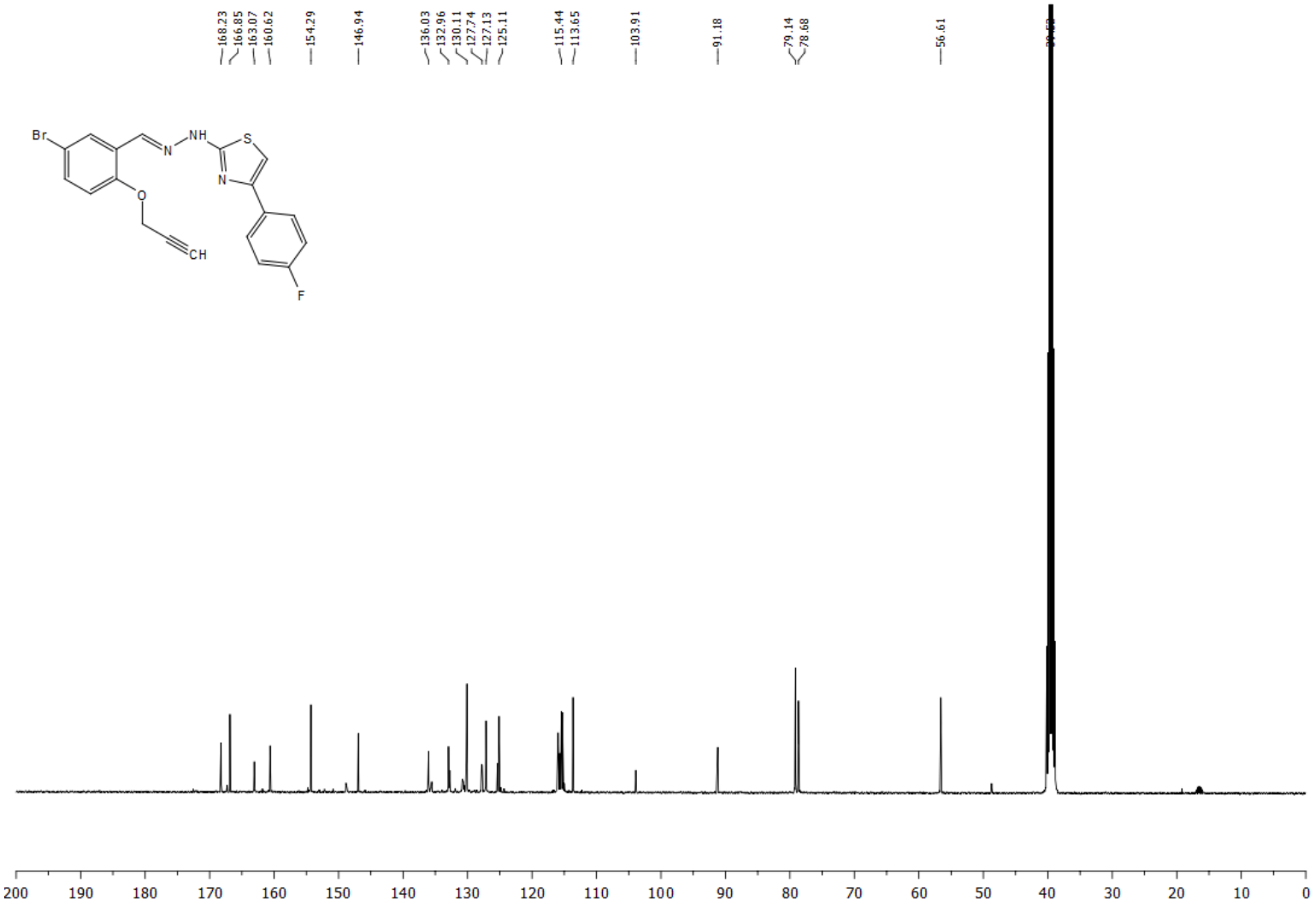
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (26)



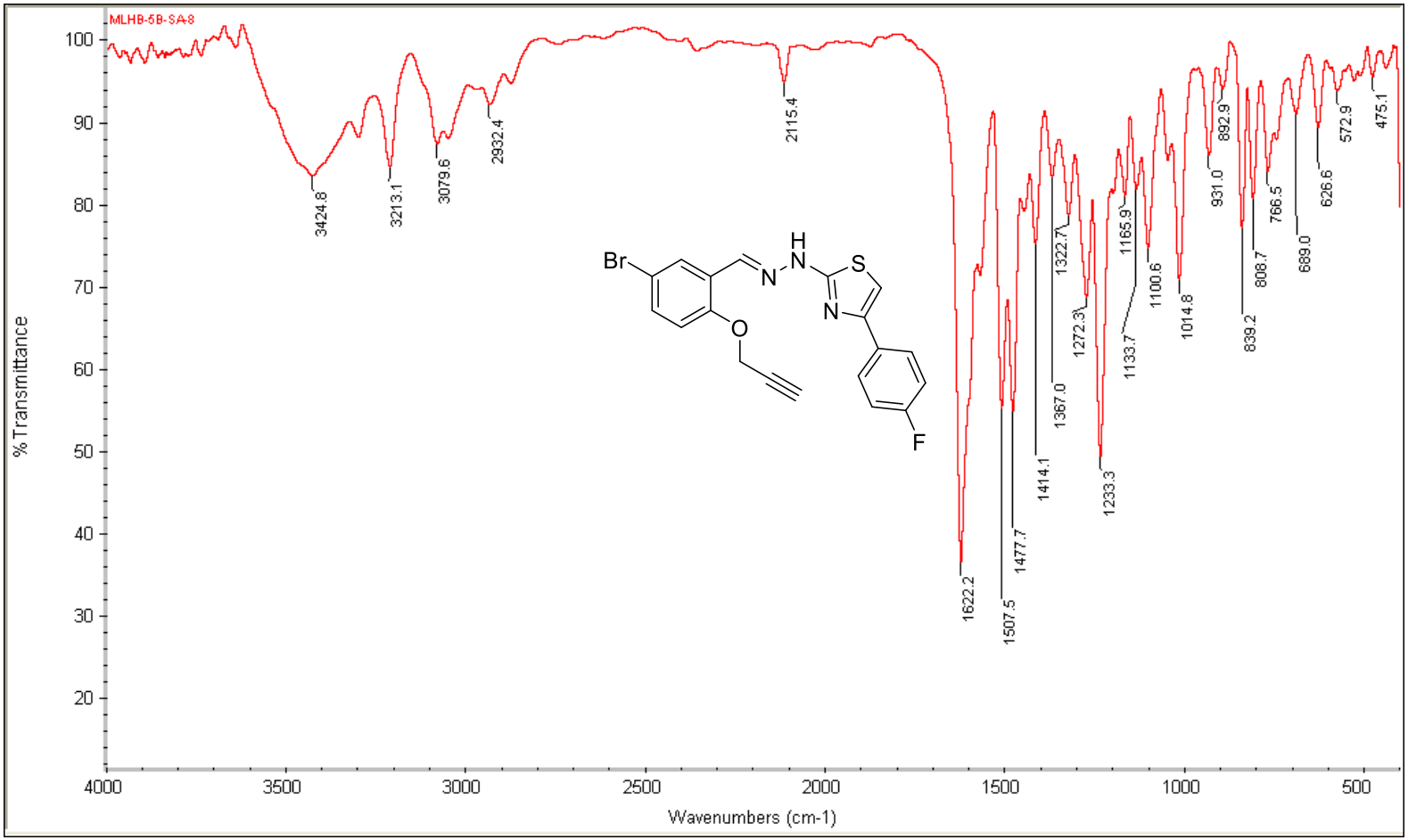
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (26)



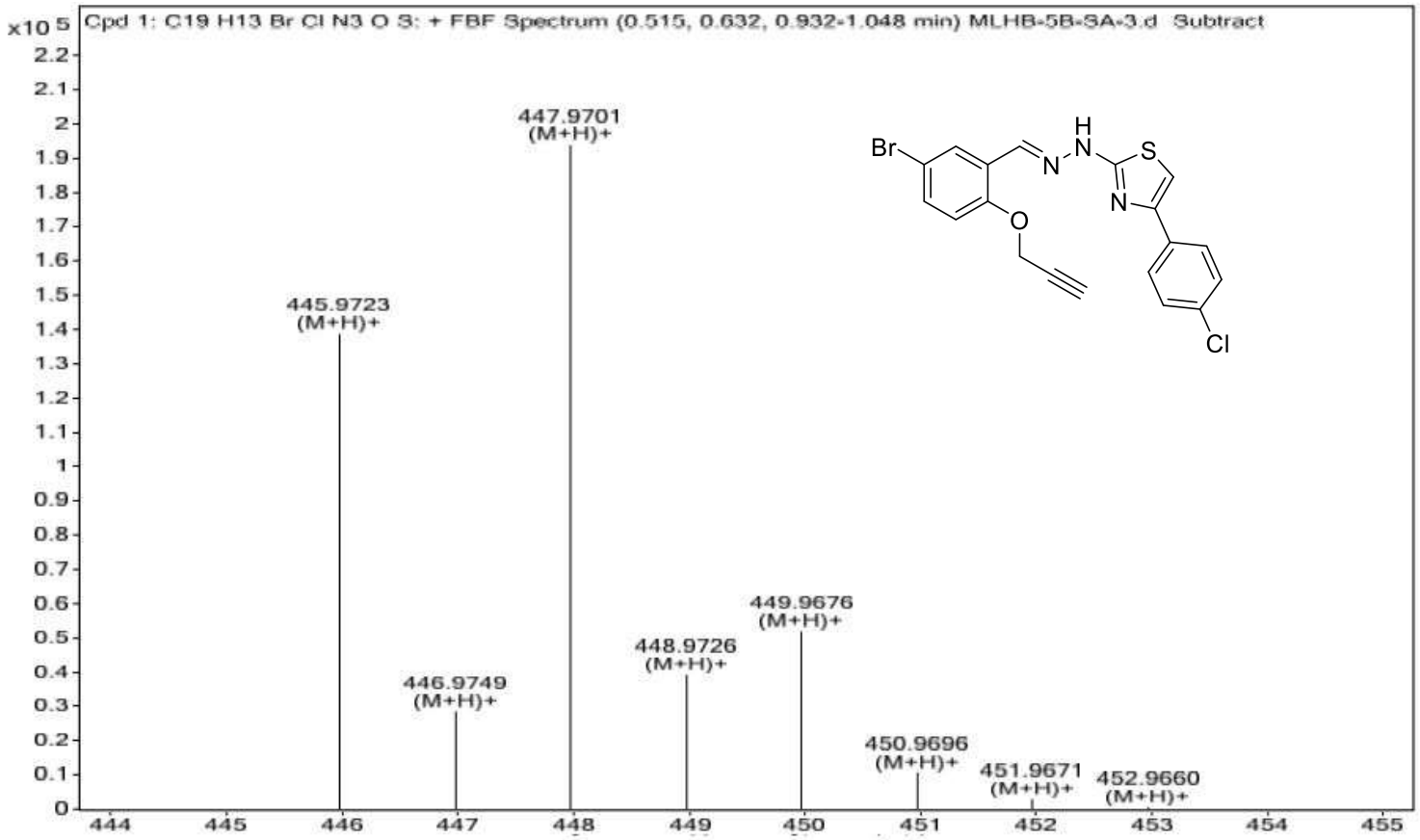
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (26)



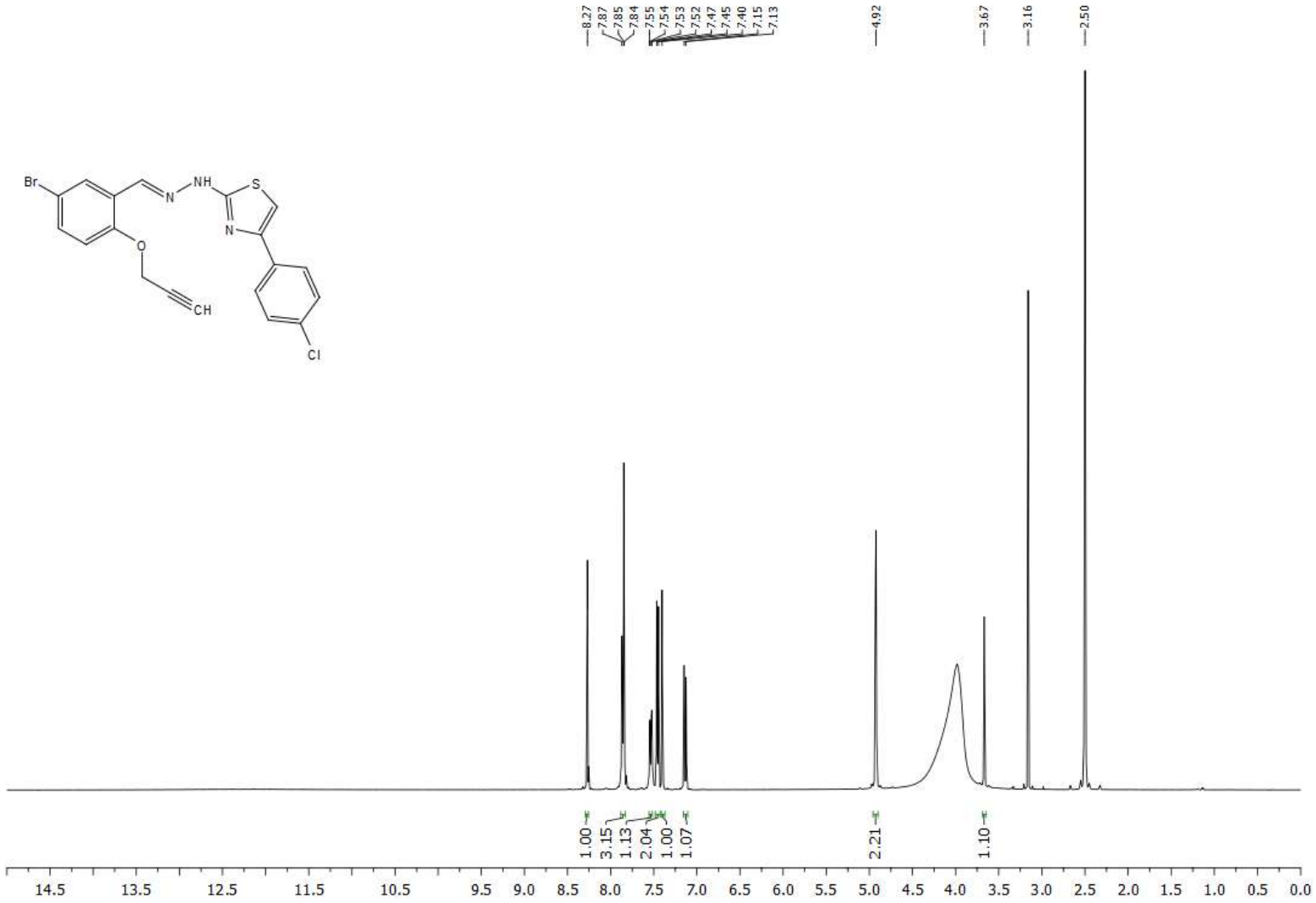
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-fluorophenyl)thiazole (26)



