Green Design and Synthesis of Some Novel Thiazolidinone-appended Benzothiazole-triazole Hybrids as Antimicrobial Agents

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I. Materials and Methods

All the solvents and reagents (analytical grade) were purchased from commercial suppliers and were used in synthesis without additional purification in the experimental procedures. The melting points of all synthesised compounds were analysed using digital melting point apparatus. The purity of the compounds was assessed using thin-layer silica Gel-G-coated glass plates with a benzene:ethyl acetate (8:2) eluent. Infrared (IR) spectra were recorded using a Shimadzu FT IR–8400S spectrophotometer with KBr pellets. Mass spectrometry measurements were obtained on Waters Xevo G2-S QT LC/MS spectrometer. ^{1}H and ^{13}C NMR spectra were recorded on a Jeol Resonance at 400 and 100MHz, respectively in dimethyl sulfoxide (DMSO-d_6) and $CDCl_3$ as a solvent. Chemical shifts and absorption frequency have been expressed in terms of δ (ppm) and ν (cm^{-1}), respectively. The abbreviations have been used in the spectral data as singlet (s), doublet (d), doublet of doublet (dd), and multiplet (m). ElementarVarioEL III Elemental analyzer is found helpful in elemental analyses.

1. **General procedure for the synthesis of benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-phenylmethanimine (4a-l)**

The reaction was carried out by using an equimolar mixture of 2-hydrazinobenzothiazole **1** (1mmol), anthranillic acid **2** (1mmol) and aromatic/heteroaromatic aldehydes **3a-l** (1mmol), mixture was refluxed in ethanol (10 mL) as solvent at 80˚C for 2 hrs which afforded pale yellow coloured solid. After the completion of reaction as indicated by TLC, the reaction mixture was cooled at room temperature and obtained precipitate was filtered under vacuum, washed with chilled water few times, dried and used in the next step without further purification.

2. **General procedure for the synthesis of benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-phenylthiazolidin-4-one (6a-h)**

To a pure synthesised compounds, benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-phenylmethanimine **4** (1 mmol) with thioglycolic acid **5** (1 mmol) in ethanol (10 mL) were heated at refluxing for 2 hrs at 80ºC which afforded solid mass. After the completion of the reaction, as indicated by TLC, the reaction mixture was cooled to room temperature, and the resulting precipitate was filtered under vacuum. It was then washed several times with chilled water, dried, and the desired compounds were obtained with good to excellent yields after further recrystallization.

3. **Antimicrobial activity**

Gram-positive (*Staphylococcus aureus* [MTCC 96], *Bacillus subtilis* [MTCC 441]) and Gram-negative (*Klebsiella planticola* [MTCC 530], *Pseudomonas aeruginosa* [MTCC 2453]) pathogenic bacterial strains and *Candida albicans* [MTCC 3017], *Candida albicans* [MTCC 1637] and *Aspergillus niger* [MTCC 872] fungal strains were used in this experiment. The antimicrobial properties of various synthesised compounds were assessed using the agar well diffusion method. Mueller Hinton agar plates were evenly inoculated with pathogenic strains, each at a concentration equivalent to 0.5 McFarland standards (1.5 × 108 cfu/mL). In a sterile laminar air flow chamber, 6 mm diameter wells were created on the agar plates. These wells were then filled with test samples dissolved in 2% DMSO, with concentrations ranging from 125 to 0.97 µg/mL. Ciprofloxacin and Miconazole were used as positive controls, while DMSO served as the vehicle control. The plates were incubated at 37°C for 24 hours for bacteria and 28°C for 48 hours for fungi. After incubation, the minimum inhibitory concentration (MIC) was determined as the lowest concentration in the series where no inhibition of visual growth

was observed in the wells. The entire experiment was conducted in duplicate, and the mean values were reported.

II. Characterization data

i. Synthesised compounds 4a-l

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(4-fluorophenyl)methanimine (4a): Pale yellow solid**,** M.p. 284°C, FT-IR (*KBr*, cm^{-1}): 1634 (C=N); ^{1}H-NMR (*$CDCl_3$*, 400 MHz) δ: 6.79-6.88 (m, 4H, Ar-H), 6.96 (d, 2H, Ar-H, *J* = 8.4 Hz), 7.33 (d, 2H, Ar-H, *J* = 8.4 Hz), 7.41-7.45 (m, 4H, Ar-H), 8.27 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 161.2, 160.9, 158.4, 153.8, 140.6, 139.7, 133.0, 132.1, 131.5, 130.4, 126.6, 126.2, 124.9, 122.8, 122.6, 122.5, 119.4, 118.9, 116.69, 116.4 ppm; MS (m/z): 373.084 $[M+H]^+$; Anal. calcd. for $C_{21}H_{13}FN_4S$: C 67.73; H 3.52; N 15.04; S 8.61%; Found C 67.85; H 3.49; N 14.99; S 8.55%.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(4-chlorophenyl)methanimine (4b): Pale yellow solid**,** M.p. 282°C, FT-IR (*KBr*, cm^{-1}): 1646 (C=N); ^{1}H-NMR (*$CDCl_3$*, 400 MHz) δ: 6.79 (d, 2H, Ar-H, *J* = 8.8 *Hz*), 6.98 (d, 2H, Ar-H, *J* = 8.8 Hz), 7.12-7.17 (m, 4H, Ar-H), 7.35-7.44 (m, 4H, Ar-H), 8.43 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 160.6, 153.5, 152.2, 148.4, 148.3, 146.1, 144.9, 143.0, 131.2, 131.1, 127.9, 125.4, 124.7, 124.6, 121.8, 118.6, 118.5, 110.7, 110.5, 110.2 ppm; MS(m/z): 389.055 $[M+H]^+$; Anal. calcd. for $C_{21}H_{13}ClN_4S$: C 64.86; H 3.37; Cl 9.12; N 14.41; S 8.24 %; Found C 64.98; H 3.34; N 14.36; S 8.18 %.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(p-tolyl)methanimine (4c): Yellow solid**,** M.p. 260°C, FT-IR (*KBr*, cm^{-1}) δ : 1653 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 2.31 (s, 3H, CH_3), 7.13 (dd, 4H, Ar-H, *J* = 8.4, 6.2 *Hz*), 7.47 (d, 2H, Ar-H, *J* = 8 Hz), 7.66 (dd, 2H, Ar-H, *J* = 8.0, 6.4 Hz), 7.94-7.99 (m, 4H, Ar-H), 8.36 (s, 1H, CH); ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 160.9, 152.9, 148.1, 148.0, 145.1, 142.1, 138.3, 138.2, 135.5, 135.4, 131.6, 131.5, 129.9, 129.8, 129.6, 128.5, 127.9, 127.8, 126.1, 124.1, 120.9, 21.2 ppm; MS(m/z): 369.110 $[M+H]^+$; Anal. calcd. for $C_{22}H_{16}N_4S$: C 71.72; H 4.38; N 15.21; S 8.70 %; Found C 71.84; H 4.35; N 15.16; S 8.64 %.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(4-nitrophenyl)methanimine (4d): Yellow solid**,** M.p. 286°C, FT-IR (*KBr*, cm^{-1}): 1647 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400

MHz) δ: 6.58-6.68 (m, 3H, Ar-H), 6.88 (d, 2H, Ar-H, *J* = 7.2 Hz), 7.00 (d, 2H, Ar-H, *J* = 7.2 Hz), 7.20-7.26 (m, 2H, Ar-H), 7.40-7.44 (m, 3H, Ar-H) 8.67 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d*$_6$, 100 MHz) δ: 161.6, 160.8, 160.7, 156.2, 155.4, 148.9, 140.1, 139.8, 133.3, 133.1, 131.3, 131.2, 129.8, 126.8, 126.2, 124.8,124.0, 122.2, 119.6, 119.5 ppm; MS(m/z): 400.079 $[M+H]^+$; Anal. calcd. for $C_{21}H_{13}N_5O_2S$: C 63.15; H 3.28; N 17.53; O 8.01; S 8.03 %; Found C 63.27; H 3.25; N 17.48; O 7.93; S 7.97 %.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(4-methoxyphenyl)methanimine (4e): White solid**,** M.p. 245°C, FT-IR (*KBr*, cm^{-1}): 1637 (C=N); ^{1}H-NMR (*DMSO-d*$_6$, 400 MHz) δ: 3.68 (s, 3H, OCH_3), 7.01-7.28 (m, 3H, Ar-H,), 7.41-7.43 (m, 3H, Ar-H), 7.54 (d, 2H, Ar-H, *J* = 8.4 Hz), 7.63-7.74 (m, 2H, Ar-H), 7.76 (d, 2H, Ar-H, *J* = 8.4 Hz), 8.48 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d*$_6$, 100 MHz) δ: 161.4, 160.4, 154.9, 154.8, 148.9, 145.5, 145.4, 142.7, 139.0, 138.9, 138.8, 136.1, 135.9, 131.5, 129.8, 128.1, 126.9, 125.9, 124.9, 119.6, 55.0 ppm; MS(m/z): 385.104 $[M+H]^+$; Anal. calcd. for $C_{22}H_{16}N_4OS$: C 68.73; H 4.20; N 14.57; O 4.16; S 8.34 %; Found C 68.85; H 4.17; N 14.52; O 4.08; S 8.28 %.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(3,4-dimethoxyphenyl)methanimine (4f): White solid**,** M.p. 281°C, FT-IR (*KBr*, cm^{-1}): 1641 (C=N); ^{1}H-NMR (*DMSO-d*$_6$, 400 MHz) δ: 3.73 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 6.64 (d, 2H, Ar-H, *J* = 7.4 Hz), 6.79 (d, 2H, Ar-H, *J* = 7.6 Hz), 6.95-7.07 (m, 2H, Ar-H), 7.31 (s, 1H, Ar-H), 7.42-7.59 (m, 4H, Ar-H), 8.34 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d*$_6$, 100 MHz) δ: 161.9, 161.8, 153.1, 152.9, 146.5, 146.4, 140.5, 140.3, 136.2, 133.8, 133.6, 130.0, 129.8, 124.5, 124.3, 122.7, 122.5, 118.4, 118.1, 53.1, 53.0 ppm; MS(m/z): 415.115 $[M+H]^+$; Anal. calcd. for $C_{23}H_{18}N_4O_2S$: C 66.65; H 4.38; N 13.52; O 7.72; S 7.73 %; Found C 66.77; H 4.35; N 13.47; O 7.64; S 7.67%.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(3,4,5-trimethoxyphenyl)methanimine (4g): White solid**,** M.p. 220°C, FT-IR (*KBr*, cm^{-1}): 1645 (C=N); ^{1}H-NMR (*DMSO-d*$_6$, 400 MHz) δ: 3.45 (s, 3H, OCH_3), 3.61 (s, 3H, di-OCH_3), 7.36 (s, 1H, Ar-H), 7.38 (s, 1H, Ar-H), 7.50-7.54 (m, 3H, Ar-H), 7.68-7.73 (m, 5H, Ar-H), 8.93 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d*$_6$, 100 MHz) δ: 161.3, 160.9, 153.4, 153.1, 148.2, 147.0, 141.9, 141.7, 133.9, 133.2, 132.9, 132.7, 127.1, 126.9, 126.8, 123.2, 123.0, 117.6, 117.5, 117.2, 56.4, 53.1, 53.0 ppm; MS(m/z): 445.126 $[M+H]^+$; Anal. calcd. for $C_{24}H_{20}N_4O_3S$: C 64.85; H 4.54; N 12.60; O 10.80; S 7.21 %; Found C 64.73; H 4.51; N 12.55; O 10.72; S 7.15 %.

4-(((2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)imino)methyl)-2-bromo-6-methoxyphenol (4h): Pale yellow solid**,** M.p. 278°C, FT-IR (*KBr*, cm^{-1}): 1639 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.85 (s, 3H, OCH_3), 7.07 (s, 1H, Ar-H), 7.30 (s, 1H, Ar-H), 7.46-7.64 (m, 8H, Ar-H), 8.64 (s, 1H, CH), 9.49 (s, 1H, OH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 162.2, 159.7, 152.6, 147.9, 147.7, 145.8, 143.8, 143.6, 140.1, 139.8, 137.9, 135.5, 134.3, 130.0, 129.9, 129.8, 128.5, 126.1, 125.3, 120.9, 120.8, 56.4 ppm; MS(m/z): 479.010 $[M+H]^+$; Anal. calcd. for $C_{22}H_{15}BrN_4O_2S$: C 55.12; H 3.15; N 11.69; O 6.68; S 6.69 %; Found C 55.24; H 3.12; N 11.64; O 6.60; S 6.63 %.