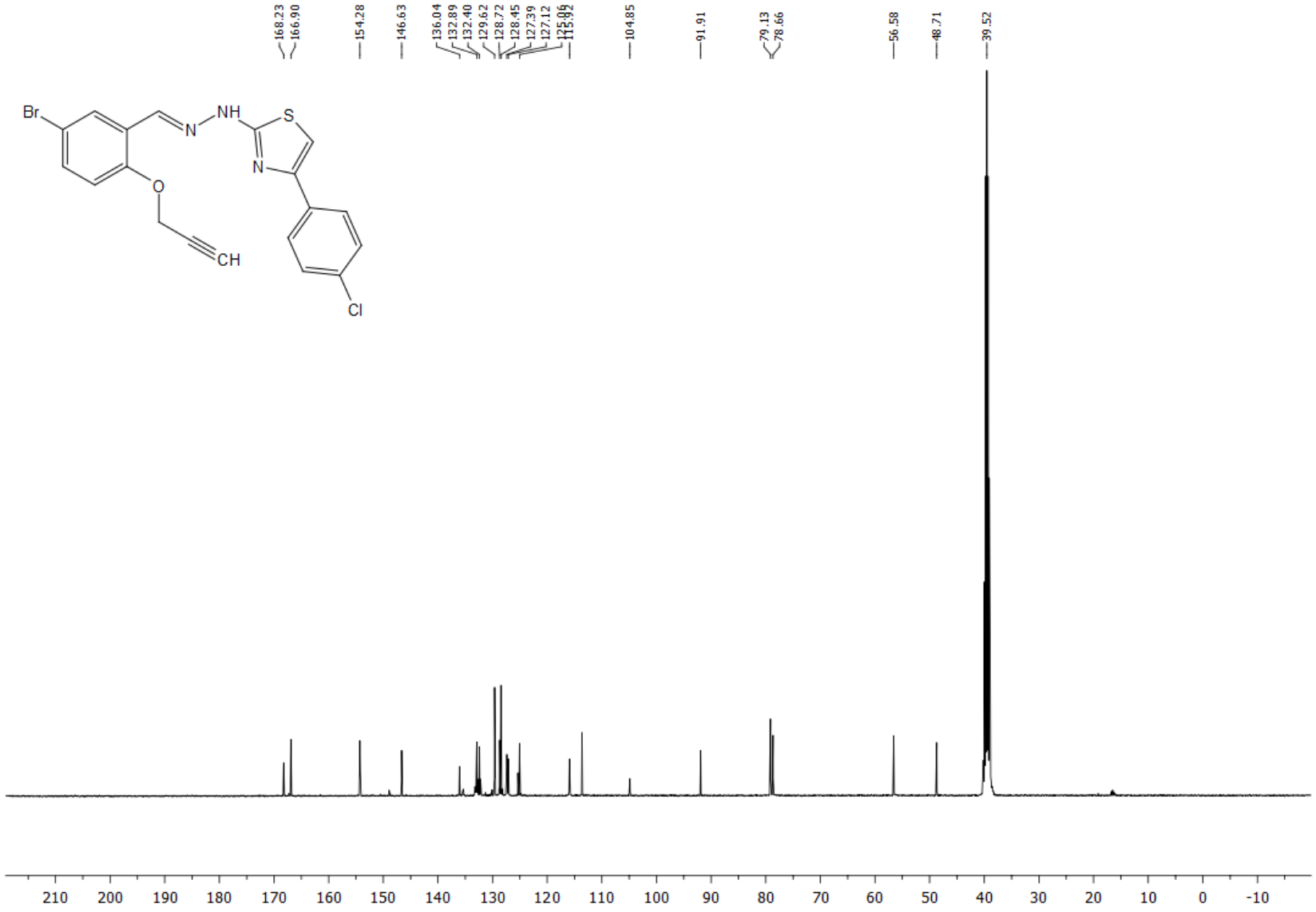
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-chlorophenyl)thiazole (27)



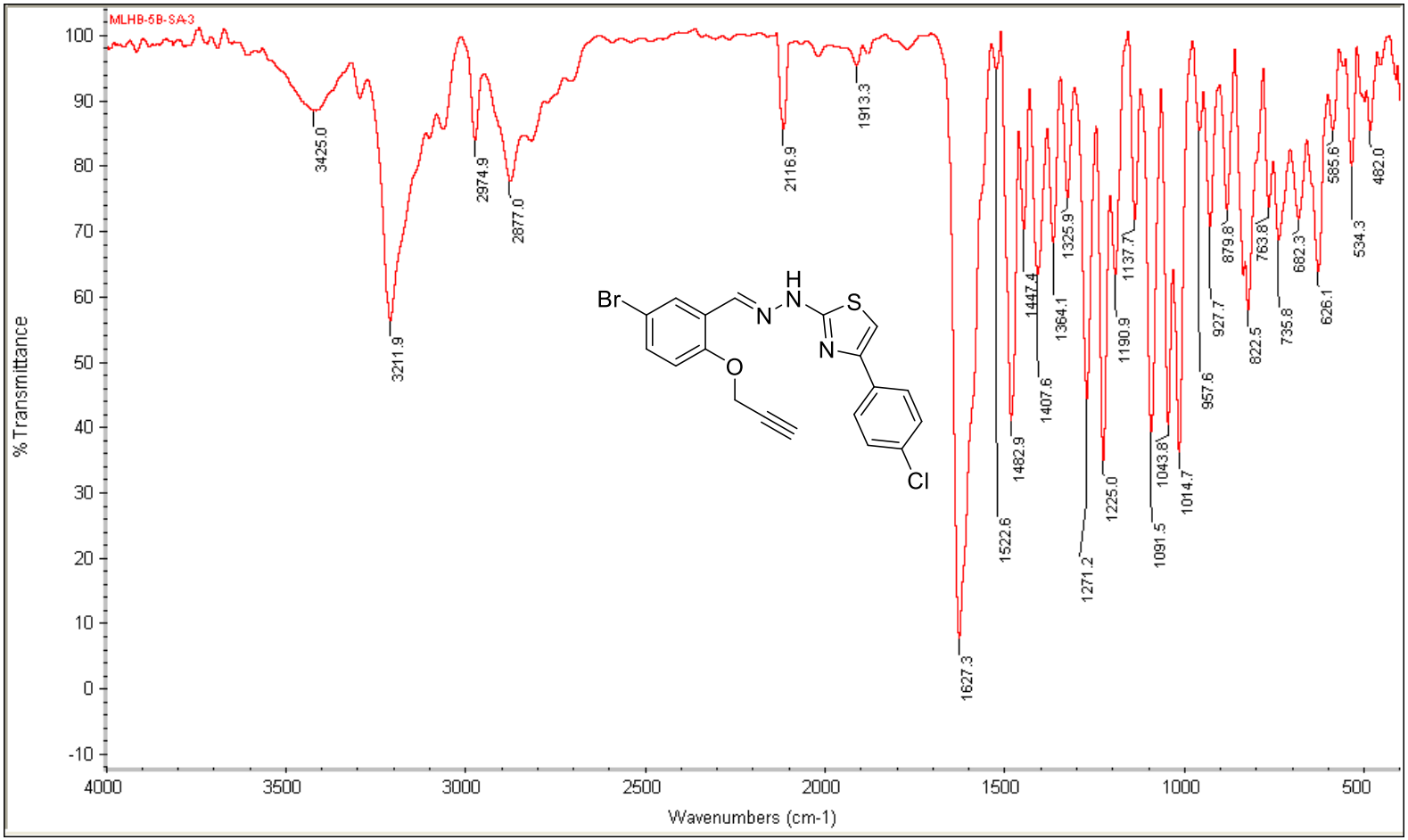
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-chlorophenyl)thiazole (27)



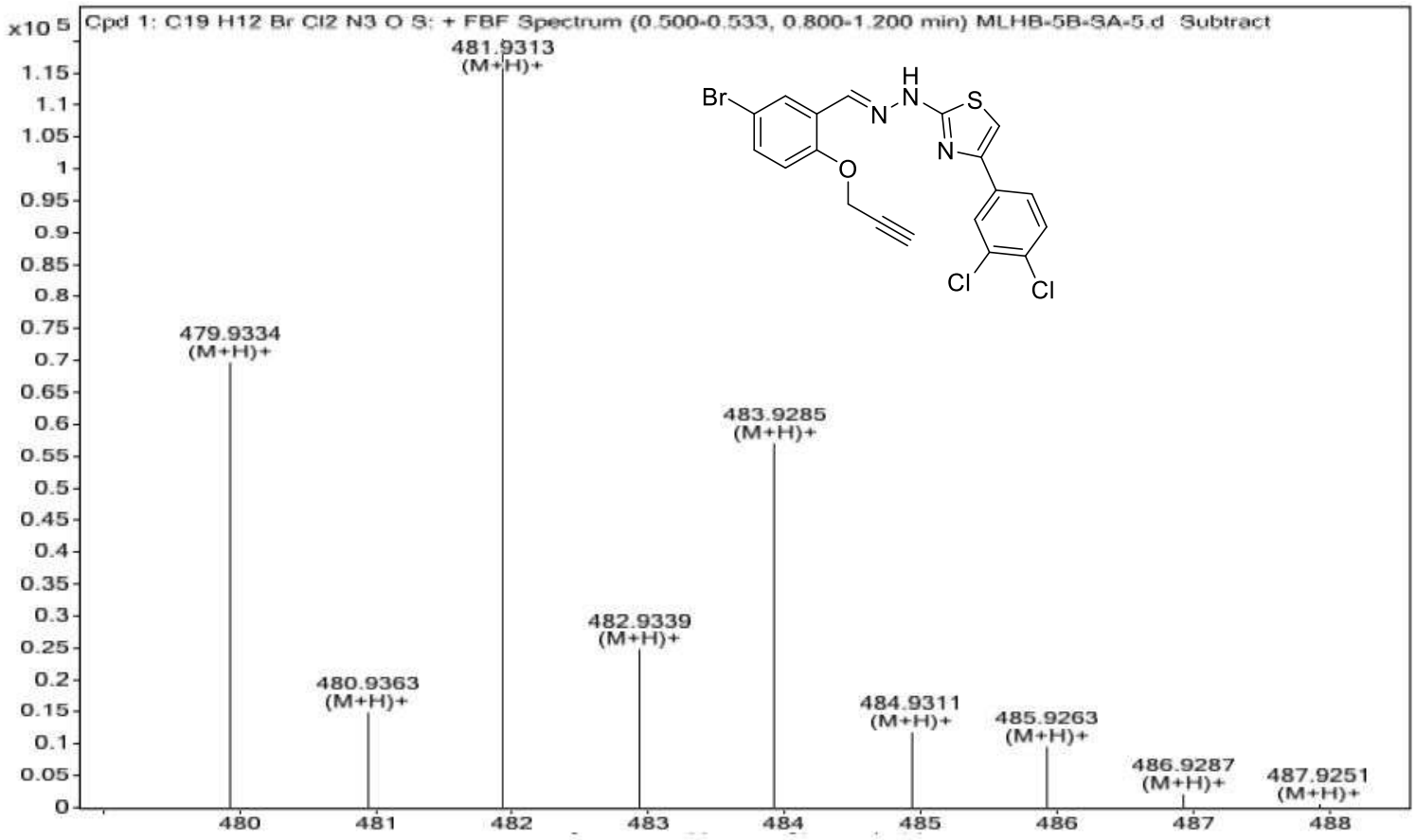
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-chlorophenyl)thiazole (27)



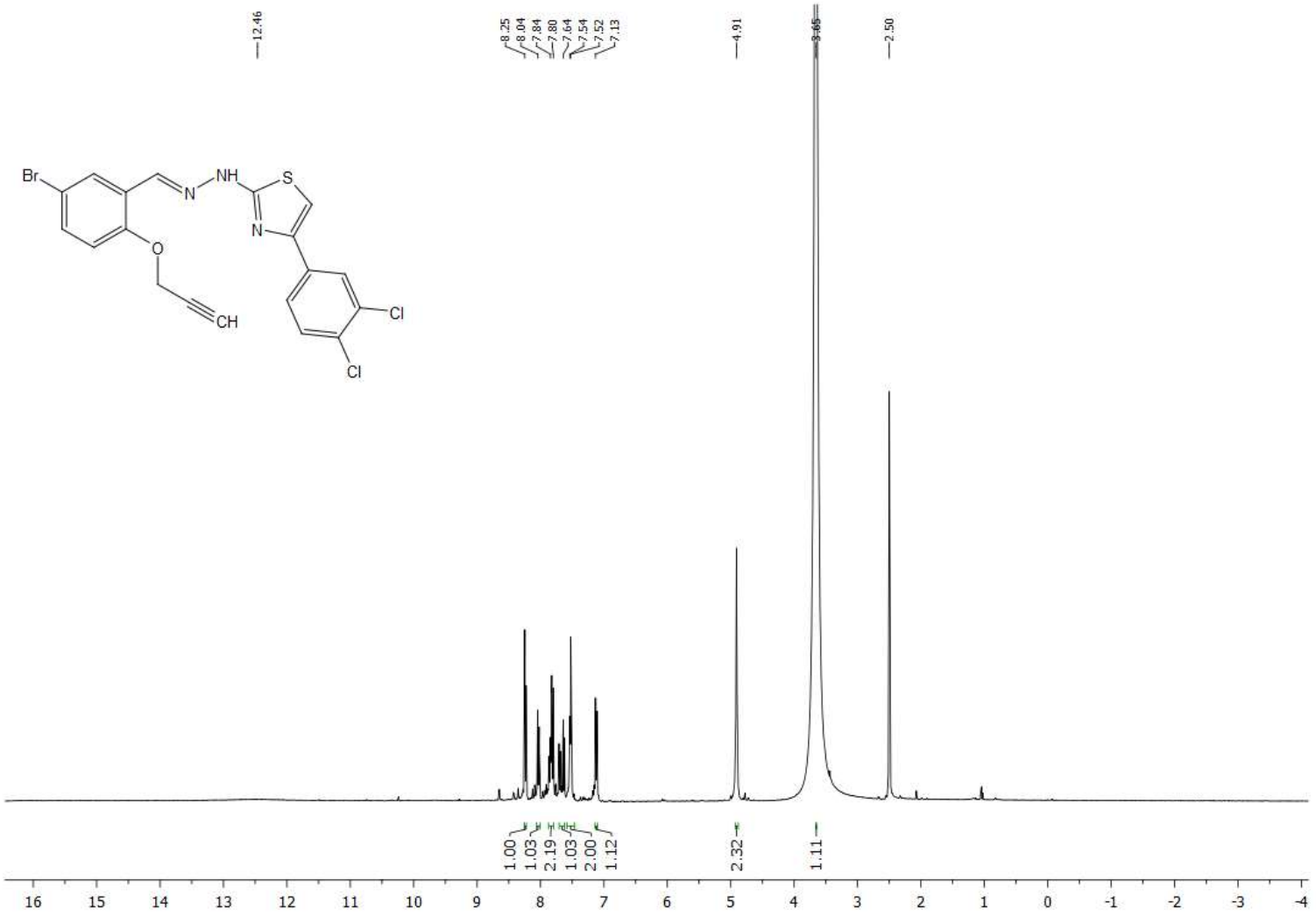
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-chlorophenyl)thiazole (27)



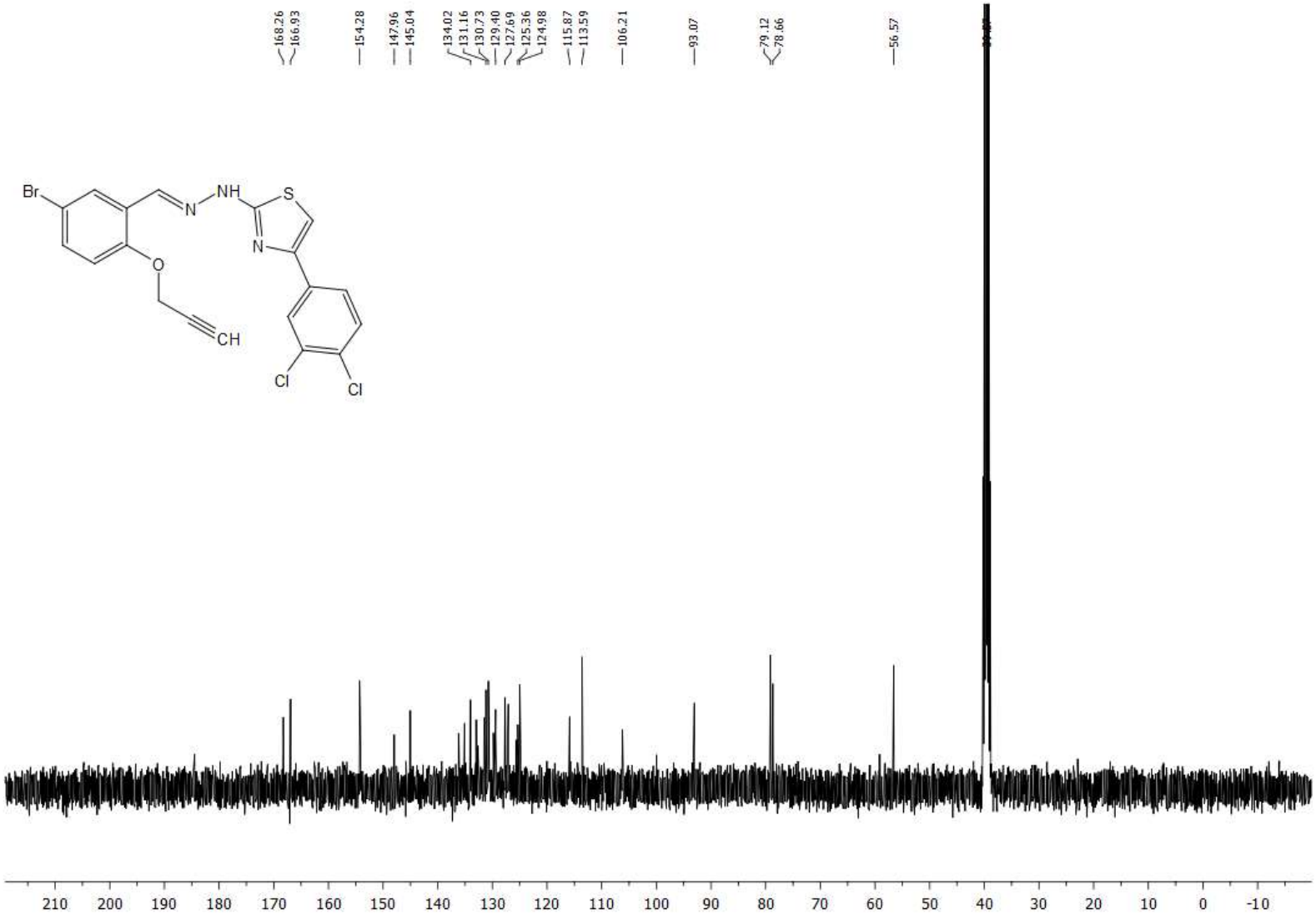
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(3,4-dichlorophenyl)thiazole (28)



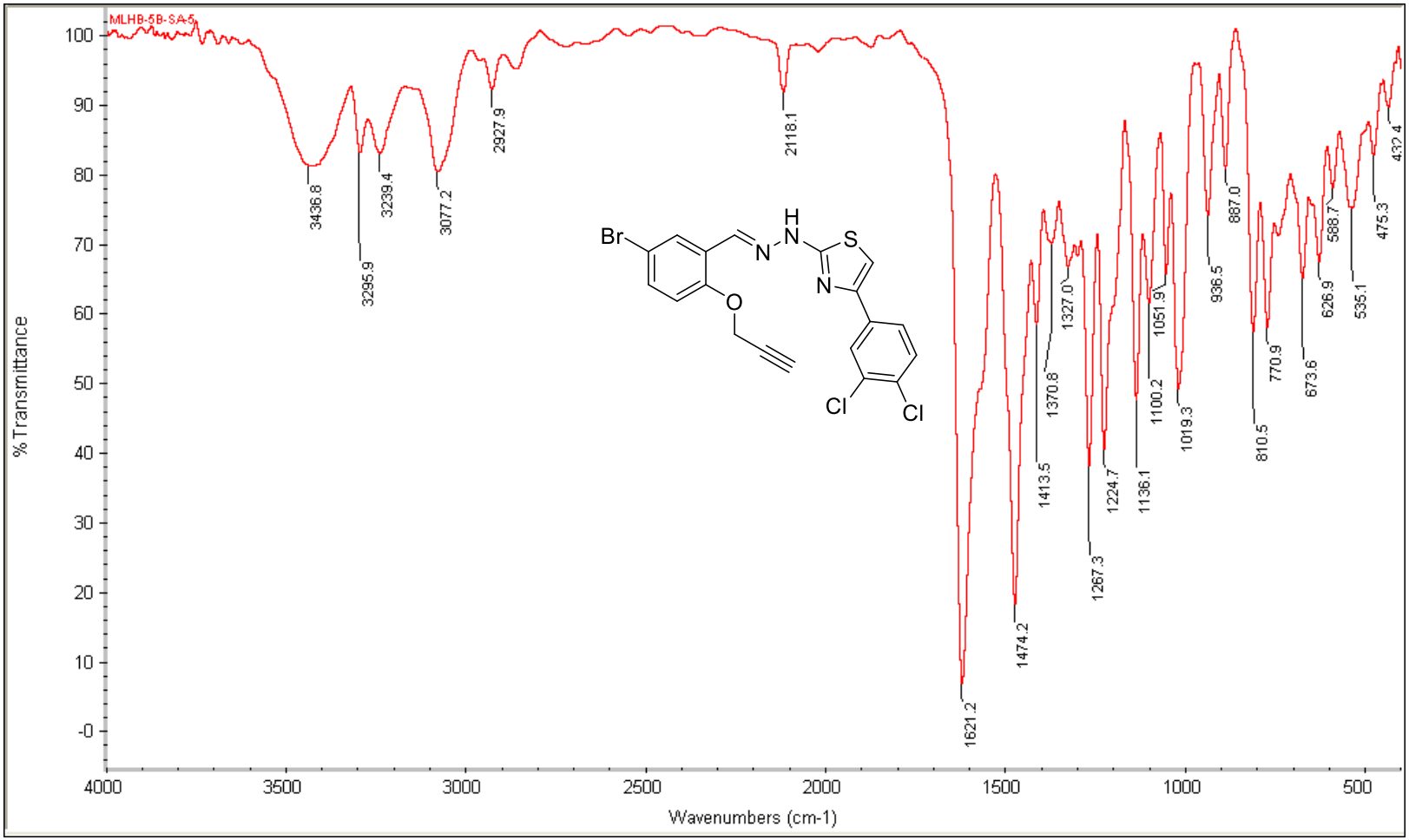
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(3,4-dichlorophenyl)thiazole (28)



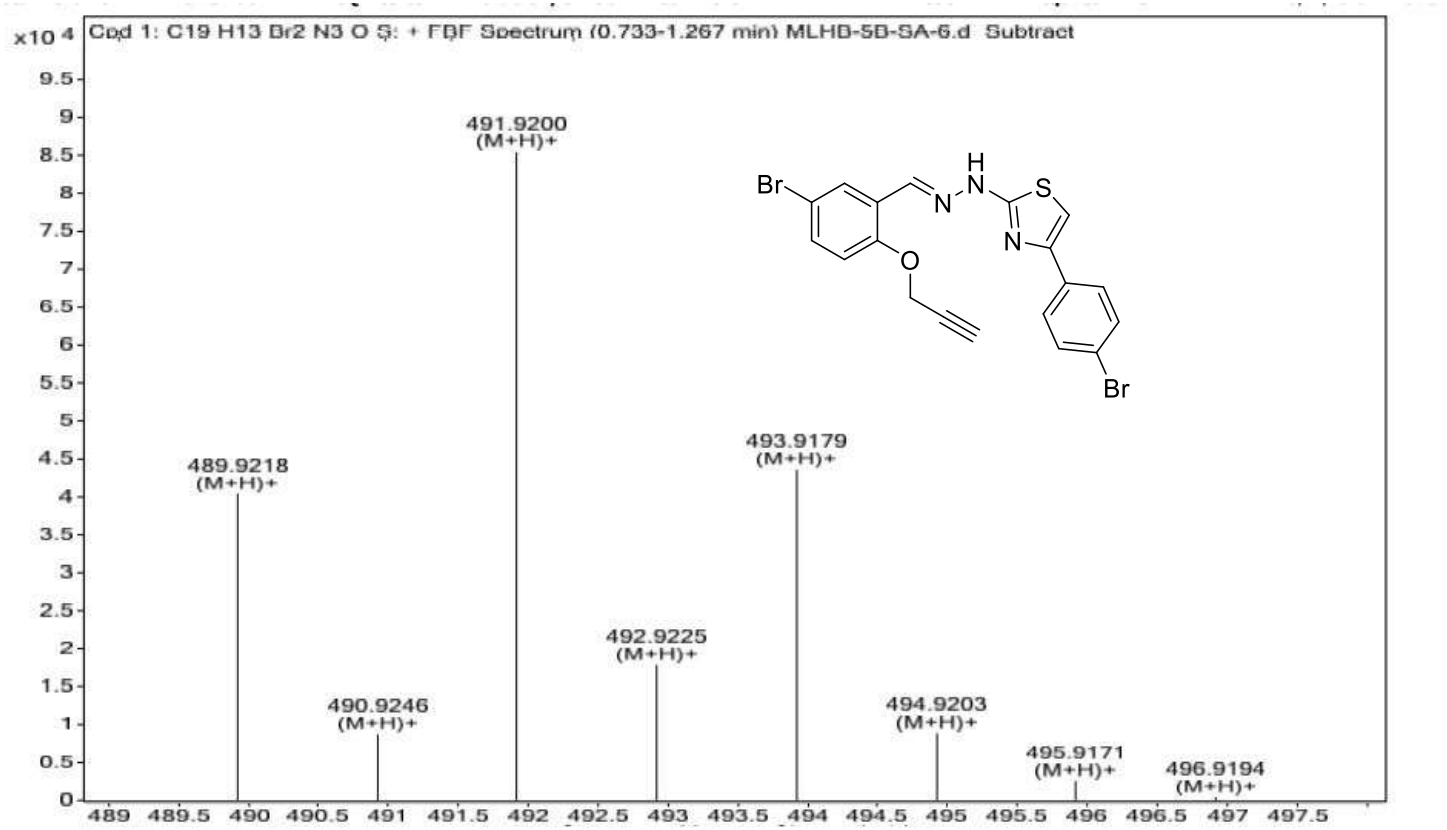
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(3,4-dichlorophenyl)thiazole (28)



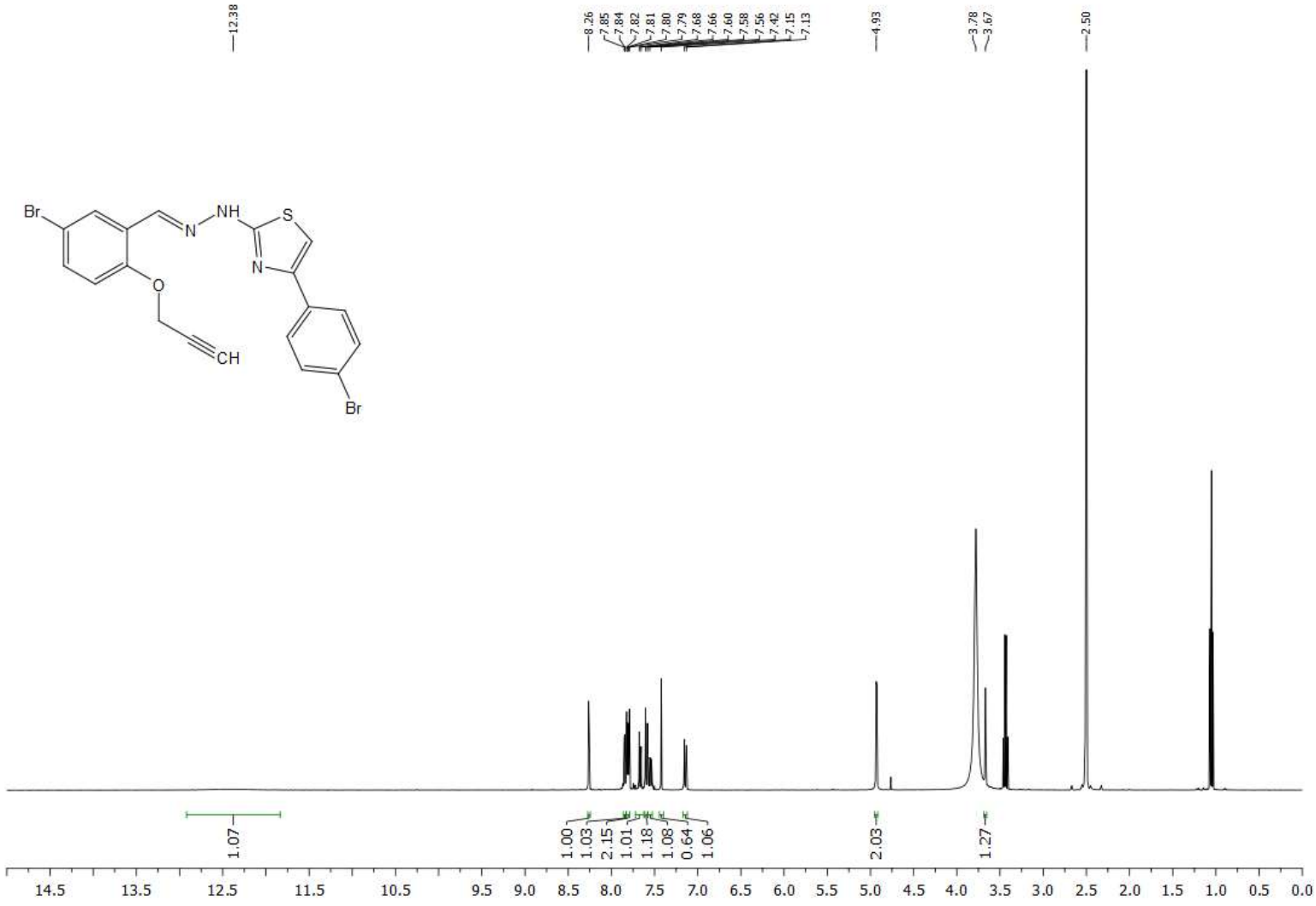
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(3,4-dichlorophenyl)thiazole (28)