N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(2,5-dimethoxyphenyl)methanimine (4i): Pale yellow solid**,** M.p 283°C, FT-IR (*KBr*, cm^{-1}): 1640 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.61 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 6.75-6.81 (m, 3H, Ar-H), 6.88 (d, 2H, Ar-H, *J* = 8 Hz), 7.12-7.28 (m, 2H, Ar-H), 7.39 (d, 2H, Ar-H, *J* = 8 Hz), 7.51 (d, 2H, Ar-H, *J* = 8 Hz), 8.86 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 161.9, 160.4, 156.5, 155.0, 148.9, 140.0, 135.4, 134.1, 133.8, 129.6, 126.8, 124.9, 124.1, 119.6, 118.5, 118.2, 116.1, 112.7, 111.6, 111.5, 56.0, 55.2 ppm; MS(m/z): 415.115 $[M+H]^+$; Anal. calcd. for $C_{23}H_{18}N_4O_2S$: C 66.65; H 4.38; N 13.52; O 7.72; S 7.73 % Found C 66.77; H 4.35; N 13.47; O 7.64; S 7.67 %.

(E)-N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(furan-2-yl)methanimine (4j): Pale yellow solid**,** M.p. 276°C, FT-IR (*KBr*, cm^{-1}): 1643 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400MHz) δ: 6.74 (dd, 2H, Ar-H, *J* = 6.8, 7.2 Hz), 7.06-7.14 (m, 2H, Ar-H), 7.34-7.49 (m, 7H, Ar-H), 8.55 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 161.1, 154.7, 148.9, 138.4, 133.4, 130.8, 129.8, 126.9, 126.4, 124.9, 124.7, 123.2, 123.1, 121.7, 121.6, 119.7, 119.6, 117.9, 112.7 ppm; MS(m/z): 345.073 $[M+H]^+$; Anal. calcd. for $C_{19}H_{12}N_4OS$: C 66.26; H 3.51; N 16.27; O 4.65; S 9.31 % Found C 66.38; H 3.48; N 16.22; O 4.57; S 9.25 %.

(E)-N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(thiophen-2-yl)methanimine (4k): Pale yellow solid**,** M.p. 295°C, FT-IR (*KBr*, cm^{-1}): 1641 (C=N); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 7.03-7.08 (m, 3H, Ar-H), 7.12 (d, 2H, Ar-H, *J* = 7.4 Hz), 7.26-7.32 (m, 2H, Ar-H), 7.42-7.48 (m, 4H, Ar-H), 8.63 (s, 1H, CH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 162.4, 154.9, 154.8, 152.1, 148.9, 142.7, 131.5, 129.4, 128.1, 126.9, 125.9, 124.9, 124.7, 124.6, 122.5, 122.3, 122.1, 119.6 ppm; MS(m/z): 361.050 $[M+H]^+$; Anal. calcd. for $C_{19}H_{12}N_4S_2$: C 63.31; H 3.36; N 15.54; S 17.79 % Found C 63.43; H 3.33; N 15.49; S 17.73 %.

(E)-N-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-1-(1H-indol-3-yl)methanimine (4l): Yellow solid**,** M.p. 289°C, FT-IR (*KBr*, cm^{-1}): 1638 (C=N), 3424 (N-H); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 6.71 (dd, 4H, Ar-H, *J* = 7.2, 6.4 Hz), 6.96 (s, 1H, Ar-H), 7.11-7.18 (m, 3H, Ar-H), 7.33-7.42 (m, 5H, Ar-H), 8.79 (s, 1H, CH), 10.55 (s, 1H, NH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 162.4, 160.4, 154.9, 148.9, 143.1, 134.4, 134.1, 130.8, 129.7, 128.4, 128.2, 126.9, 124.9, 124.6, 123.8, 123.6, 122.3, 122.2, 121.1, 119.6, 113.5, 112.7, 112.6 ppm; MS(m/z): 394.105 $[M+H]^+$; Anal. calcd. for $C_{23}H_{15}N_5S$: C 70.21; H 3.84; N 17.80; S 8.15 % Found C 70.33; H 3.81; N 17.75; S 8.09 %.

ii. Synthesised compounds 6a-h

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(4-fluorophenyl)thiazolidin-4-one (6a): Pale yellow solid**,** M.p. 280°C, FT-IR (*KBr*, cm^{-1}): 1690 (C=O), 685 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.59 (d, 1H, CH_2, *J* = 8.8 Hz), 3.90 (d, 1H, CH_2, *J* = 8.8 Hz), 5.93 (s, 1H, CH), 6.64-7.05 (m, 4H, Ar-H), 7.21-7.32 (m, 2H, Ar-H), 7.42-7.46 (m, 2H, Ar-H), 7.54-7.58 (m, 2H, Ar-H), 7.60-7.62 (m, 2H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.5, 77.7, 112.3, 112.7, 119.2, 119.5, 121.9, 123.6, 123.9, 124.8, 126.2, 126.5, 126.8, 129.2, 131.2, 131.6, 133.0, 133.3, 139.8, 140.1, 148.9, 155.4, 169.6 ppm; MS(m/z): 447.067 $[M+H]^+$; Anal. calcd. for $C_{23}H_{15}FN_4OS_2$: C 61.87; H 3.39; F 4.25; N 12.55; O 3.58; S 14.36 % Found C 61.99; H 3.36; N 12.50; O 3.50; S 14.30 %

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(3,4-dimethoxyphenyl)thiazolidin-4-one (6b): White solid**,** M.p. 278°C, FT-IR (*KBr*, cm^{-1}): 1710 (C=O), 692 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.31 (s, 3H, OCH_3), 3.40 (s, 3H, OCH_3), 3.70 (d, 1H, CH_2, *J* = 9.6 Hz), 4.162 (d, 1H, CH_2, *J* = 9.6 Hz), 6.042 (s, 1H, CH), 6.86-6.99 (m, 3H, Ar-H), 7.06 (s, 1H, Ar-H), 7.18-7.27 (m, 3H, Ar-H), 7.43-7.45 (m, 3H, Ar-H), 7.60-7.62 (m, 1H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.3, 53.1, 53.8, 68.3, 112.7, 116.4, 116.7, 119.6, 119.7, 123.2, 123.5, 124.9, 126.4, 126.9, 129.9, 130.8, 133.4, 133.7, 139.4, 139.8, 142.2, 148.9, 154.7, 168.9 ppm; MS(m/z): 489.098 $[M+H]^+$; Anal. calcd. for $C_{25}H_{20}N_4O_3S_2$: C 61.46; H 4.13; N 11.47; O 9.82; S 13.12 % Found C 61.58; H 4.10; N 11.42; O 9.74; S 13.06 %

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(3-bromo-4-hydroxy-5-methoxyphenyl)thiazolidin-4-one (6c): Pale yellow solid**,** M.p. 272°C, FT-IR (*KBr*, cm^{-1}): 1704 (C=O), 689 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.40 (s, 3H, OCH_3), 3.70 (d, 1H, CH_2, *J* = 5.2 Hz), 4.26 (d, 1H, CH_2, *J* =5.2 Hz), 6.30 (s, 1H, CH), 6.77 (s, 1H, Ar-H), 6.98-7.11

(m, 1H, Ar-H), 7.25-7.32 (m, 6H, Ar-H), 7.52-7.54 (m, 1H, Ar-H), 7.72 (s, 1H, Ar-H), 9.53 (s, 1H, OH) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.1, 56.0, 72.5, 112.1, 112.7, 119.6, 124.7, 124.9, 125.9, 126.9, 128.1, 129.8, 131.5, 133.7, 133.9, 134.1, 135.5, 139.7, 140.0, 142.7, 148.9, 154.7, 154.9, 169.4 ppm; MS(m/z): 552.993 $[M+H]^+$; Anal. calcd. for $C_{24}H_{17}BrN_4O_3S_2$: C 52.09; H 3.10; N 10.12; O 8.67; S 11.59 % Found C 52.21; H 3.07; N 10.07; O 8.59; S 11.53 %.

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(4-nitrophenyl)thiazolidin-4-one (6d): Yellow solid**,** M.p. 281°C, FT-IR (*KBr*, cm^{-1}): 1708 (C=O), 691 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.38 (d, 1H, CH_2, *J* = 8.0 Hz), 3.80 (d, 1H, CH_2, *J* = 8.0 Hz), 6.32 (s, 1H, CH), 6.78-6.80 (m, 1H, Ar-H), 7.19-7.22 (m, 3H, Ar-H), 7.32-7.37 (m, 5H, Ar-H), 7.45-7.48 (m, 1H, Ar-H), 7.58-7.60 (m, 1H, Ar-H), 7.88-7.92 (m, 1H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.1, 72.6, 111.5, 111.6, 112.7, 116.0, 119.6, 124.1, 124.9, 126.8, 129.6, 136.2, 138.1, 140.0, 144.1, 144.5, 145.1, 146.3, 148.9, 155.0, 156.5, 169.5 ppm; MS(m/z): 474.062 $[M+H]^+$; Anal. calcd. for $C_{23}H_{15}N_5O_3S_2$: C 58.34; H 3.19; N 14.79; O 10.14; S 13.54 % Found C 58.46; H 3.16; N 14.74; O 10.06; S 13.48%.

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(3,4,5-trimethoxyphenyl)thiazolidin-4-one (6e): White solid**,** M.p. 216°C, FT-IR (*KBr*, cm^{-1}): 1700 (C=O), 687 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.35 (s, 6H, OCH_3), 3.42 (s, 3H, OCH_3), 3.90 (d, 1H, CH_2, *J* = 7.2 Hz), 4.08 (d, 1H, CH_2, *J* = 7.2 Hz), 6.18 (s, 1H, CH), 6.76 (s, 1H, Ar-H), 7.24-7.34 (m, 6H, Ar-H), 7.53-7.57 (m, 2H, Ar-H), 7.72 (s, 1H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.1, 56.0, 56.8, 60.3, 72.2, 110.3, 110.7, 112.2, 112.6, 119.5, 122.3, 124.4, 124.8, 125.7, 126.5, 126.8, 128.9, 129.2, 130.2, 130.8, 141.3, 141.6, 148.9, 154.0, 155.3, 169.6 ppm; MS(m/z): 519.108 $[M+H]^+$; Anal. calcd. for $C_{26}H_{22}N_4O_4S_2$: C 60.22; H 4.28; N 10.80; O 12.34; S 12.36 % Found C 60.34; H 4.25; N 10.75; O 12.26; S 12.28 %.

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(furan-2-yl)thiazolidin-4-one (6f): Pale yellow solid**,** M.p. 271°C, FT-IR (*KBr*, cm^{-1}): 1705 (C=O), 688 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.41 (d, 1H, CH_2, *J* = 8.8 Hz), 3.61 (d, 1H, CH_2, *J* = 8.8 Hz), 6.31 (s, 1H, CH), 6.71-6.75 (m, 1H, Ar-H), 6.98-7.19 (m, 2H, Ar-H), 7.24-7.31 (m, 4H, Ar-H), 7.42-7.45 (m, 1H, Ar-H), 7.52-7.54 (m, 1H, Ar-H), 7.72-7.73 (m, 1H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.2, 67.5, 112.6, 112.7, 113.5, 119.6, 122.0, 122.6, 124.6, 124.9, 126.9, 128.1, 129.7, 130.8, 133.2, 133.4, 134.4, 143.1, 148.9, 154.9, 169.4 ppm; MS(m/z):

419.056 $[M+H]^+$; Anal. calcd. for $C_{21}H_{14}N_4O_2S_2$: C 60.27; H 3.37; N 13.39; O 7.65; S 15.32 % Found C 60.39; H 3.34; N 13.34; O 7.57; S 15.24 %.

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(thiophen-2-yl)thiazolidin-4-one (6g): Pale yellow solid**,** M.p. 290°C, FT-IR (*KBr*, cm^{-1}): 1700 (C=O), 689 (C-S); ^{1}H-NMR (*DMSO-d_6*, 400 MHz) δ: 3.39 (d, 1H, CH_2, *J* = 10 Hz), 3.61 (d, 1H, CH_2, *J* = 10 Hz), 6.11 (s, 1H, CH), 6.69-6.71 (m, 3H, Ar-H), 7.22-7.38 (m, 5H, Ar-H), 7.52-7.54 (m, H, Ar-H), 7.68-7.73 (m, 2H, Ar-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 35.2, 64.4, 110.4, 110.6, 112.6, 115.4, 115.8, 119.5, 119.8, 121.0, 121.9, 123.7, 124.9, 126.9, 128.9, 129.8, 131.5, 143.8, 149.0, 155.3, 168.8 ppm; MS(m/z): 435.033 $[M+H]^+$; Anal. calcd. for $C_{21}H_{14}N_4OS_3$: C 58.04; H 3.25; N 12.89; O 3.68; S 22.13 % Found C 58.16; H 3.22; N 12.84; O 3.60; S 22.07 %.

3-(2-(benzo[4,5]thiazolo[2,3-c][1,2,4]triazol-3-yl)phenyl)-2-(1H-indol-3-yl)thiazolidin-4-one (6h): White solid**,** M.p. 283°C, FT-IR (*KBr*, cm^{-1}): 1695 (C=O), 686 (C-S), 3412 (N-H); ^{1}H-NMR (*DMSO-d_6*, 400MHz) δ: 3.86 (d, 1H, CH_2, J=7.2 Hz), 3.92 (d, 1H, CH_2, J=7.2 Hz), 6.31 (s, 1H, CH), 6.74-6.76 (m, 1H, Ar-H), 6.88 (s, 1H, Ar-H), 7.14-7.17 (m, 3H, Ar-H), 7.25-7.32 (m, 2H, Ar-H), 7.52-7.60 (m, 3H, Ar-H), 7.72-7.78 (m, 3H, Ar-H), 10.78 (s, 1H, N-H) ppm; ^{13}C-NMR (*DMSO-d_6*, 100 MHz) δ: 33.4, 72.2, 112.0, 112.3, 112.8, 114.1, 116.3, 117.5, 119.3, 121.6, 121.9, 123.0, 124.3, 126.5, 127.7, 129.8, 130.0, 132.4, 132.7, 142.1, 142.4, 149.7, 158.2, 169.0 ppm; MS(m/z): 468.087 $[M+H]^+$; Anal. calcd. for $C_{25}H_{17}N_5OS_2$: C 64.22; H 3.66; N 14.98; O 3.42; S 13.71 % Found C 64.34; H 3.63; N 14.93; O 3.34; S 13.65 %.

NMR spectra Information

Chemical Shifts: The chemical shifts of each peak are displayed below the peaks, as per the standard practice at the institution where the spectra were obtained.

Integration: Similarly, the integration values are displayed at the top of the spectra, again, in accordance with the standard practice at the institution where the spectra were obtained.