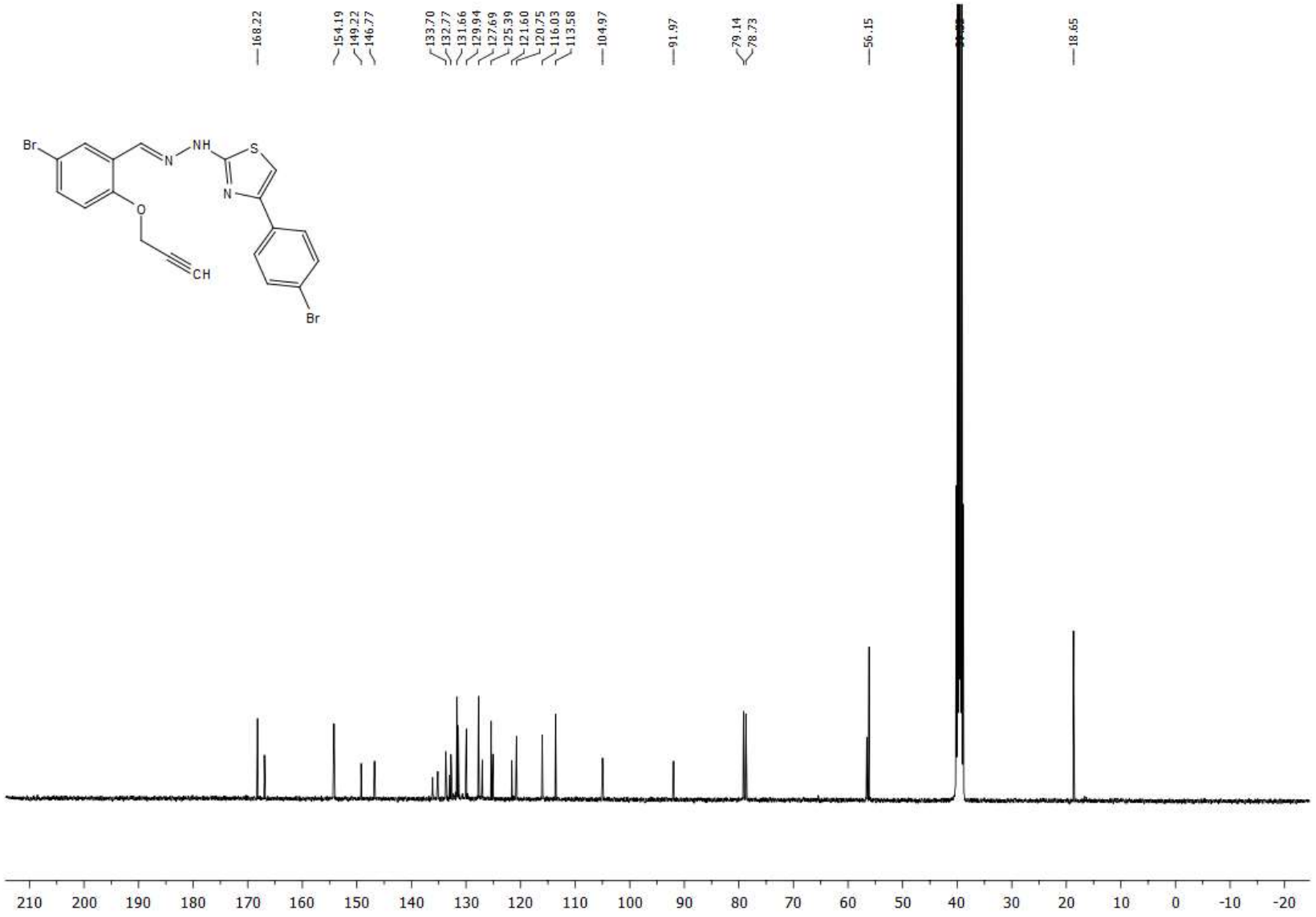
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-bromophenyl)thiazole (29)



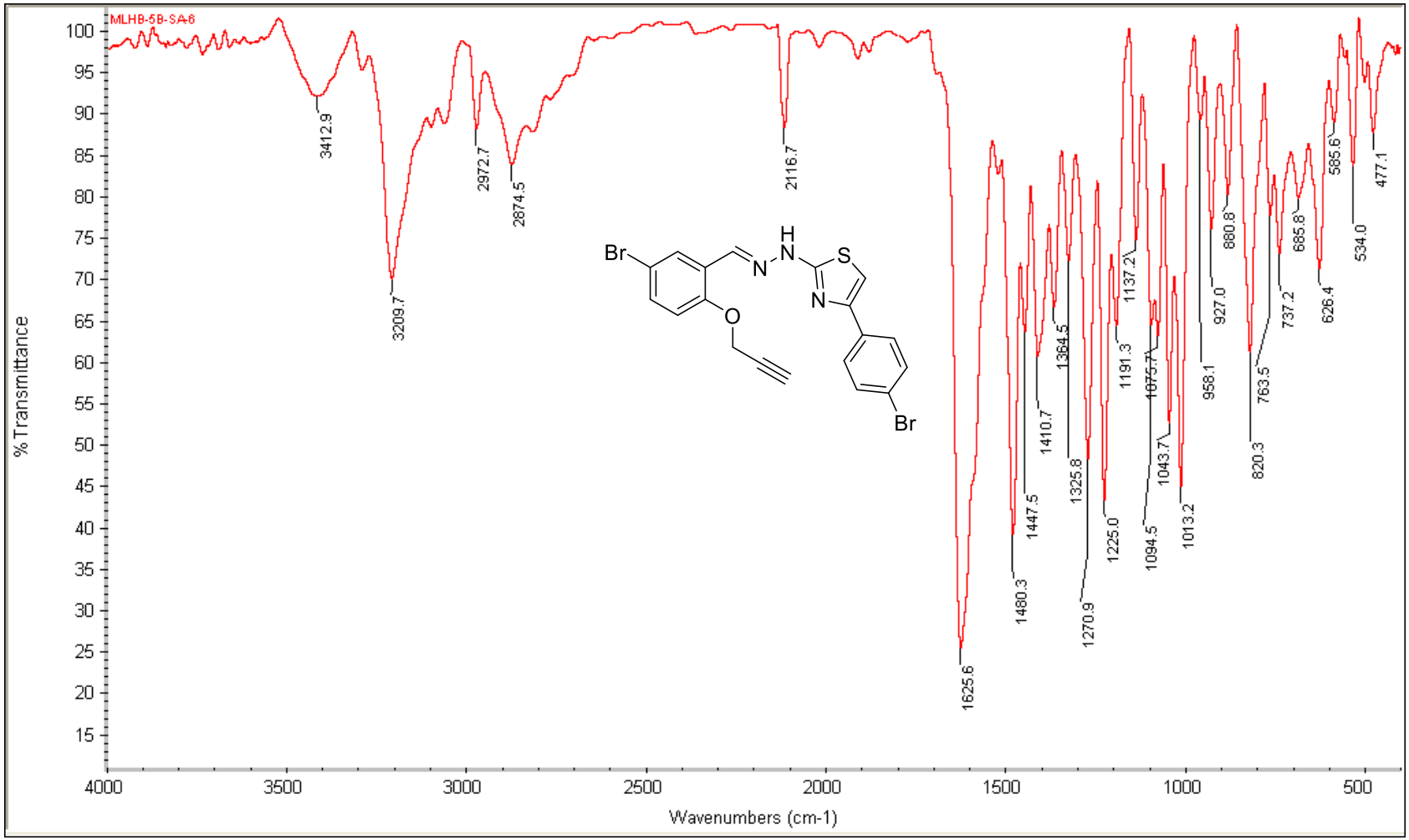
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-bromophenyl)thiazole (29)



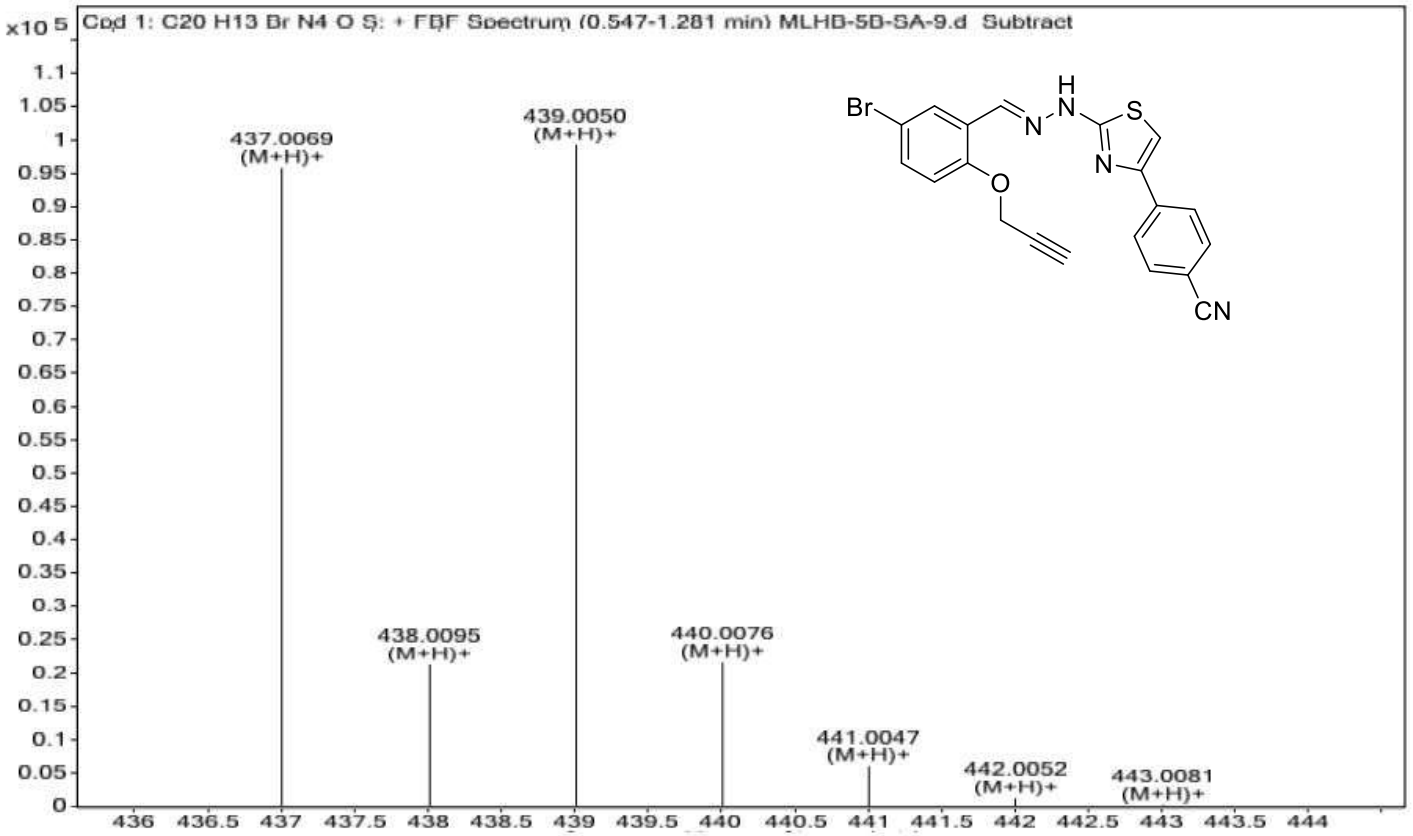
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-bromophenyl)thiazole (29)



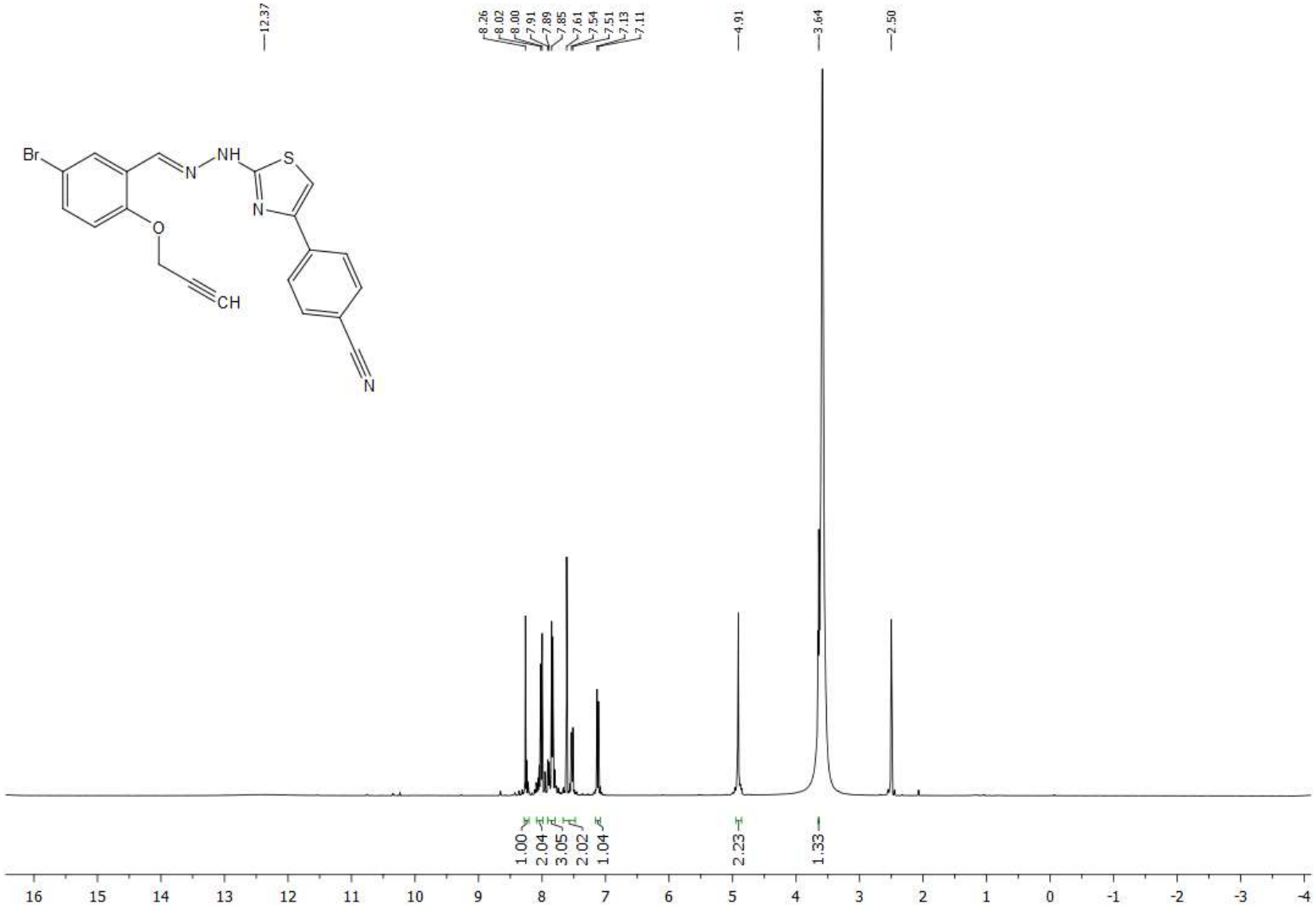
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-bromophenyl)thiazole (29)