III. [1]HNMR and [13]CNMR of synthesised compounds 4a-l

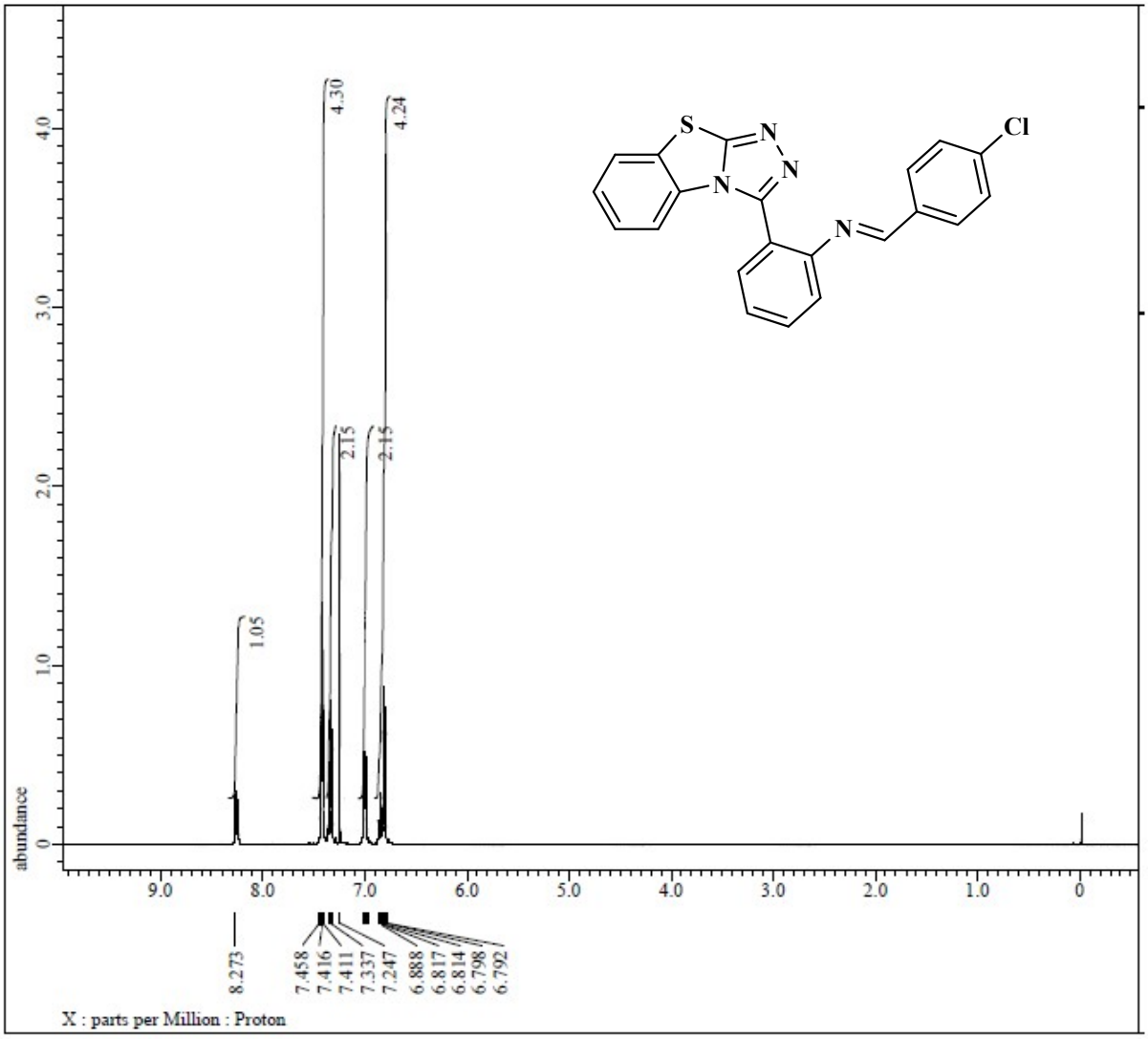

Figure S1(a) [1]H NMR spectrum of the synthesized compound **4a**

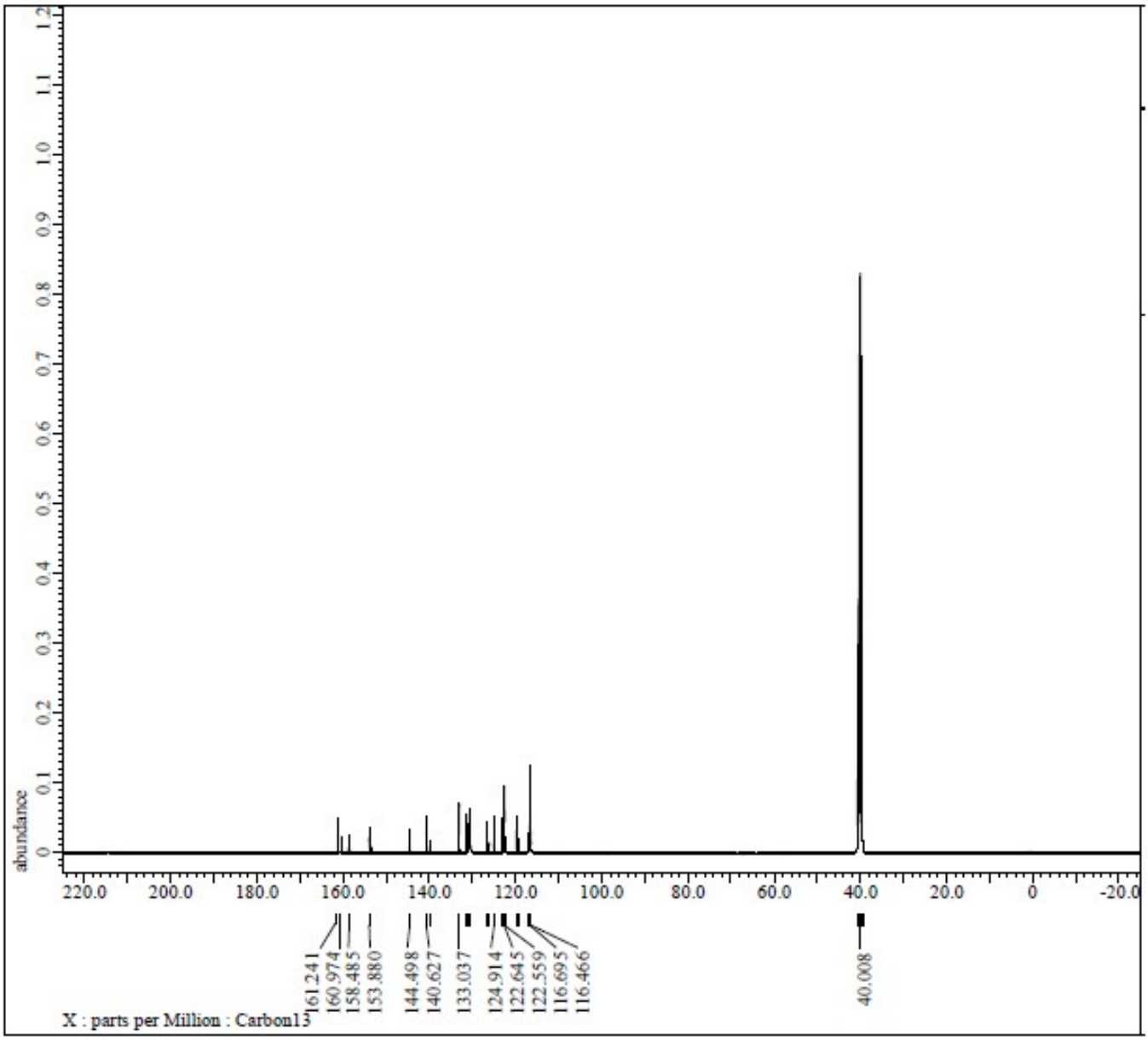

Figure S1(b) ^{13}C NMR spectrum of the synthesized compound **4a**

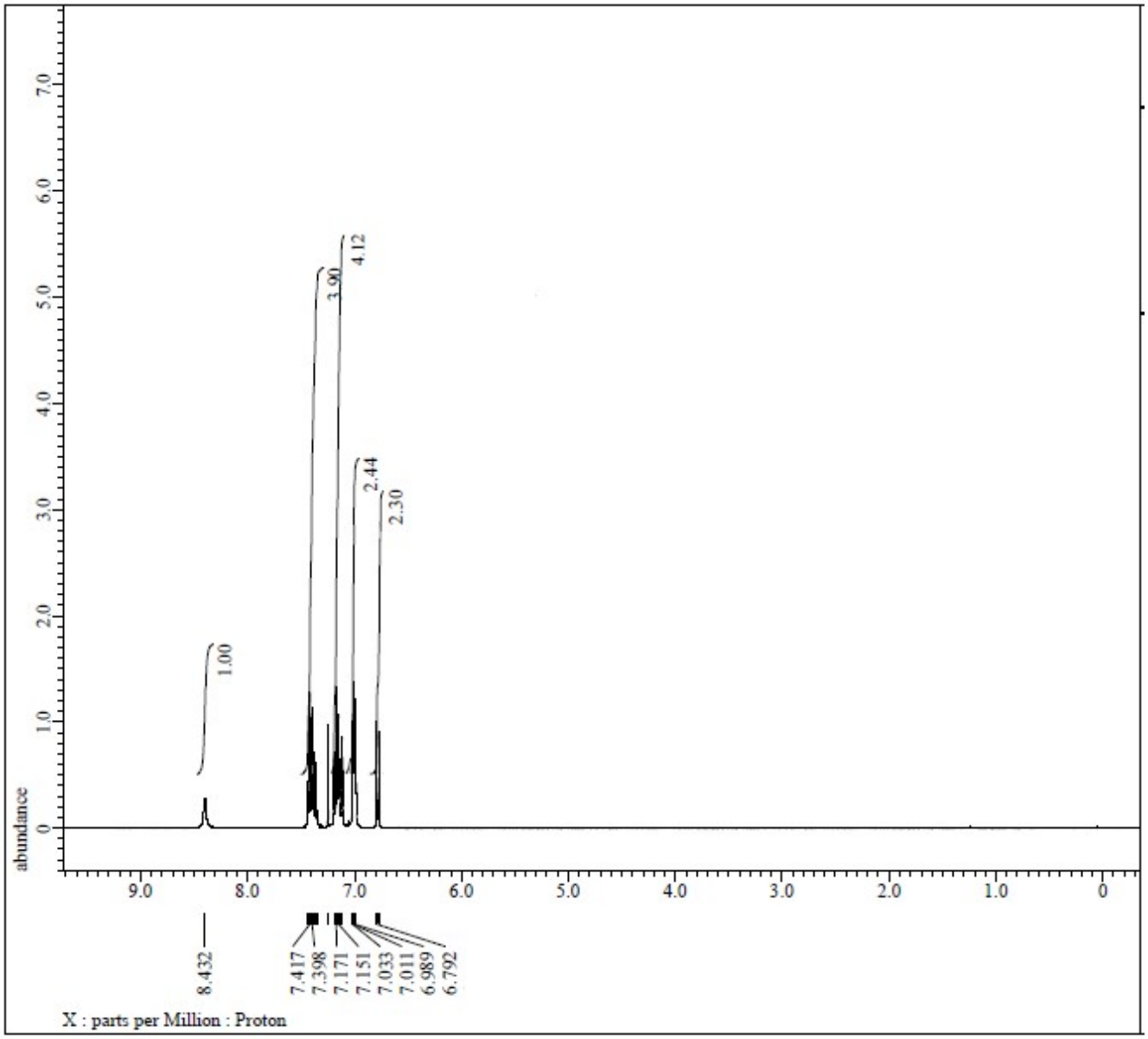

Figure S2(a) ^{1}H NMR spectrum of the synthesized compound **4b**

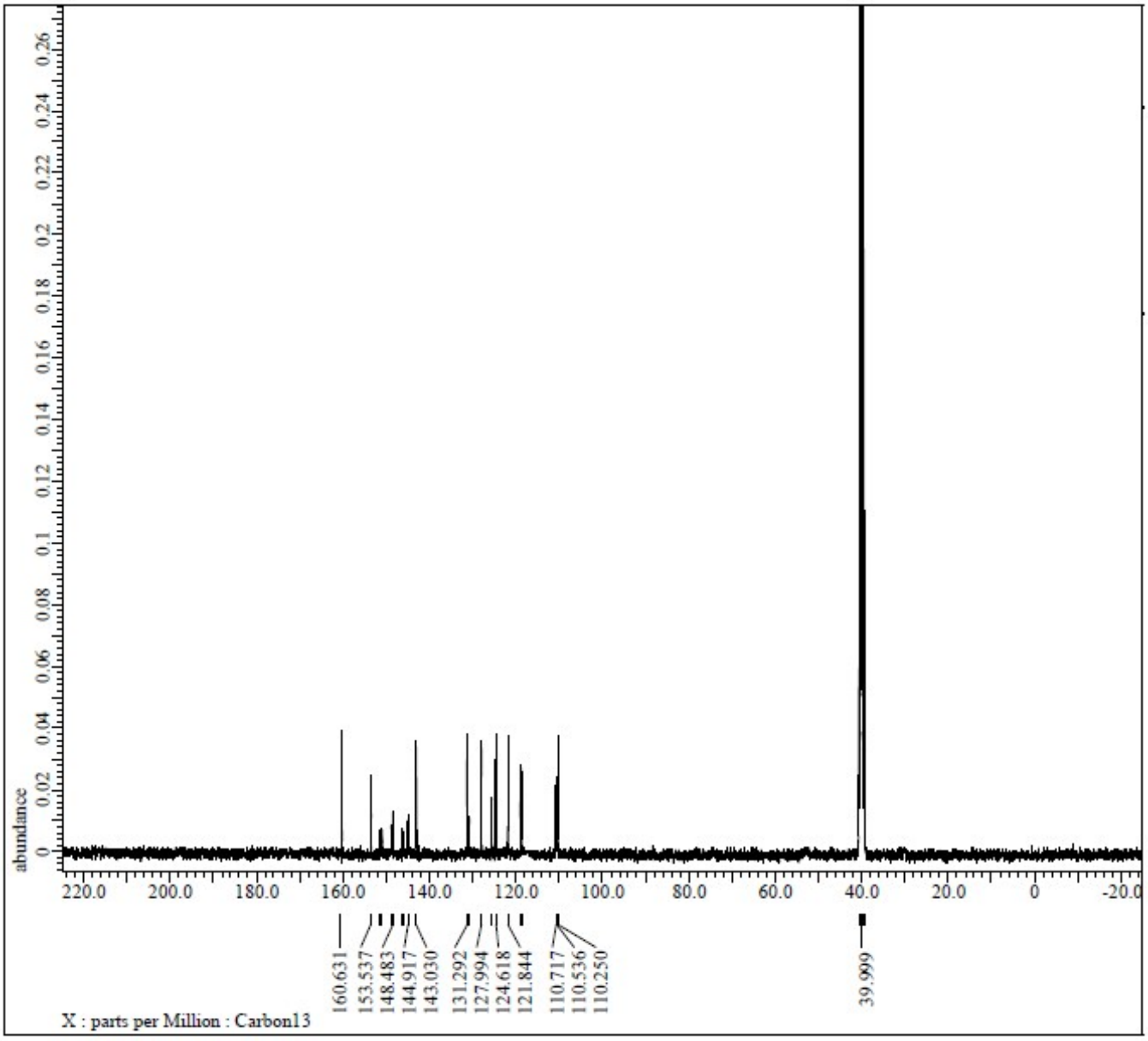

Figure S2(b) ^{13}C NMR spectrum of the synthesized compound **4b**

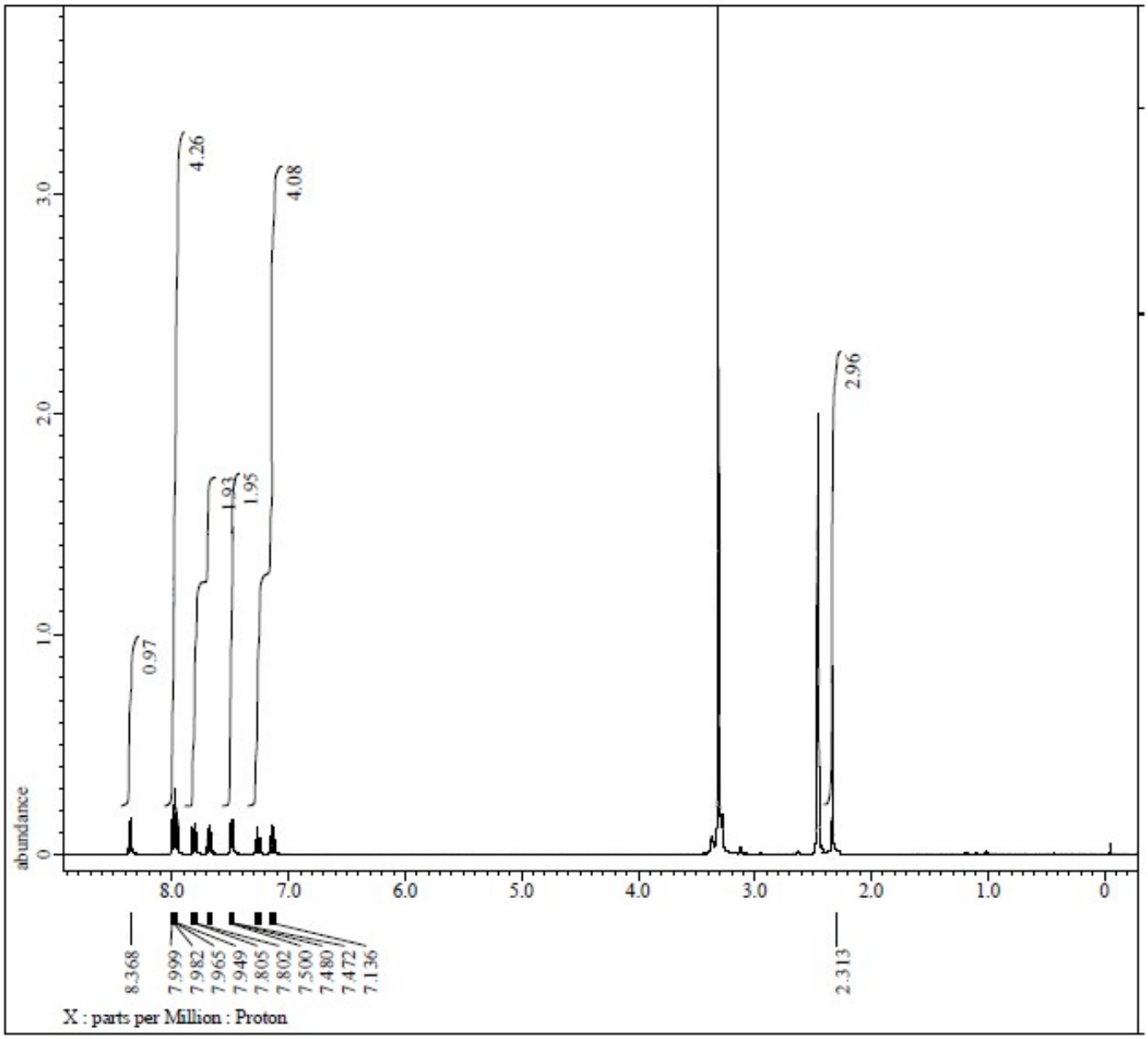

Figure S3(a) ^{1}H NMR spectrum of the synthesized compound **4c**

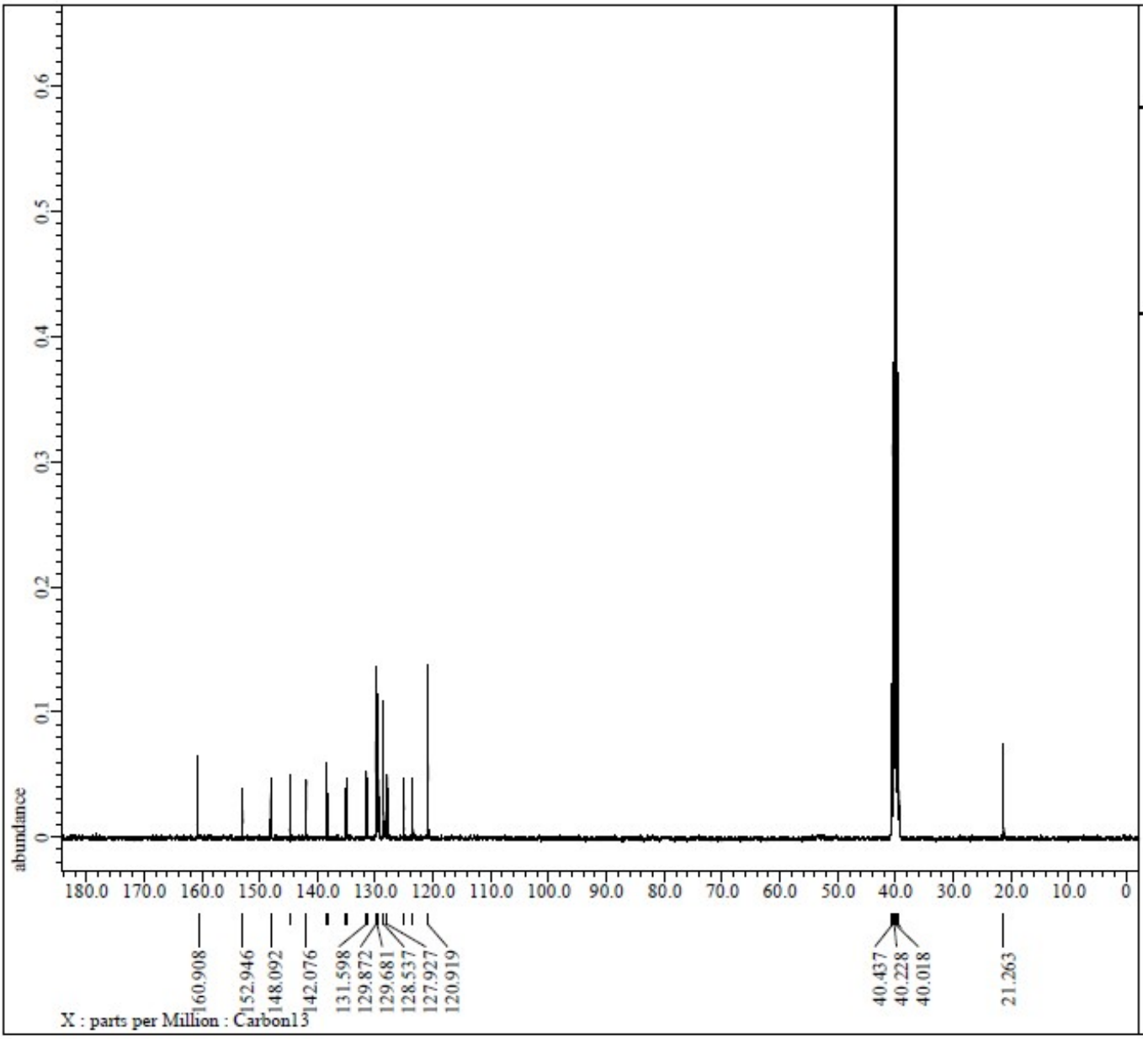

Figure S3(b) ^{13}C NMR spectrum of the synthesized compound **4c**

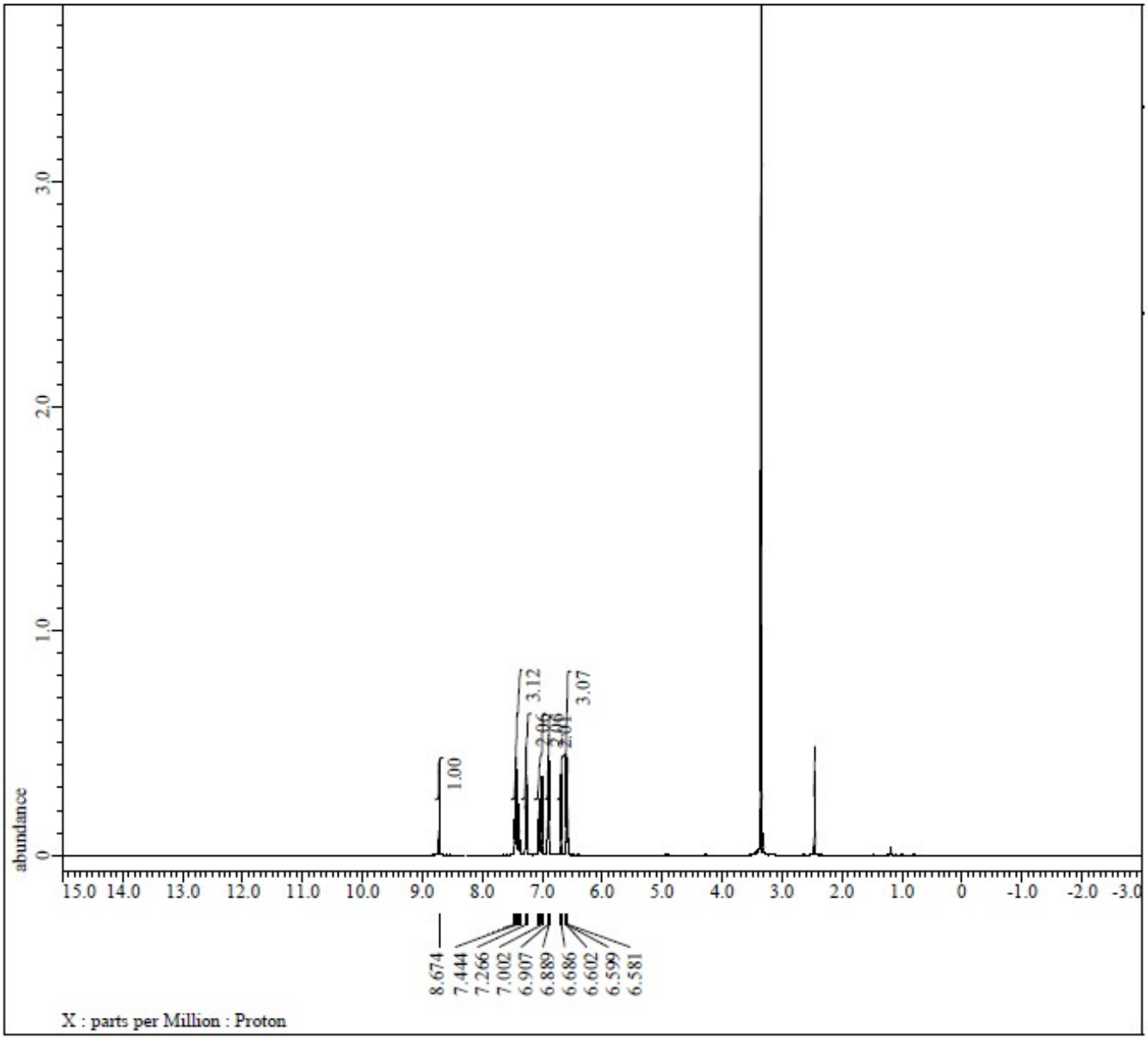

Figure S4(a) ^{1}H NMR spectrum of the synthesized compound **4d**