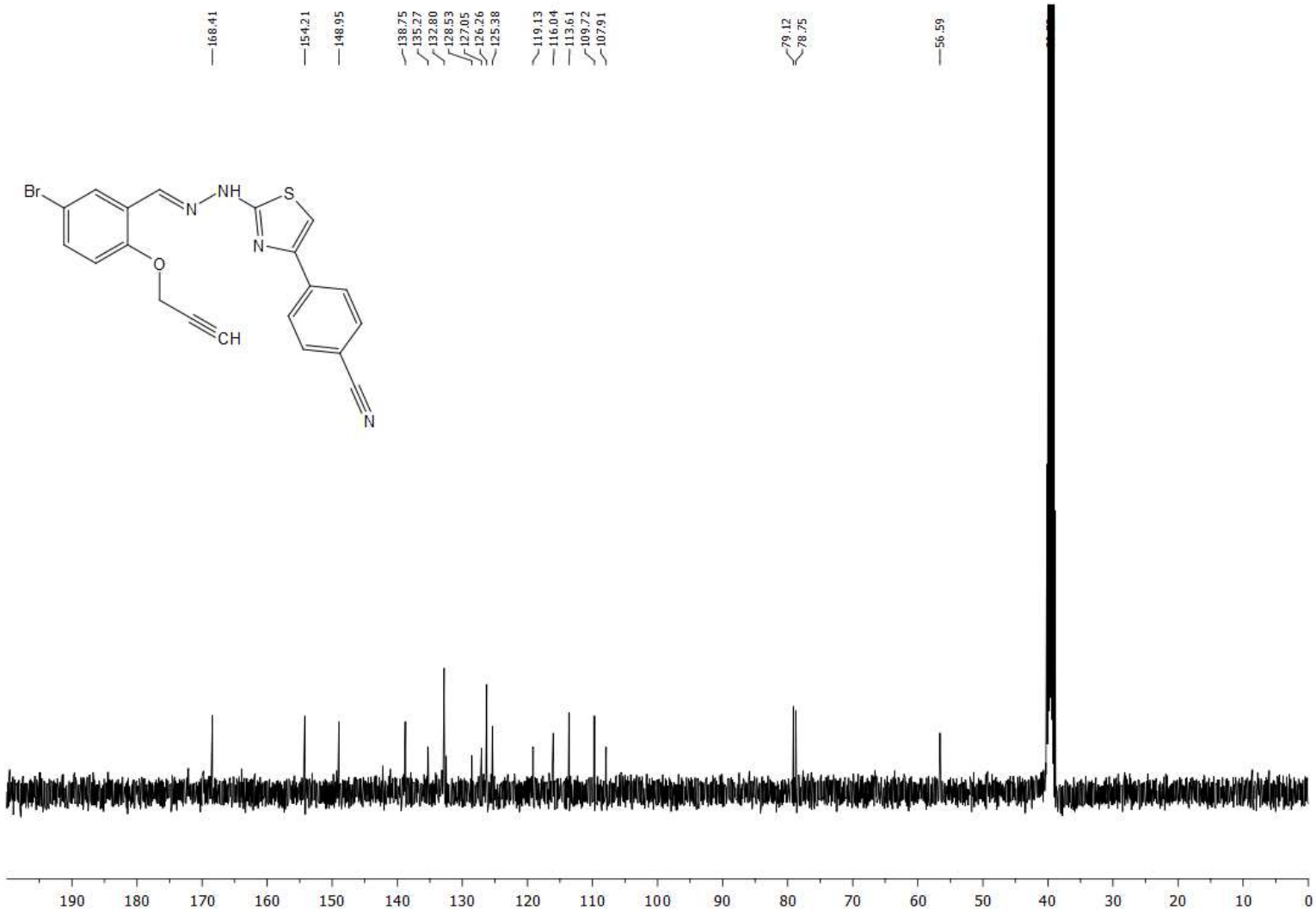
Mass spectrum of (*E*)-4-(2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (30)



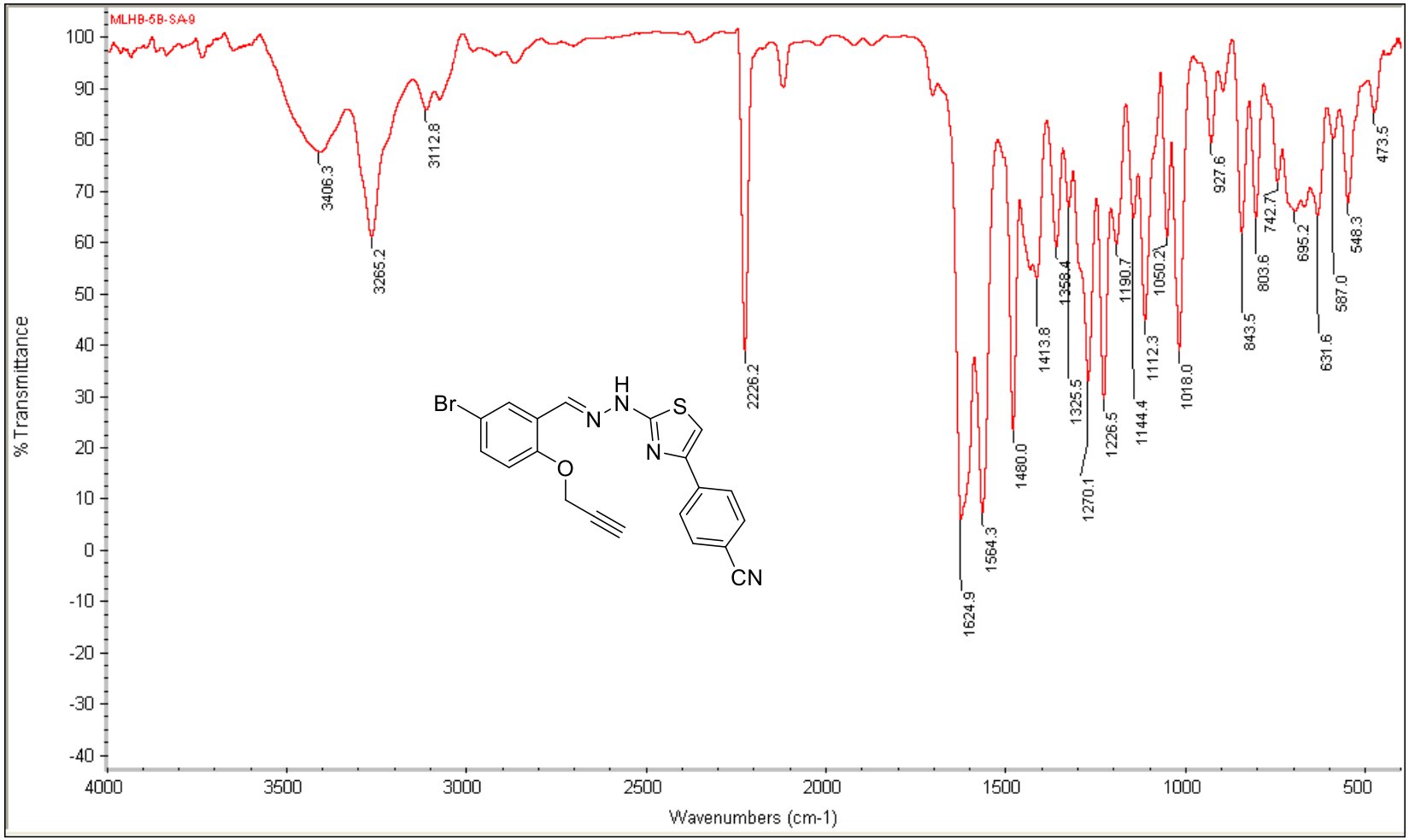
^{1}H NMR spectrum of (*E*)-4-(2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (30)



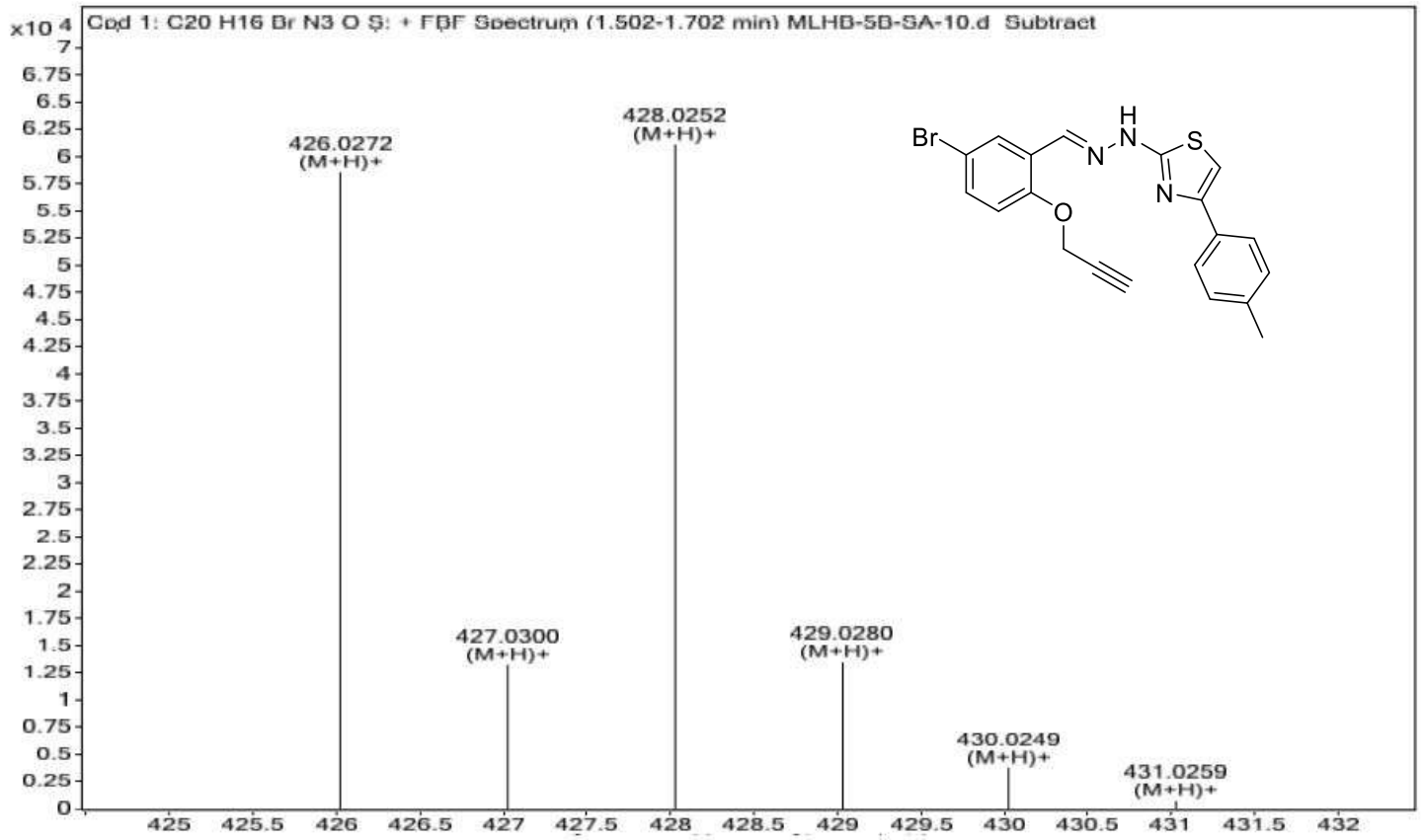
^{13}C NMR spectrum of (*E*)-4-(2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (30)



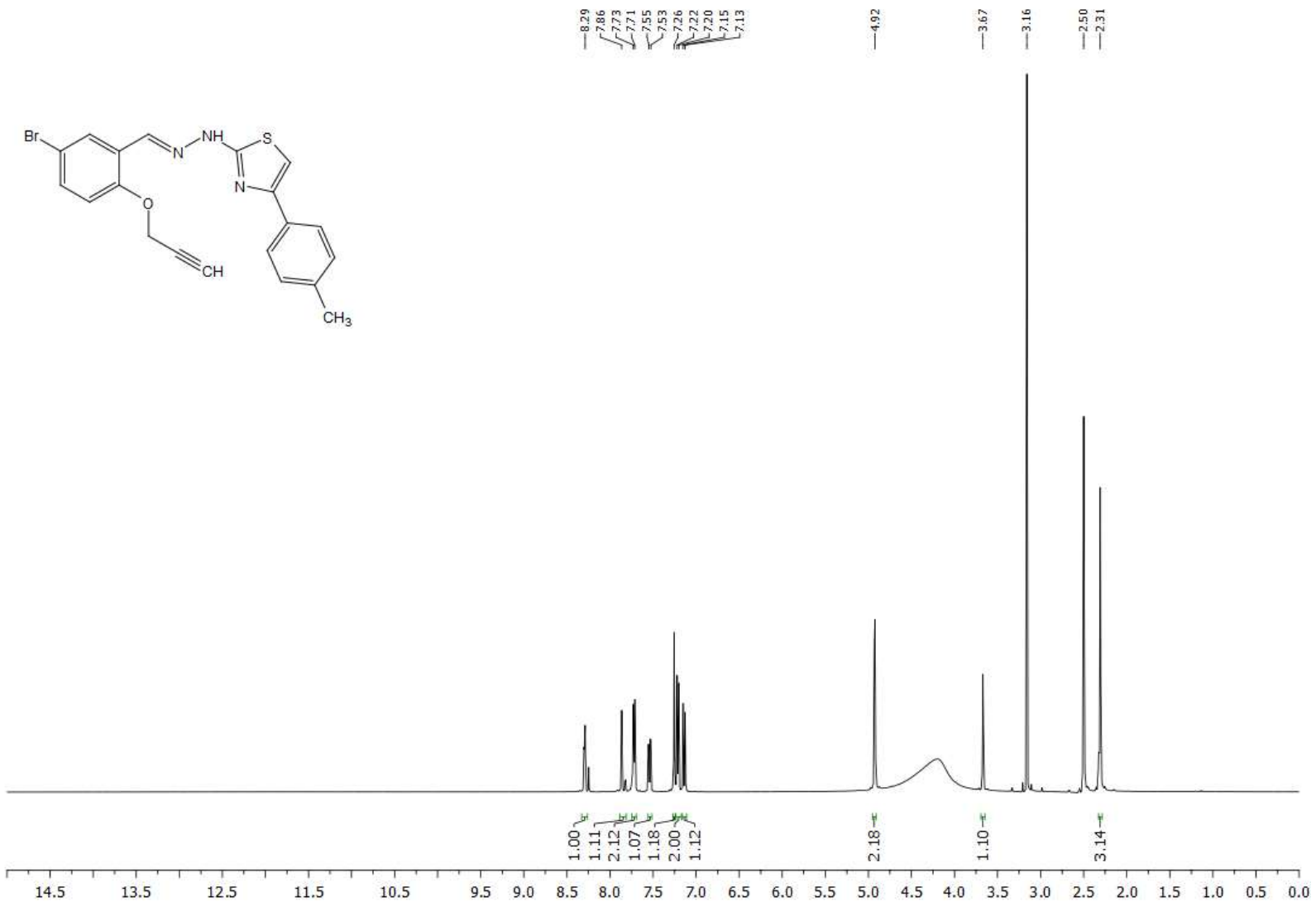
FT-IR spectrum of (*E*)-4-(2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)thiazol-4-yl)benzonitrile (30)