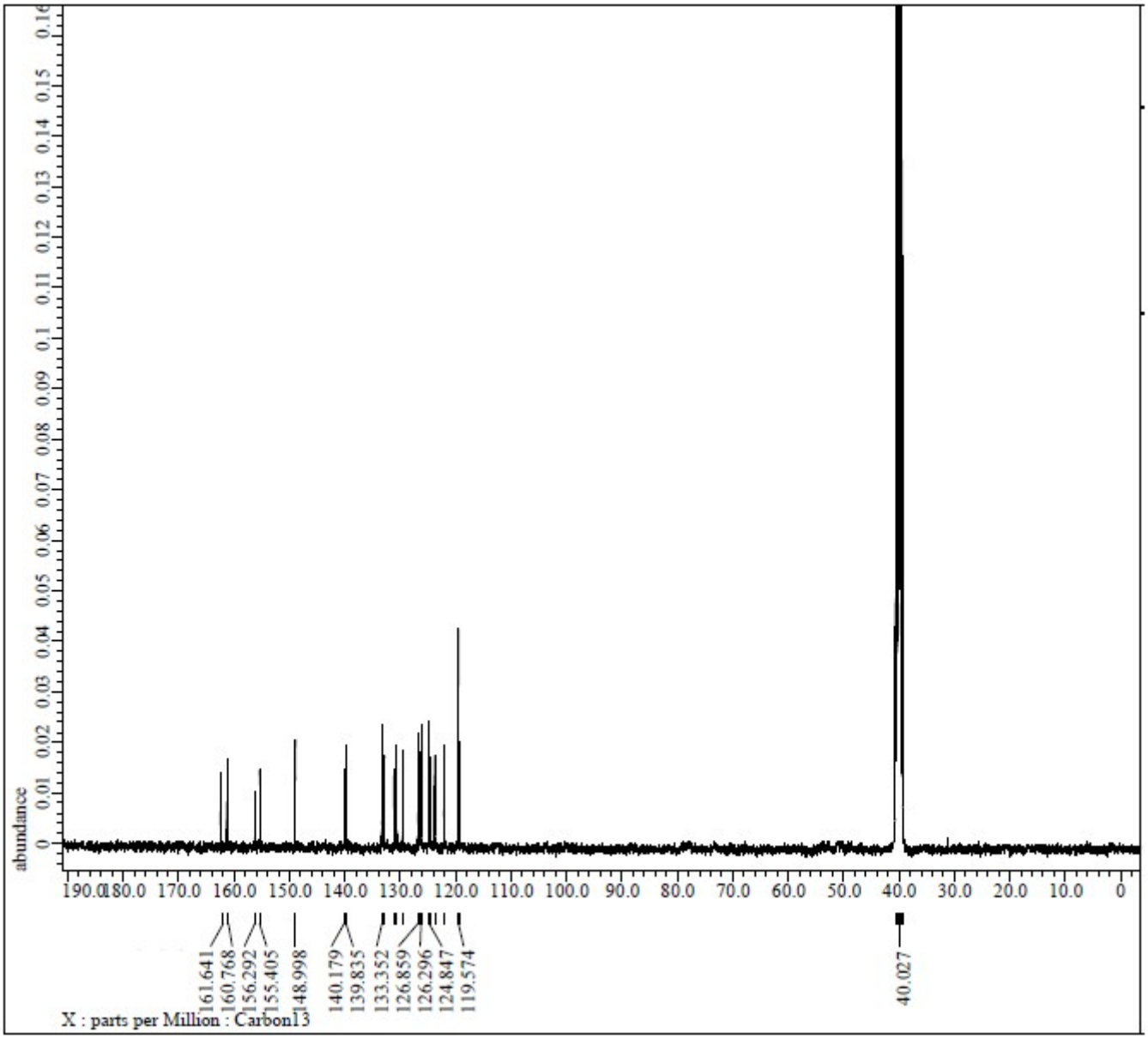

Figure S4(b) ^{13}C NMR spectrum of the synthesized compound **4d**

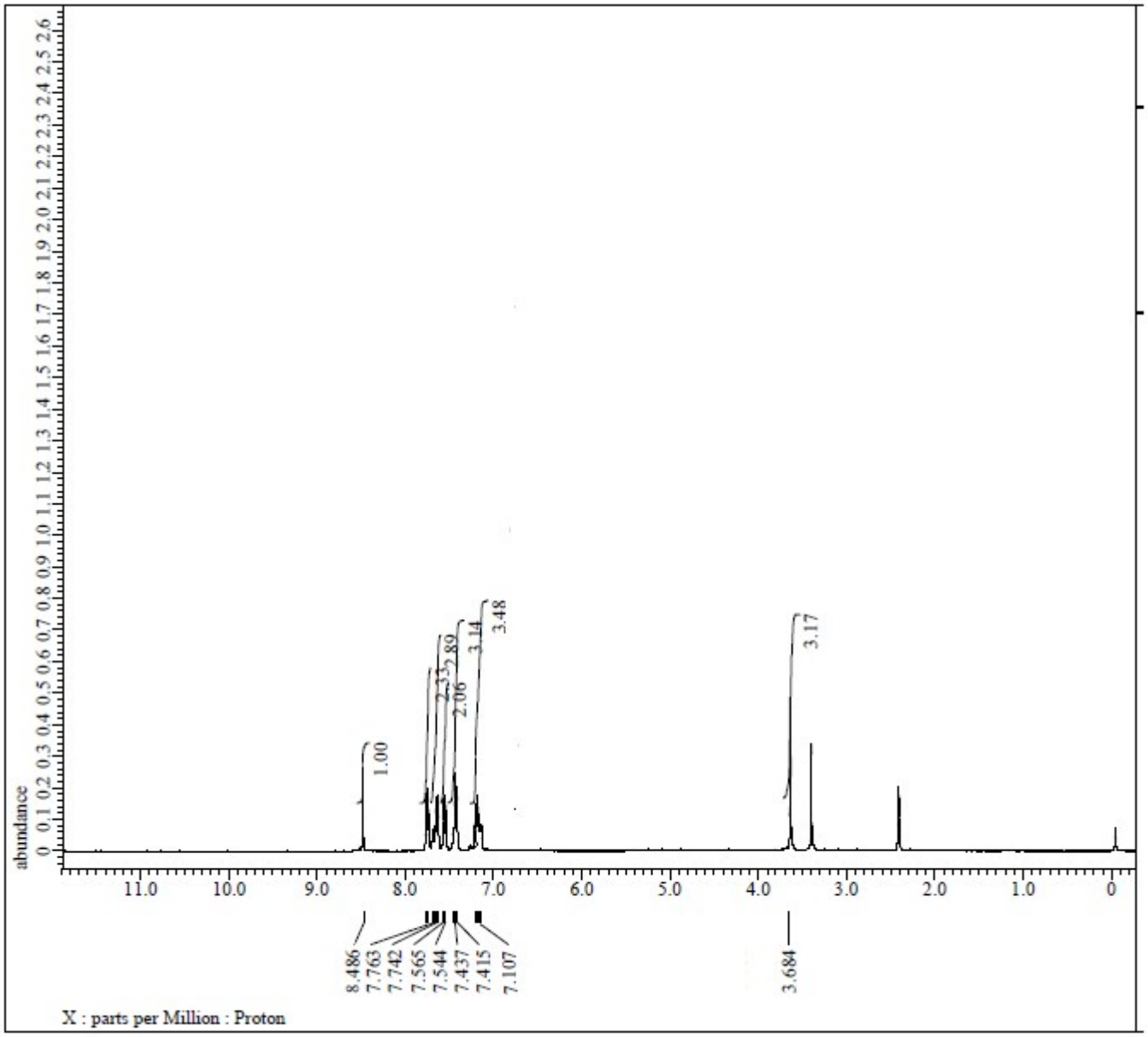

Figure S5(a) ^{1}H NMR spectrum of the synthesized compound **4e**

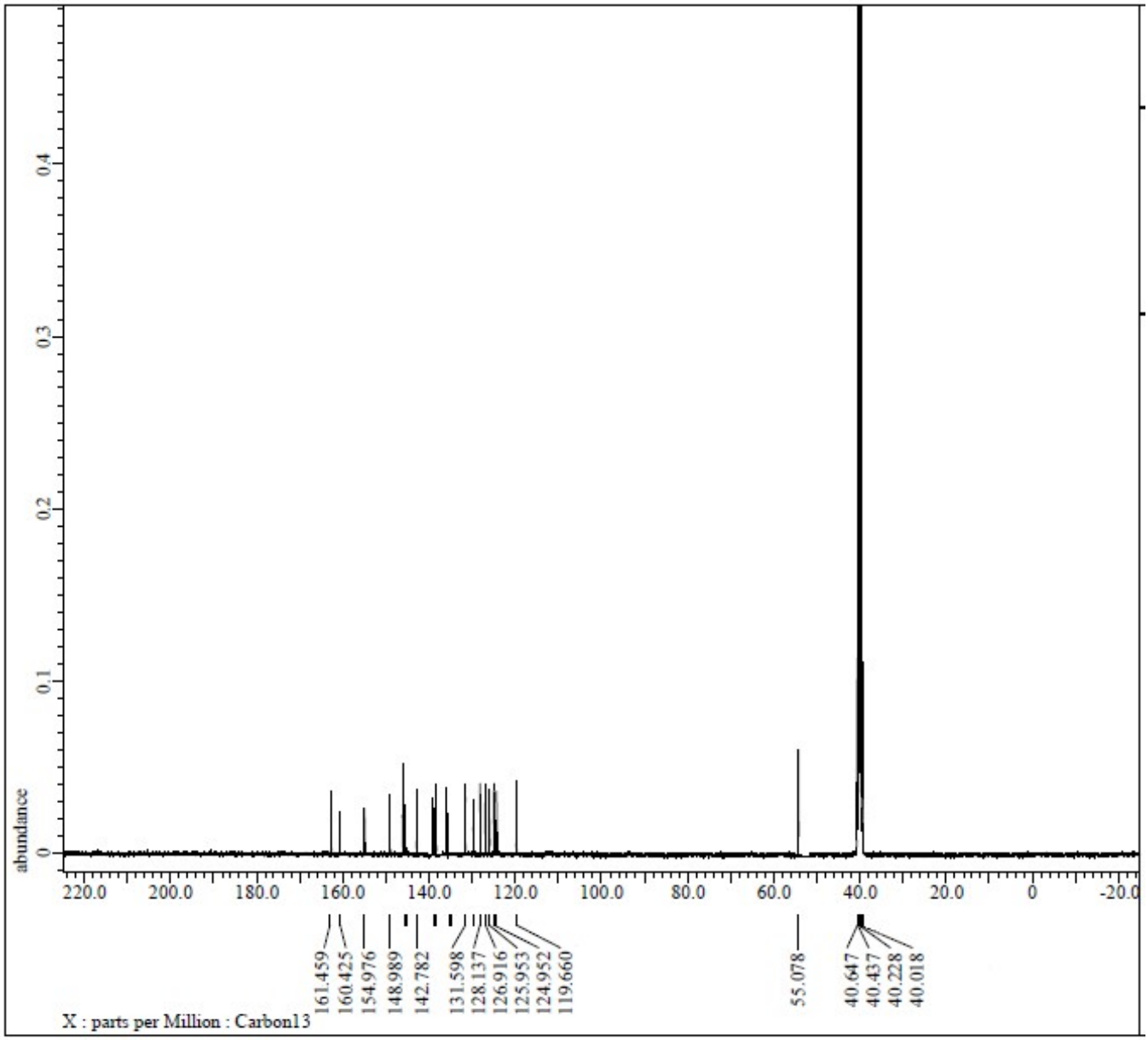

Figure S5(b) ^{13}C NMR spectrum of the synthesized compound **4e**

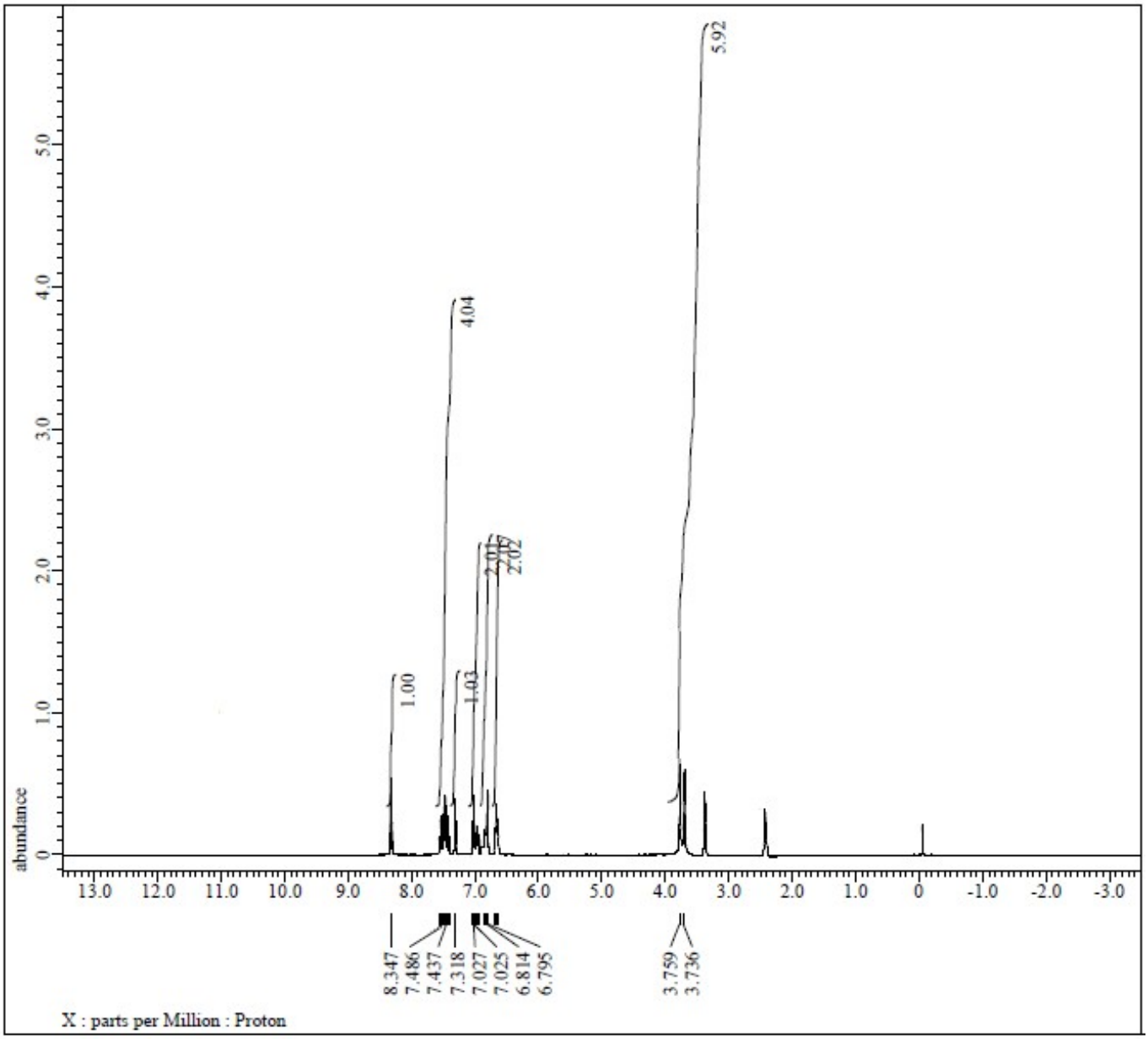