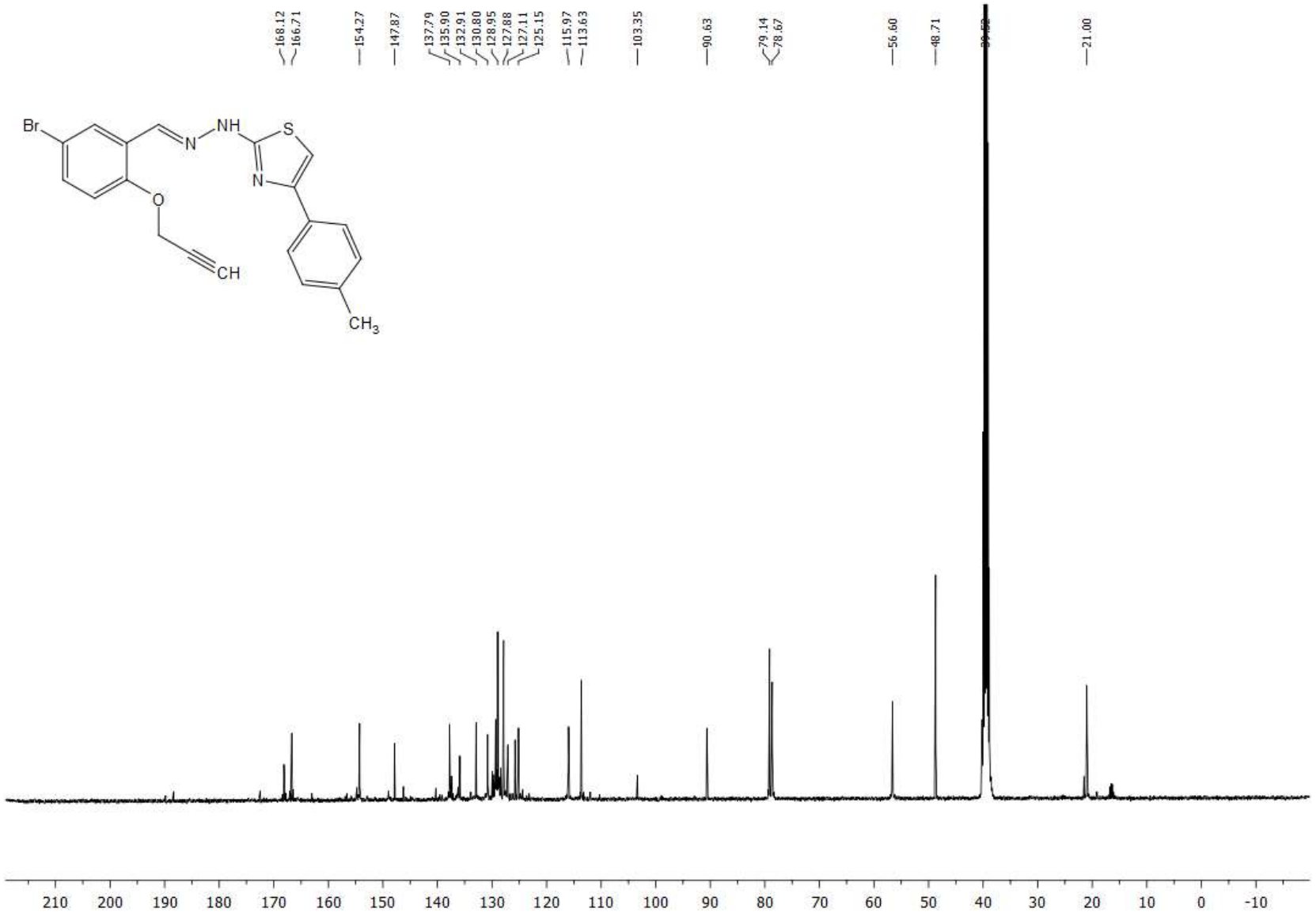
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (31)



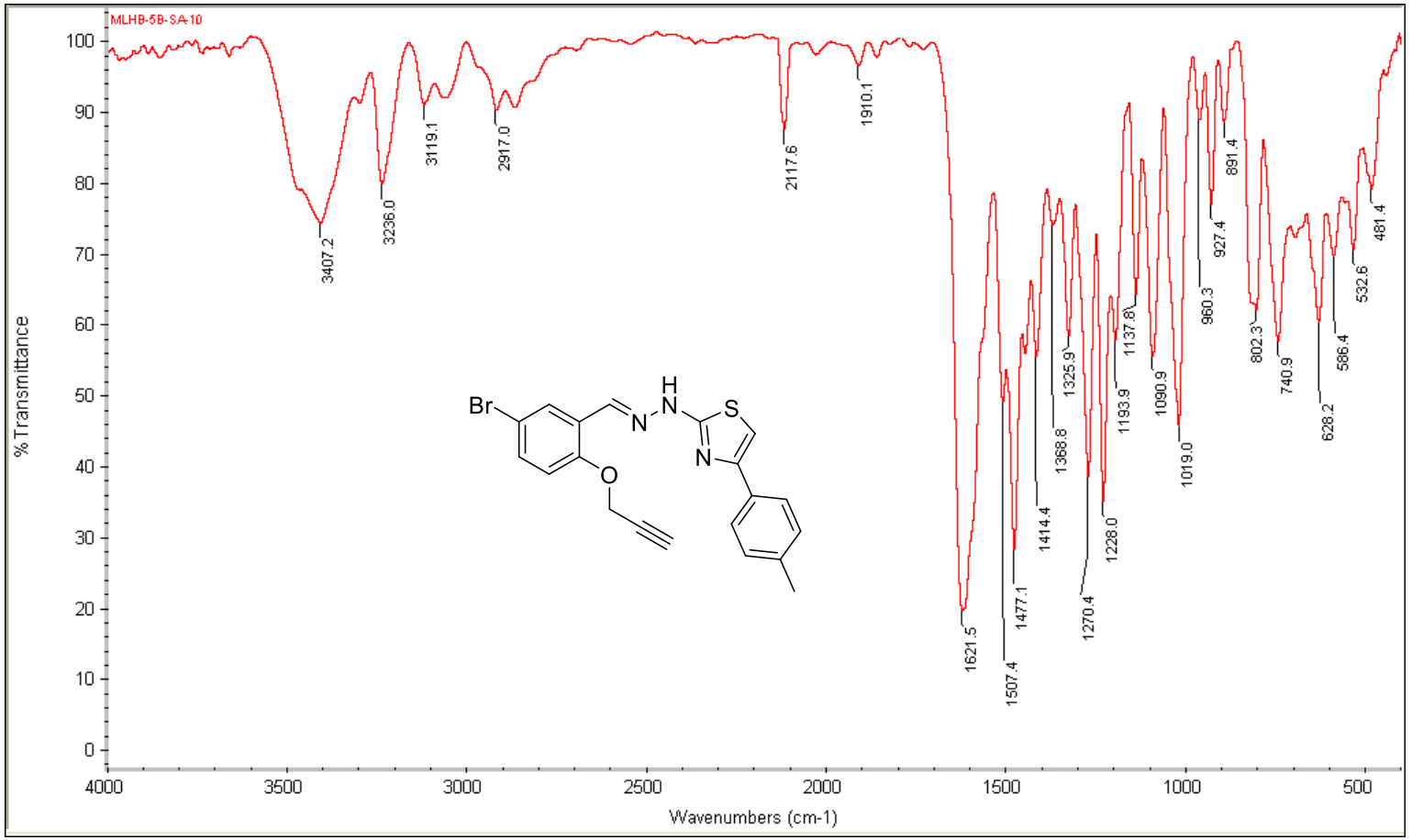
^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (31)



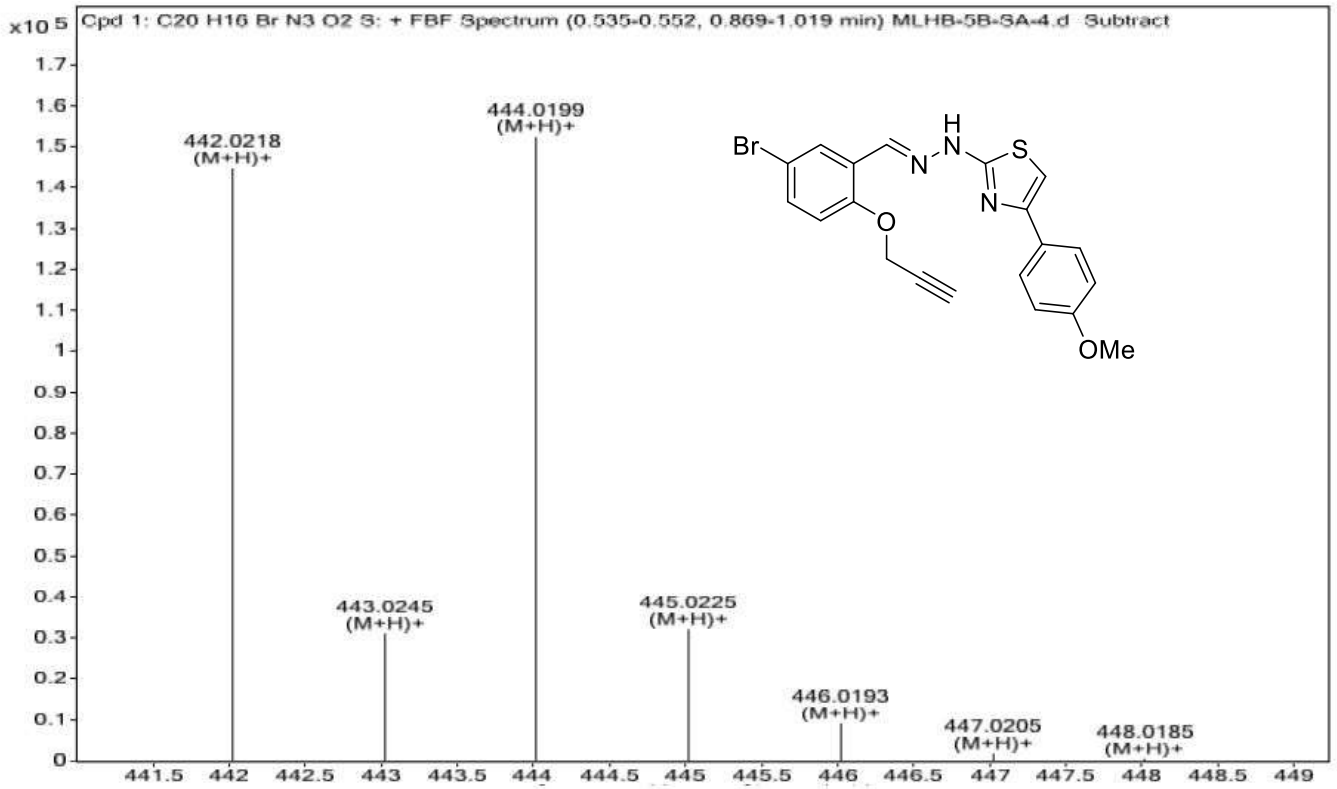
^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (31)



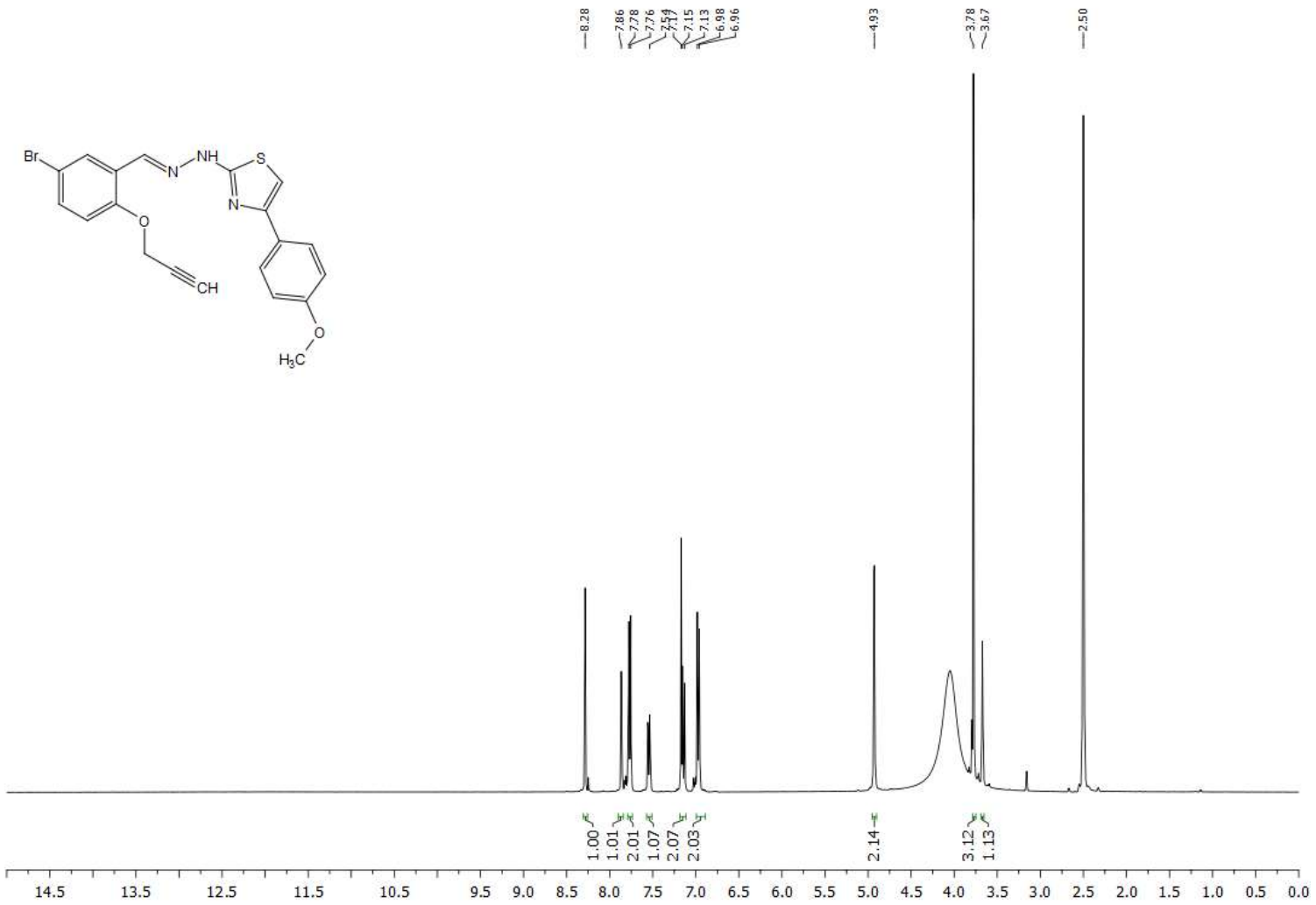
FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(p-tolyl)thiazole (31)



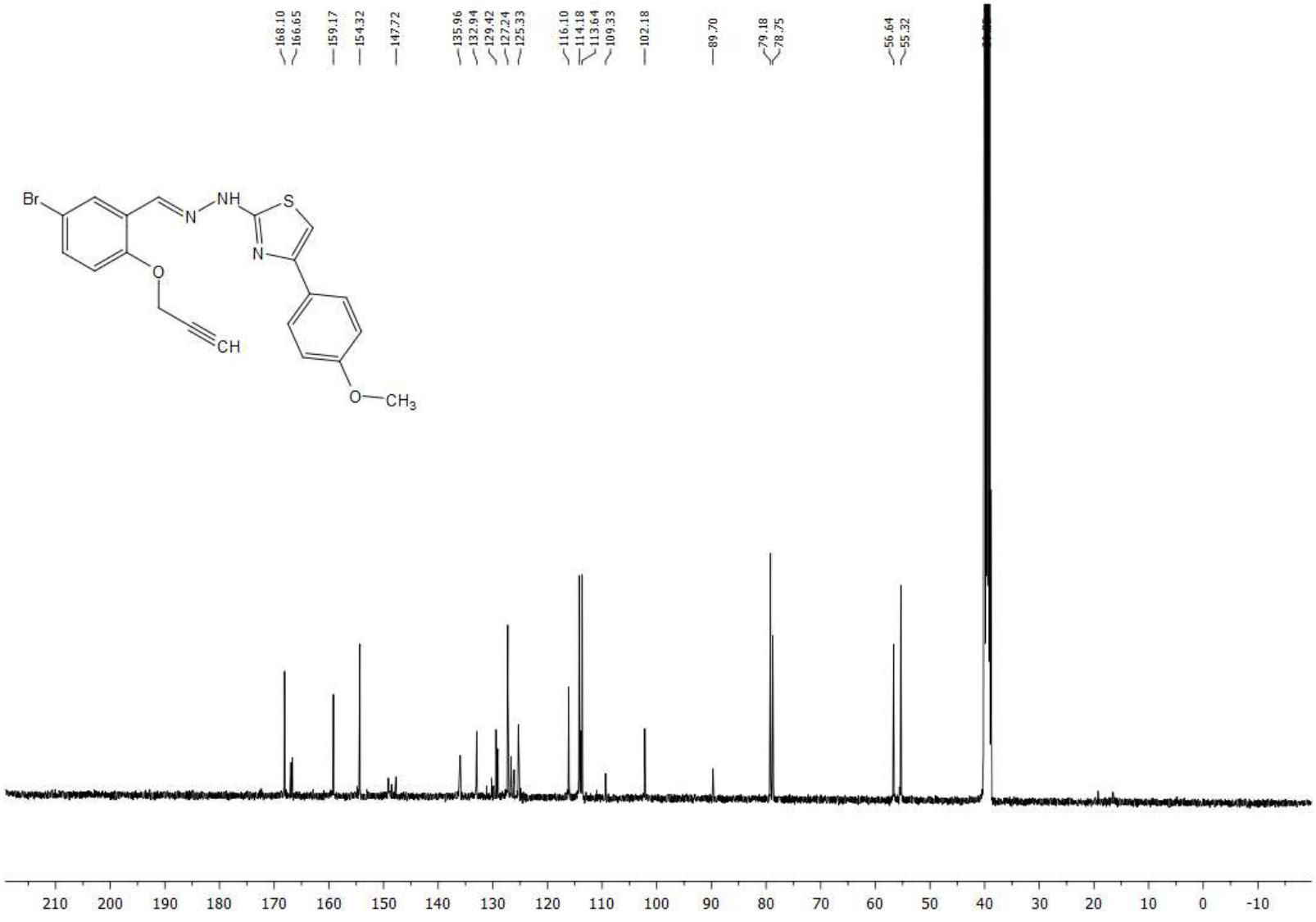
Mass spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (32)



^{1}H NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (32)



^{13}C NMR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (32)



FT-IR spectrum of (*E*)-2-(2-(5-Bromo-2-(prop-2-yn-1-yloxy)benzylidene)hydrazinyl)-4-(4-methoxyphenyl)thiazole (32)

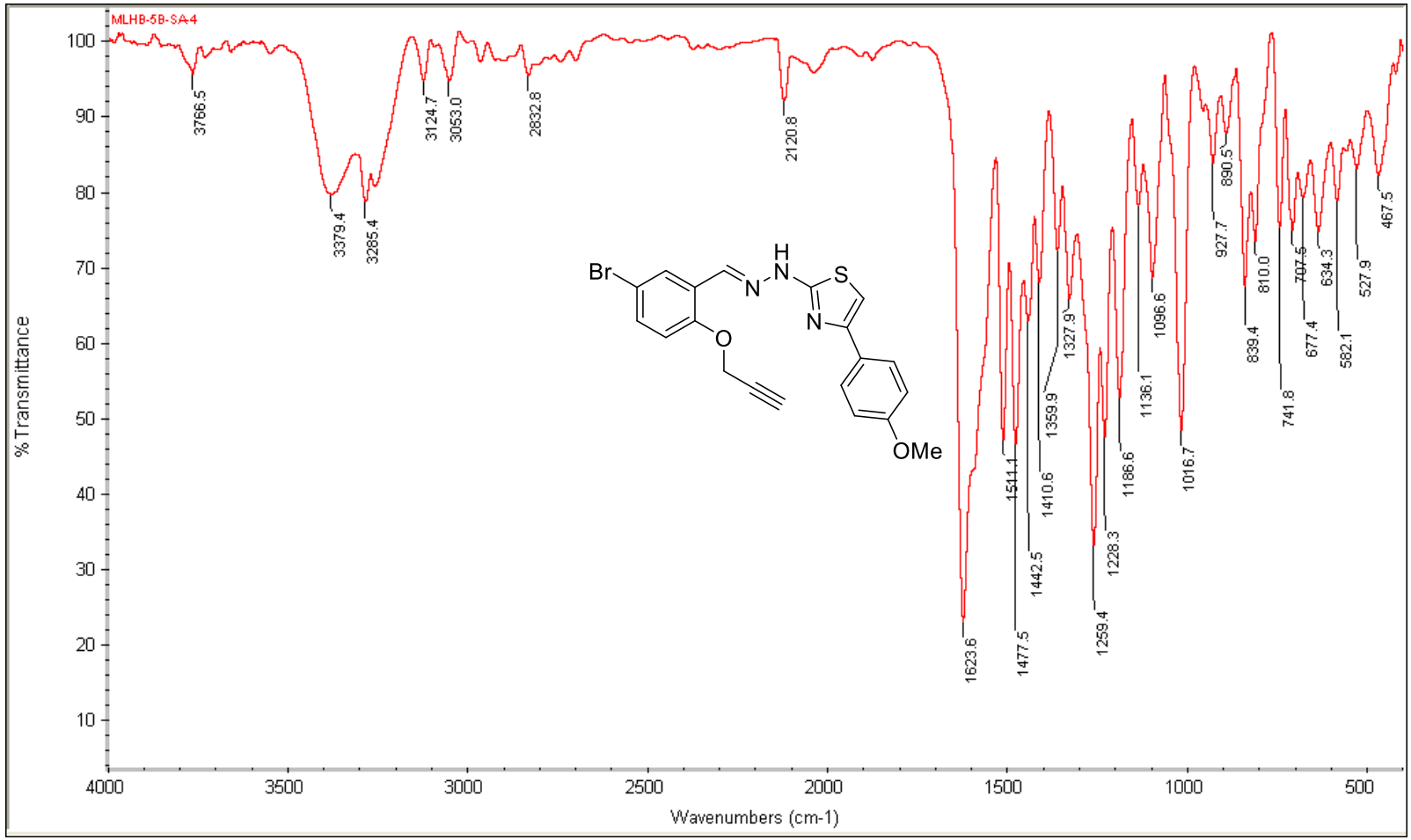
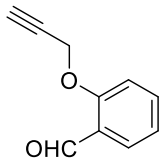
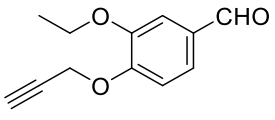
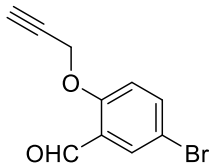
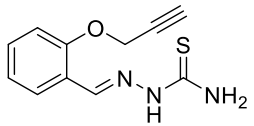
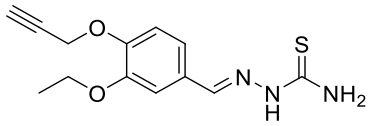
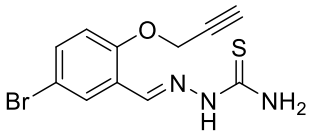
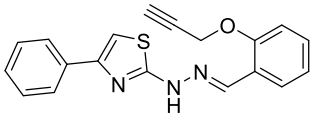
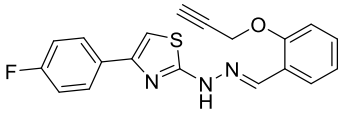
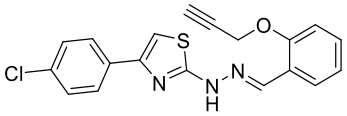
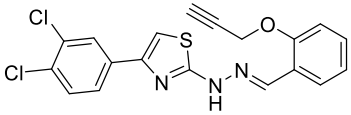
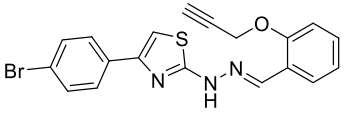
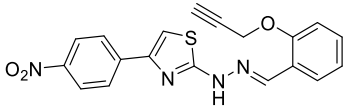
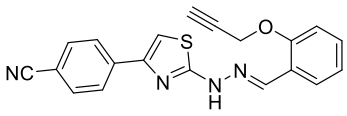


Table S1. Library of acetylene containing 2-(2-hydrazinyl)thiazole derivatives used in the present investigation

Category 1: Library of acetylene containing aldehyde derivatives (1-3)
 **1**  **2**  **3**
Category 2: Library of acetylene containing thiosemicarbazone derivatives (4-6)
 **4**  **5**  **6**
Category 3: Library of acetylene containing 2-(2-hydrazinyl)thiazole derivatives (7-32)
 **7**  **8**  **9**
 **10**  **11**  **12**



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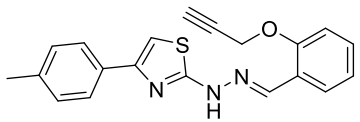

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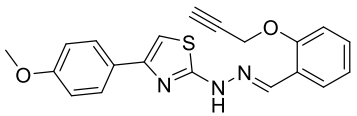

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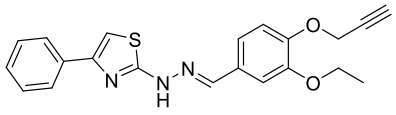

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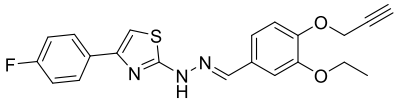

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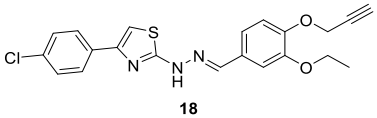

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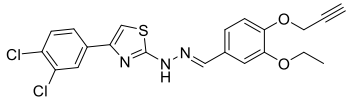

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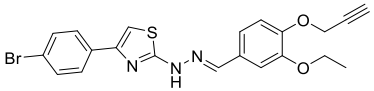

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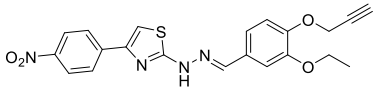

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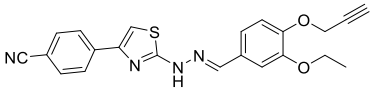

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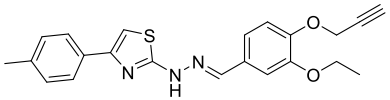

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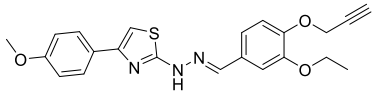

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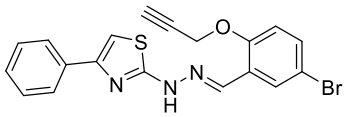

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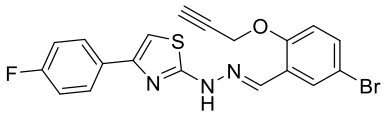

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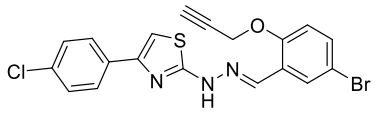

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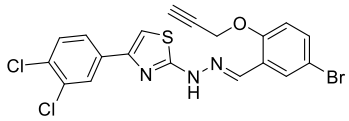

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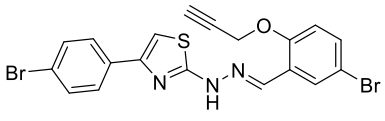

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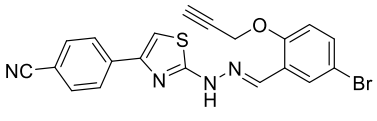

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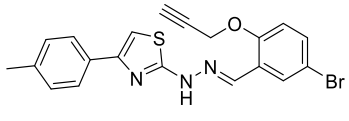

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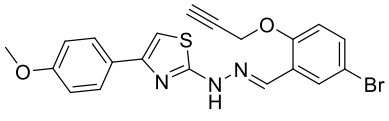

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Table S2. Pharmacokinetic analysis and *in vitro* mycobacterial analysis results of acetylene containing 2-(2-hydrazinyl)thiazole derivatives.

Code.	Lipinski's Rule of 5					Veber Rule		% Inhibition ± SD	
	Log P	MW	H-bond donors	H-bond acceptors A	Total no. of violations	TPSA (Å^2)	Number of rotatable bonds	100 µg/ml	50 µg/ml
1.	1.90	160.17	0	2	0	26.30	3	-	39.29 ± 1.17
2.	1.91	204.23	0	3	0	35.54	5	8.08 ± 0.24	7.73 ± 0.23
3.	2.68	239.07	0	2	0	26.30	3	50.85 ± 1.52	48.71 ± 1.46
4.	2.05	233.29	3	4	0	59.65	5	-	46.75 ± 1.40
5.	2.06	277.34	3	5	0	68.88	7	77.75 ± 2.33	74.58 ± 2.23
6.	2.84	312.19	3	4	0	59.65	5	56.86 ± 1.70	51.21 ± 1.53
7.	4.13	333.41	1	4	0	46.52	6	-	51.66 ± 1.54
8.	4.29	351.40	1	4	0	46.52	6	-	38.01 ± 1.14
9.	4.80	367.85	1	4	0	46.52	6	-	50.81 ± 1.52
10.	5.41	402.29	1	4	1	46.52	6	-	52.00 ± 1.56

11.	4.93	412.31	1	4	0	46.52	6	-	49.13 ± 1.47
12.	4.08	378.41	1	7	0	92.34	7	-	29.06 ± 0.87
13.	3.88	358.42	1	5	0	70.31	6	-	54.33 ± 1.62
14.	4.57	347.44	1	4	0	46.52	6	-	38.18 ± 1.14
15.	4.18	363.44	1	5	0	55.75	7	-	10.26 ± 0.30
16.	4.14	377.46	1	5	0	55.75	8	48.71 ± 1.46	40.49 ± 1.21
17.	4.30	395.45	1	5	0	55.75	8	11.41 ± 0.34	2.06 ± 0.06
18.	4.82	411.90	1	5	0	55.75	8	17.79 ± 0.53	6.36 ± 0.19
19.	5.42	446.35	1	5	1	55.75	8	7.21 ± 0.21	2.38 ± 0.07
20.	4.95	456.36	1	5	0	55.75	8	12.13 ± 0.36	7.35 ± 0.22
21.	4.10	422.46	1	8	0	101.58	9	50.85 ± 1.52	48.74 ± 1.46
22.	3.89	402.47	1	6	0	79.54	8	57.18 ± 1.71	50.86 ± 1.52
23.	4.59	391.49	1	5	0	55.75	8	10.49 ± 0.31	8.72 ± 0.26
24.	4.20	407.49	1	6	0	64.98	9	32.98 ± 0.98	5.64 ± 0.16
25.	4.91	412.31	1	4	0	46.52	6	66.22 ± 1.98	61.86 ± 1.85
26.	5.07	430.30	1	4	1	46.52	6	57.7 ± 1.73	50.7 ± 1.52

27.	5.59	446.75	1	4	1	46.52	6	52.69 ± 1.58	38.15 ± 1.14
28.	6.20	481.19	1	4	1	46.52	6	50.16 ± 1.50	43.8 ± 1.31
29.	5.72	491.20	1	4	1	46.52	6	37.24 ± 1.11	27.05 ± 0.81
30.	4.67	437.32	1	5	0	70.31	6	48.69 ± 1.46	43.73 ± 1.31
31.	5.36	426.33	1	4	1	46.52	6	56.32 ± 1.68	54.86 ± 1.64
32.	4.97	442.33	1	5	0	55.75	7	48.68 ± 1.46	43.69 ±1.31
INH	-0.96	137.14	3	4	0	68.01	1	> 99% *	
RIF	2.62	822.95	6	16	3	220.16	5	> 99% *	

Note: Pharmacokinetic analyses are obtained from the online server Molinspiration (http://www.molinspiration.com). * at 2 µg/ml.