Figure S6(a) ^{1}H NMR spectrum of the synthesized compound **4f**

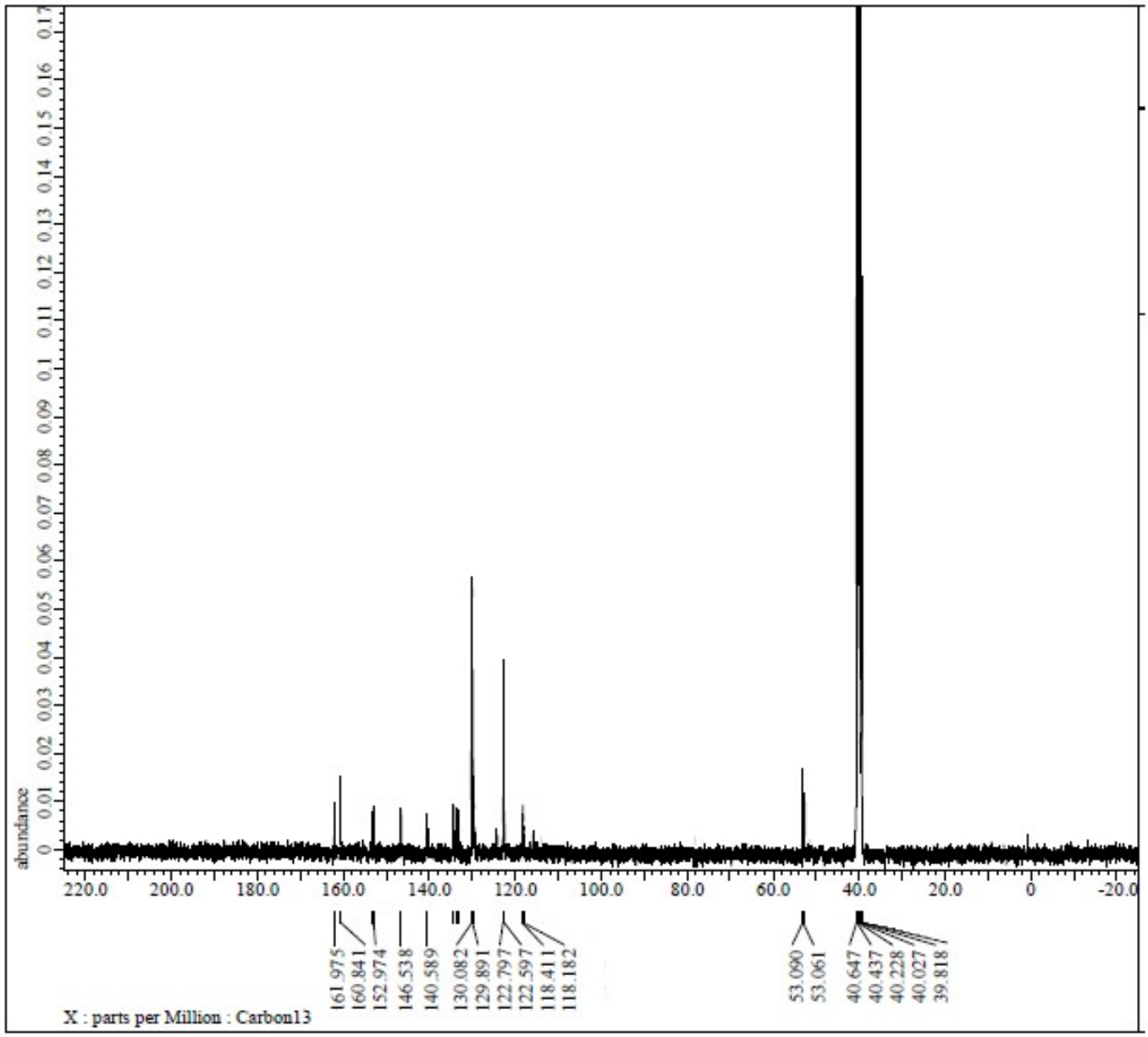

Figure S6(b) ^{13}C NMR spectrum of the synthesized compound **4f**

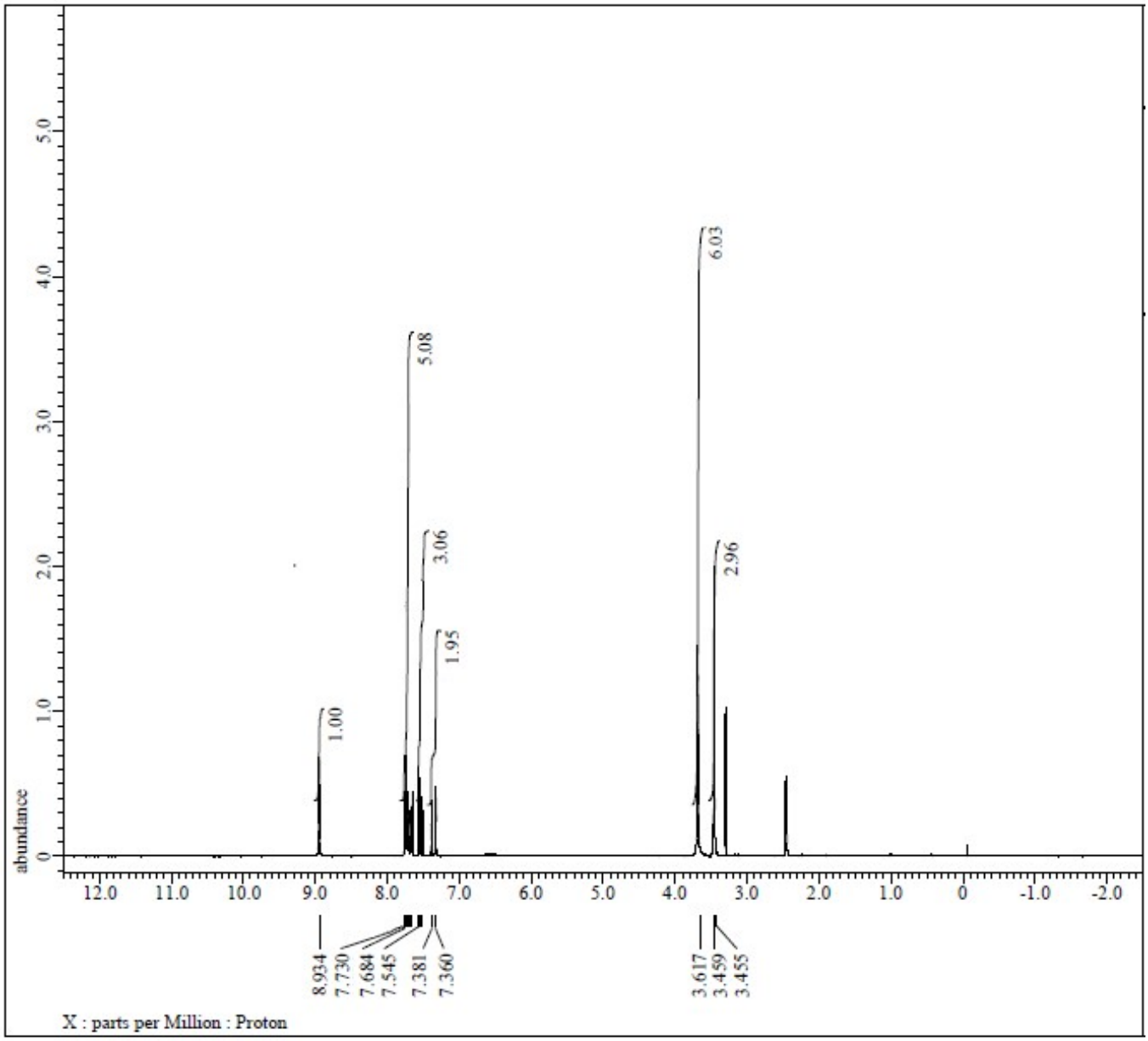

Figure S7(a) ^{1}H NMR spectrum of the synthesized compound **4g**

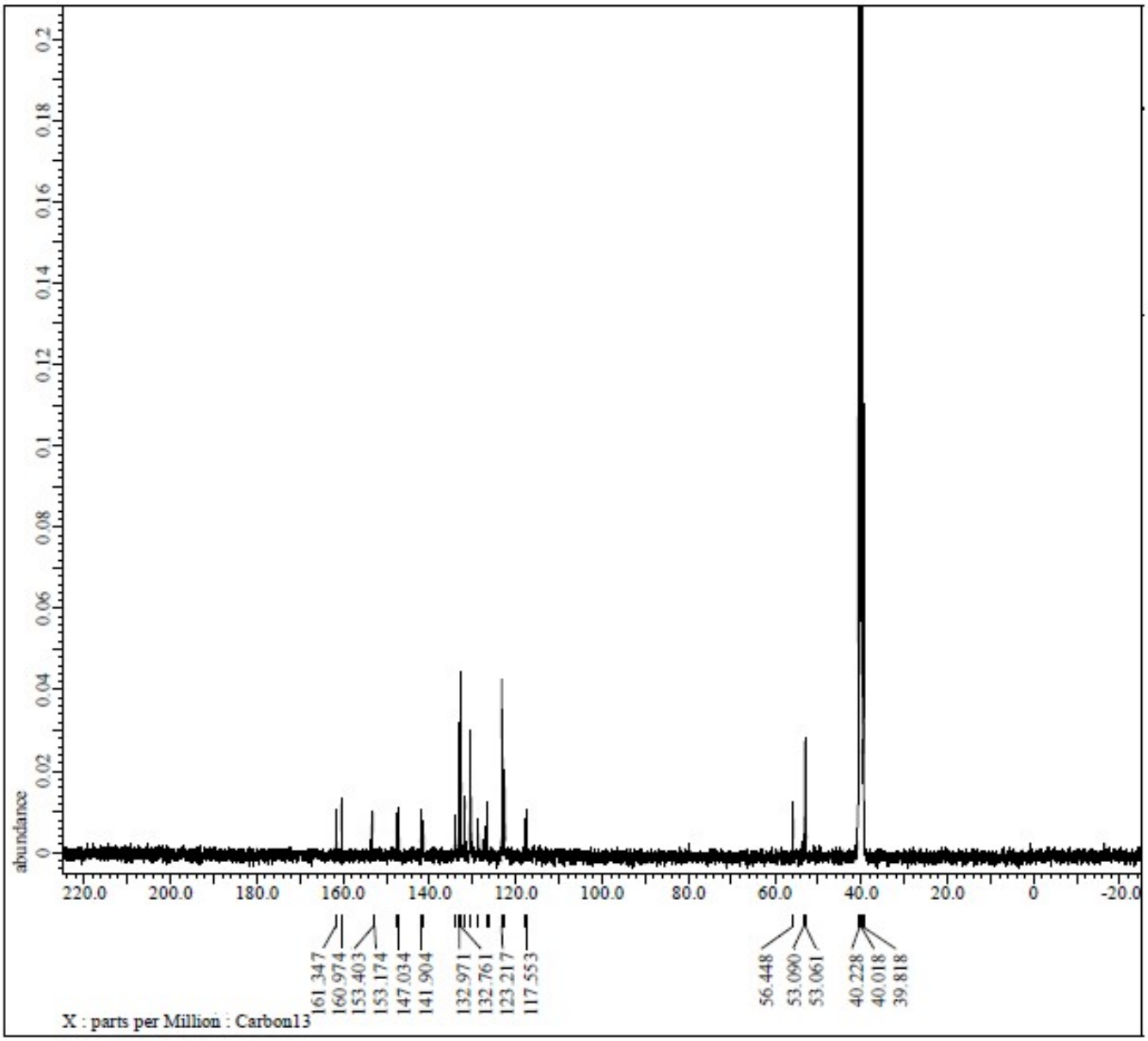

Figure S7(b) ^{13}C NMR spectrum of the synthesized compound **4g**

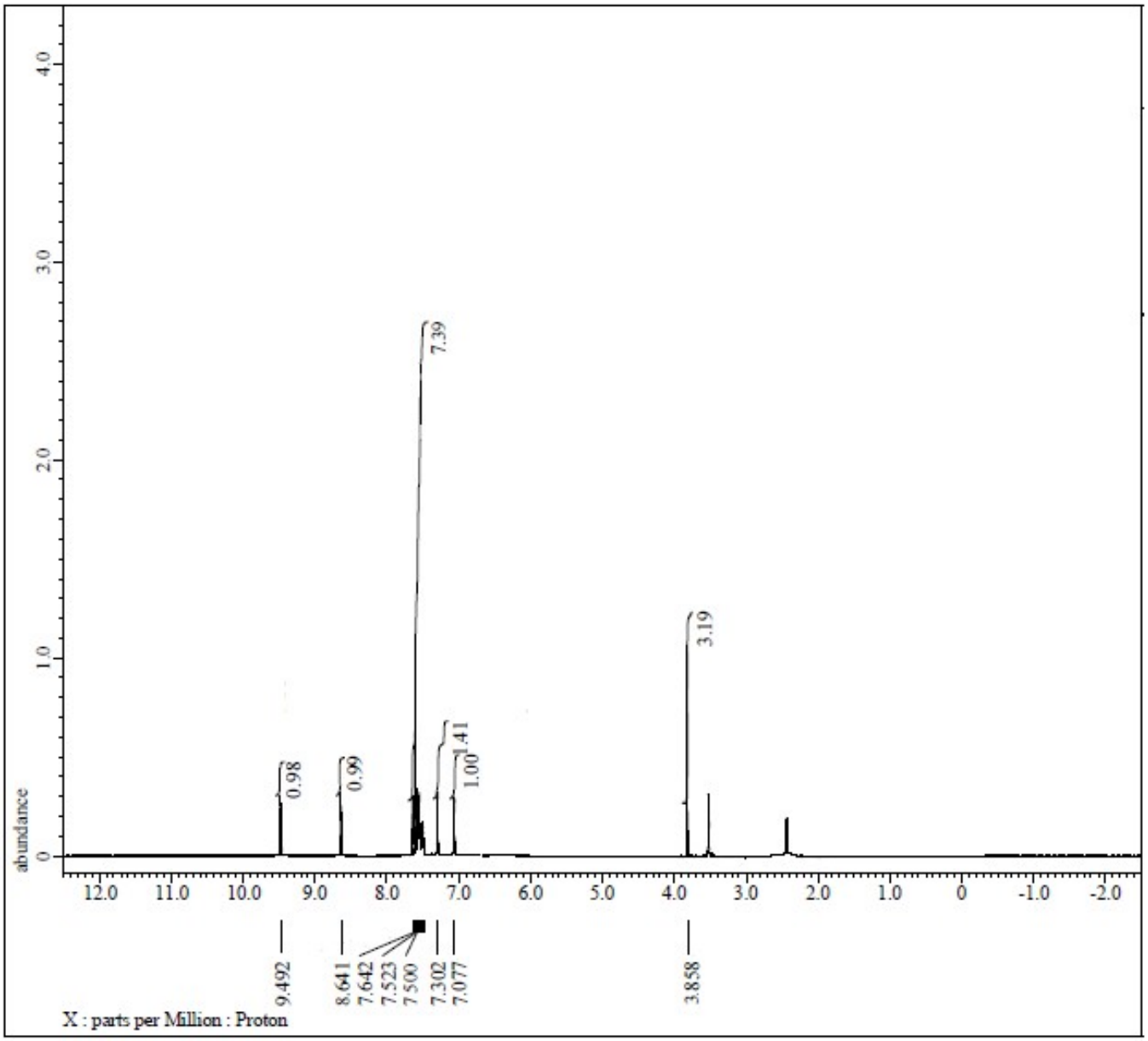