Table S3. ADME properties of acetylene containing 2-(2-hydrazinyl)thiazole derivatives.

Code	Absorption			Distribution				Metabolism	Excretion
	Log S (log mol/L)	Caco-2 perm. (log Papp in 10^{-6} cm/s)	Int. absorption. (% absorbed)	VDss (log L/kg)	Fraction. Unbound (Fu)	BBB perm (log BB)	BBB predicted		Total clearance (logml/min/kg)
1.	-1.645	1.65	97.94	0.042	0.341	0.159	Yes	CYP1A2 inhibitor	0.274
2.	-2.604	1.3	99.692	0.088	0.337	0.03	Yes	CYP1A2 inhibitor	0.402
3.	-2.56	1.545	96.684	0.04	0.354	0.247	Yes	CYP1A2 inhibitor	0.234
4.	-2.579	1.216	87.469	-0.116	0.377	-0.22	No	CYP1A2 inhibitor	-0.021
5.	-2.418	0.719	73.221	-0.462	0.383	-0.438	No	-	-0.048
6.	-2.852	1.268	93.642	-0.217	0.357	-0.133	No	CYP1A2 inhibitor	-0.108
7.	-4.788	1.439	92.889	0.211	0.002	0.268	Yes	CYP3A4, substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.376
8.	-4.872	1.332	92.508	0.212	0.046	0.093	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.113
9.	-5.334	1.291	91.44	0.265	0.002	0.219	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.244
10.	-5.912	1.28	91.164	0.361	0	0.196	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4	0.374

								inhibitor	
11.	-5.422	1.288	91.373	0.285	0	0.218	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.223
12.	-5.411	0.529	91.021	0.102	0	-0.794	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.28
13.	-4.896	0.672	93.917	0.19	0	-0.447	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.342
14.	-5.051	1.293	92.898	0.296	0.014	0.232	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.318
15.	-4.905	1.291	93.917	0.303	0.014	-0.03	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.294
16.	-5.325	1.086	93.591	0.35	0.037	0.2	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.345
17.	-5.216	1.118	93.191	0.357	0.095	0.025	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.082
18.	-5.772	1.077	92.095	0.405	0.04	0.152	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.213
19.	-6.193	1.068	91.819	0.498	0.027	0.142	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4	0.343

								inhibitor	
20.	-5.844	1.074	92.028	0.426	0.037	0.15	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.192
21.	-6.039	0.766	93.403	0.18	0	-0.83	No	CYP3A4 substrate. CYP2C19, CYP2C9, CYP3A4 inhibitor	0.249
22.	-5.386	1.151	94.572	0.33	0.034	-0.501	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.312
23.	-5.538	1.079	93.554	0.433	0.05	0.165	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.287
24.	-5.221	1.092	94.599	0.444	0.057	-0.097	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.263
25.	-5.4	1.284	91.396	0.273	0.006	0.221	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.283
26	-5.373	1.316	91.015	0.262	0.058	0.046	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.021
27	-5.941	1.275	89.947	0.324	0.007	0.173	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.152
28	-6.495	1.264	89.67	0.413	0	0.15	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.282

29	-6.023	1.273	89.88	0.344	0.003	0.171	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.13
30	-5.527	0.683	92.424	0.24	0.005	-0.645	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.25
31	-5.674	1.277	91.405	0.356	0.019	0.186	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.226
32	-5.405	1.276	92.423	0.347	0.024	-0.077	No	CYP3A4 substrate. CYP1A2, CYP2C19, CYP2C9, CYP3A4 inhibitor	0.201
INH	-2.024	0.695	96.452	0.053	0.776	-0.002	No	-	0.703
RIF	-2.914	-0.219	41.095	1.49	0.209	-2.577	No	-	-0.624

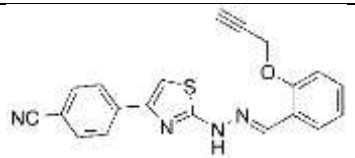
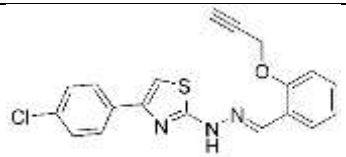
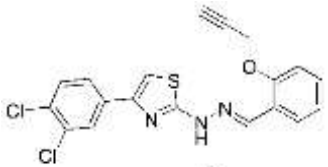
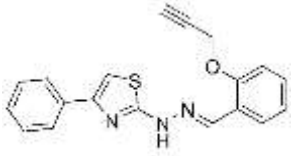
Note: ADME properties were obtained from online servers pkCSM (http://biosig.unimelb.edu.au/pkcsm/) and SwissADME (http://www.swissadme.ch/).

Table S4. Single-crystal XRD data.

	Compound 4	**Compound 7**
CCDC Number	2038796	2038797
Empirical formula	$C_{22}H_{22}N_6O_2S_2$	$C_{18}H_{14}N_4OS$
Formula weight	466.58	334.39
Temperature/K	298	298
Crystal system	triclinic	monoclinic
Space group	P-1	P2/n
a/Å	8.6009(5)	10.6038(7)
b/Å	10.6365(7)	9.9316(7)
c/Å	13.6233(9)	16.1177(11)
α/°	95.201(5)	90
β/°	95.934(5)	93.716(7)
γ/°	107.575(5)	90
Volume/Å^3	1171.95(12)	1693.8(2)
Z	2	4

ρ_{calc}g/cm^3	1.322	1.311
μ/mm^{-1}	0.258	0.203
F(000)	488.0	696.0
Crystal size/mm^3	0.4 × 0.38 × 0.24	0.64 × 0.58 × 0.26
Radiation	MoKα (λ = 0.71073)	MoKα (λ = 0.71073)
2Θ range for data collection/°	6.24 to 58.88	6.52 to 58.72
Index ranges	-11 ≤ h ≤ 11, -13 ≤ k ≤ 14, -18 ≤ l ≤ 18	-13 ≤ h ≤ 11, -13 ≤ k ≤ 12, -21 ≤ l ≤ 20
Reflections collected	12789	9712
Independent reflections	5520 [R_{int} = 0.0284, R_{sigma} = 0.0509]	3990 [Rint = 0.0198, Rsigma = 0.0242]
Goodness-of-fit on F^2	0.981	1.033

Table S5. Summary of active compounds % inhibition at 50 µg/ml.

Structure of thiosemicarbazone	Structure of acetylene containing 2-(2-hydrazinyl)thiazoles	
	 **13**	 **9**
	54%	50%
	 **10**	 **7**
	52%	51%

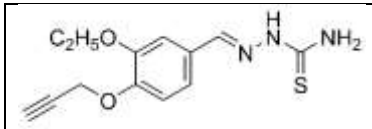
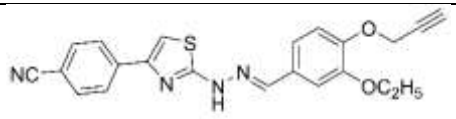
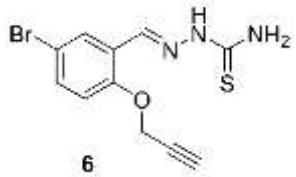
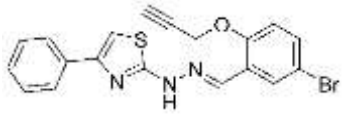
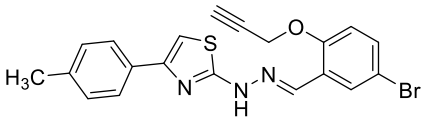
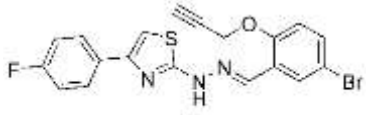
 **5** 74%	 **22** 50%	
 **6** 51%	 **25** 61%  **31** 54%	 **26** 50%

Table S6. *In silico* studies of active compounds with KasA protein.

Code	*In silico* studies with KasA protein		
	Binding Affinity (kcal/mol)	**Binding const. (Ki) (µM)**	**Interacting amino acids**
1	-6.1	33.39686	GLY403, GLY318, VAL278, PRO280, ALA287, ALA321, HIS311, PHE402, PHE404
2	-5.9	46.82409	THR315, ILE317, ALA279, MET213, ALA215
3	-5.0	214.2428	ALA215, ILE317, PRO280, MET213, VAL278, PHE404, ALA279
4	-5.6	77.73472	MET213, ILE317, ALA279, ILE317, MET213, ALA215
5	-5.2	152.8067	THR315, ILE317, HIS311, ALA215, ALA279
6	-5.5	92.0443	MET213, ARG214, ILE317, PRO280, PHE404, ALA215, ALA279
7	-6.4	20.11685	GLY39, GLU40, LEU371
8	-6.6	14.34816	MET213, ILE317, ALA215, ALA279
9	-6.5	16.9894	GLY39, GLU40, HIS44, LEU371

10	-7.7	2.236638	GLU374, ASN372, GLU224, GLY39, GLU40, PRO369, LEU371
11	-6.7	12.11754	MET213, VAL278, ILE317, MET277, ALA215, ALA279
12	-6.4	20.11685	MET213, ILE317, PHE404, ALA215, ALA279
13	-6.9 -6.1	8.642724 33.39686	TYR373, ALA38, GLY39, GLU40, LEU371 TYR373, GLY39, LEU371
14	-6.9	8.642724	MET213, ARG214, ILE317, ALA279, PRO280, PHE404
15	-6.8 -6.4	10.2337 20.11685	GLY387, GLY39, TYR373, GLU40, ASN372, LEU371 GLY387, GLY39, ASN372, GLU224, ARG225, ALA38, LEU371
16	-6.5	16.9894	GLU40, GLU224, GLY39, LEU371
17	-6.8	10.2337	GLU40, ASN372, GLY39, TYR373, GLU374, LEU371
18	-6.5	16.9894	GLY39, GLU40, LEU371
19	-7.2	5.20601	MET213, ARG214, MET212, HIS311, PHE404, ALA215, ALA279, ILE317
20	-6.9	8.642724	TYR373, GLY39, GLU40, LEU371, HIS44, ALA386
21	-6.7	12.11754	MET213, ARG214, ILE317, HIS311, PHE404, ALA215, ALA279
22	-6.9	8.642724	GLU40, PRO27
23	-6.6	14.34816	GLY39, SER41, ASN372, LEU371

24	-6.7	12.11754	VAL19, SER97, ASP28, LYS260, LEU262
25	-6.8	10.2337	ASN372, GLU40, LEU371, PRO369
26	-6.9	8.642724	GLU224, GLU224, GLY387, GLU40, LEU371, ARG225
27	-6.5	16.9894	GLU40, LEU371, PRO369
28	-7.0	7.299091	ASN372, GLU40, LEU371, PRO369
29	-6.6	14.34816	GLU40, LEU371
30	-6.9	8.642724	TYR373, GLU40, LEU371
31	-6.7	12.11754	GLU40, LEU371, PRO369
32	-6.9	8.642724	GLU40, LEU371, ASN372
INH	-6.1	33.39686	VAL 278, GLY 403, HIS 311, PRO 280
RIF	-7.8	1.888921	GLU 224, LEU 371

Table S7. Summary of the analysis of variance (ANOVA) data at 50 µg/ml.

SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Trial 1	32	1178.15	36.81719	396.4437		
Trial 2	32	1145.17	35.78656	382.4966		
Trail 3	32	1206.55	37.70469	413.8735		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	58.97651	2	29.48825	0.074165	0.928574	3.094337
Within Groups	36977.23	93	397.6046			
Total	37036.2	95				

Table S8. Summary of the analysis of variance (ANOVA) data at 100 µg/ml.

SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Trail 1	21	859.99	40.9519	454.4107		
Trail 2	21	877.49	41.78524	465.459		
Trail 3	21	843.35	40.15952	437.3954		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	27.75681	2	13.87841	0.030676	0.969805	3.150411
Within Groups	27145.3	60	452.4217			
Total	27173.06	62				

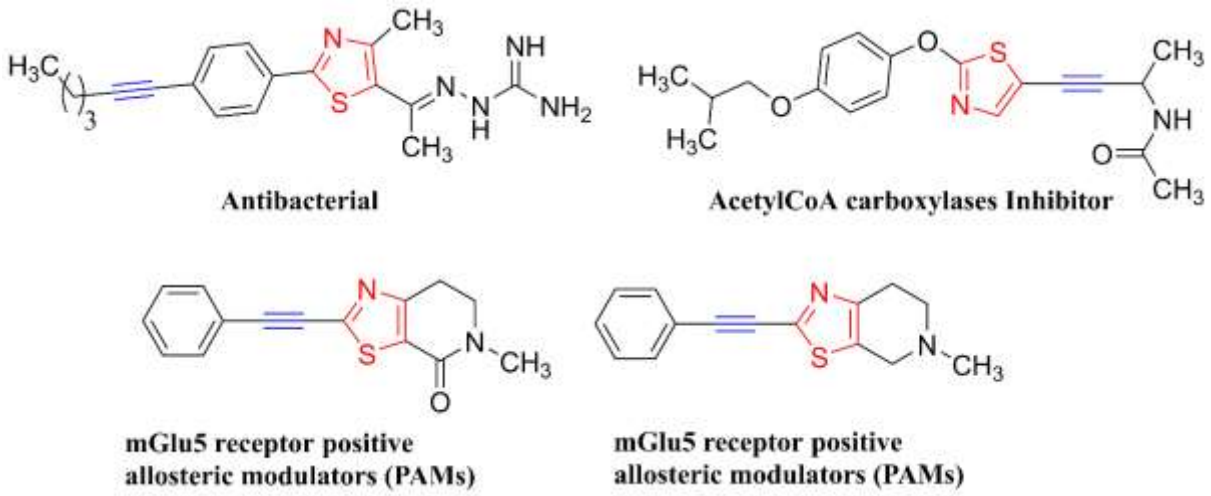


Fig. S1. Reported biological compounds containing thiazole and acetylene pharmacophores.