Figure S8(a) ^{1}H NMR spectrum of the synthesized compound **4h**

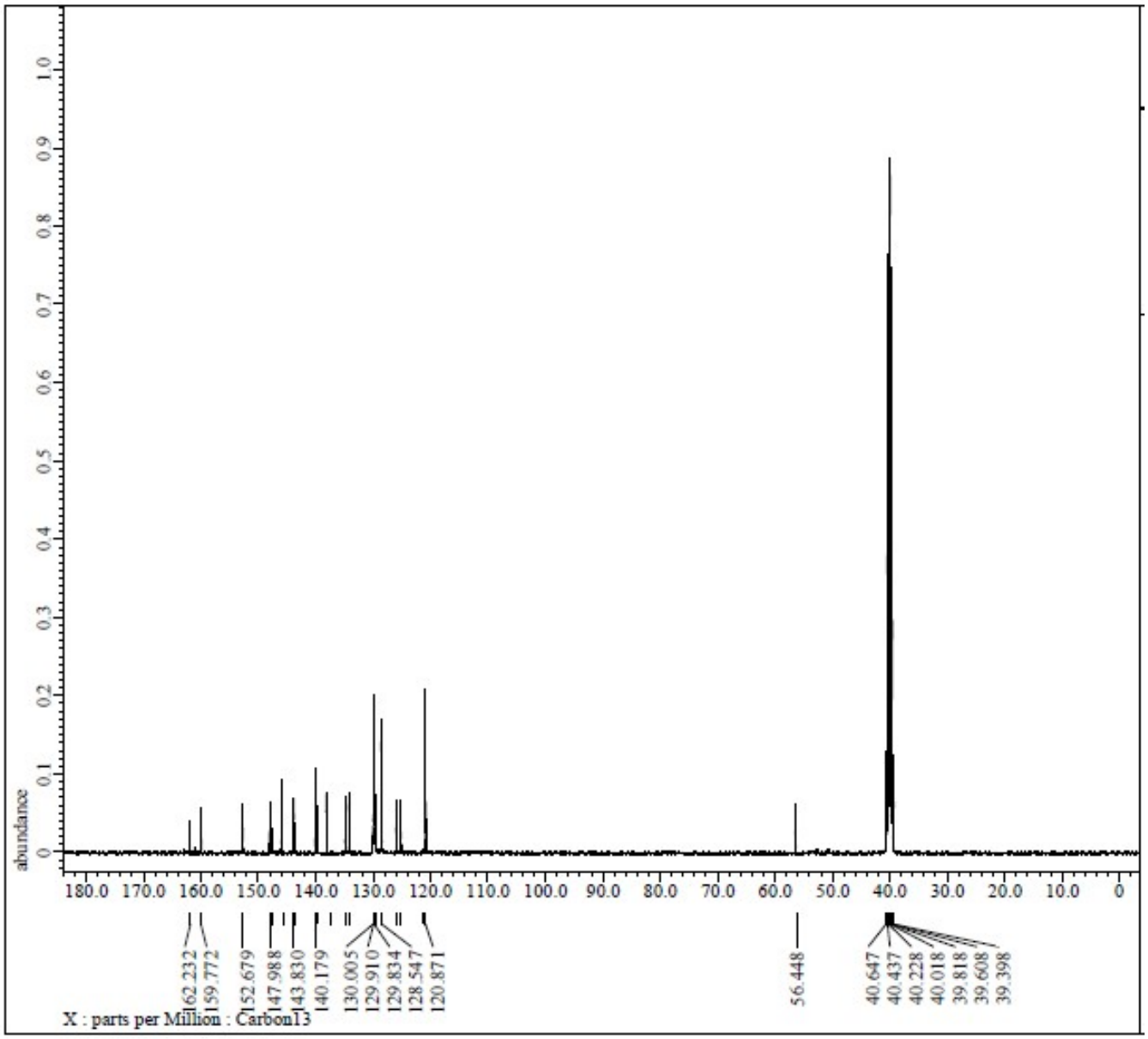

Figure S8(b) ^{13}C NMR spectrum of the synthesized compound **4h**

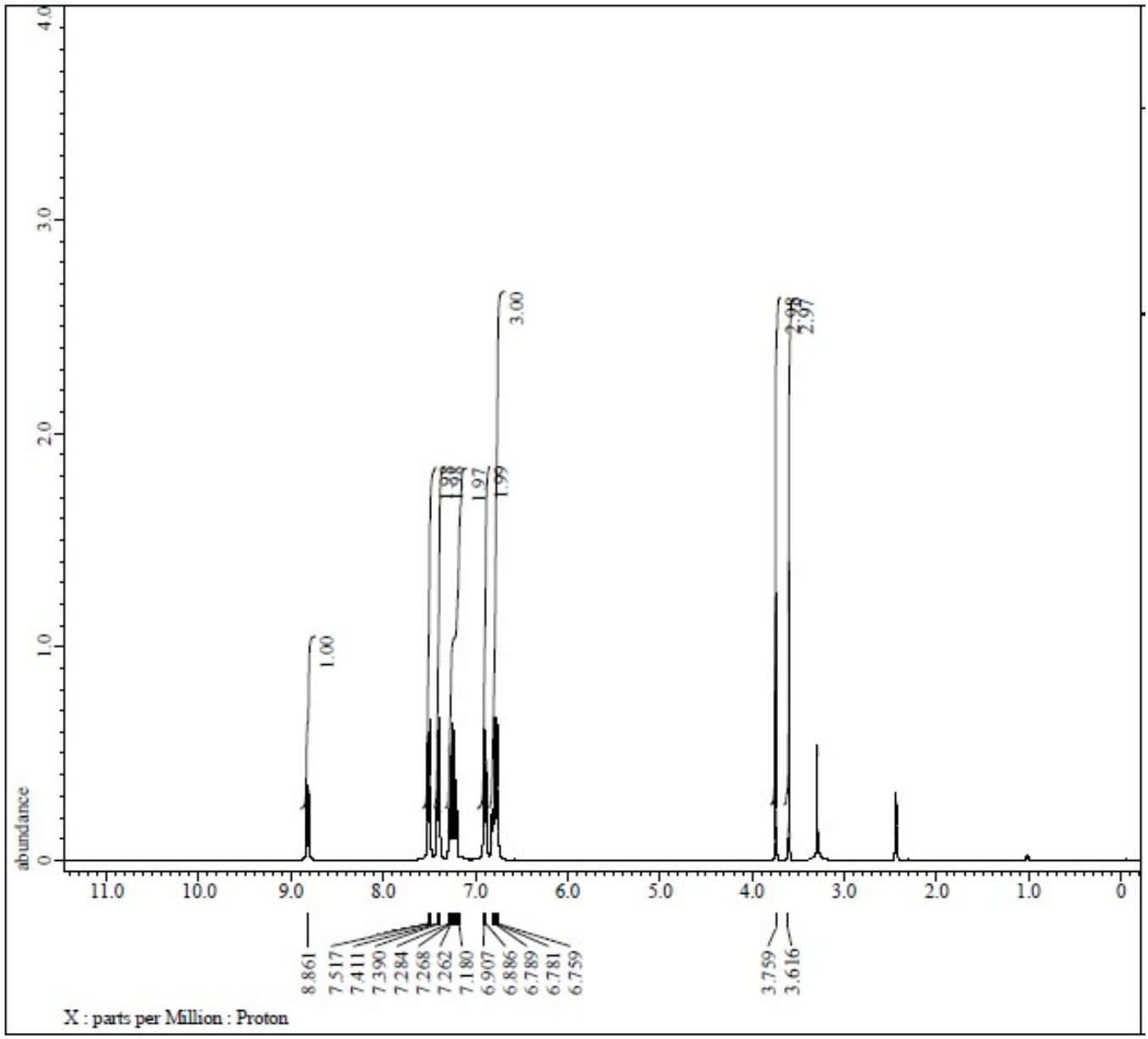

Figure S9(a) ^{1}H NMR spectrum of the synthesized compound **4i**

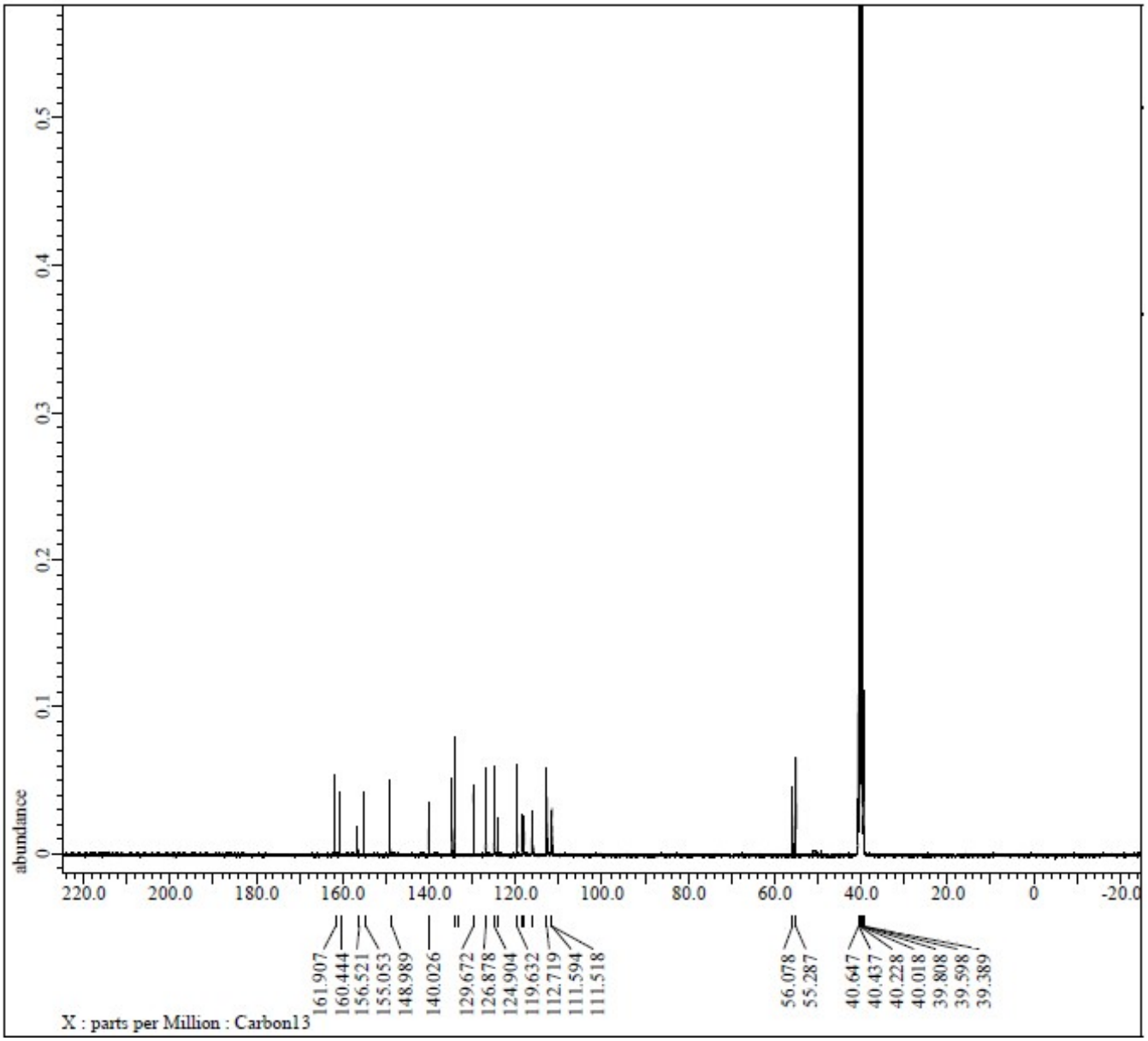

Figure S9(b) ^{13}C NMR spectrum of the synthesized compound **4i**

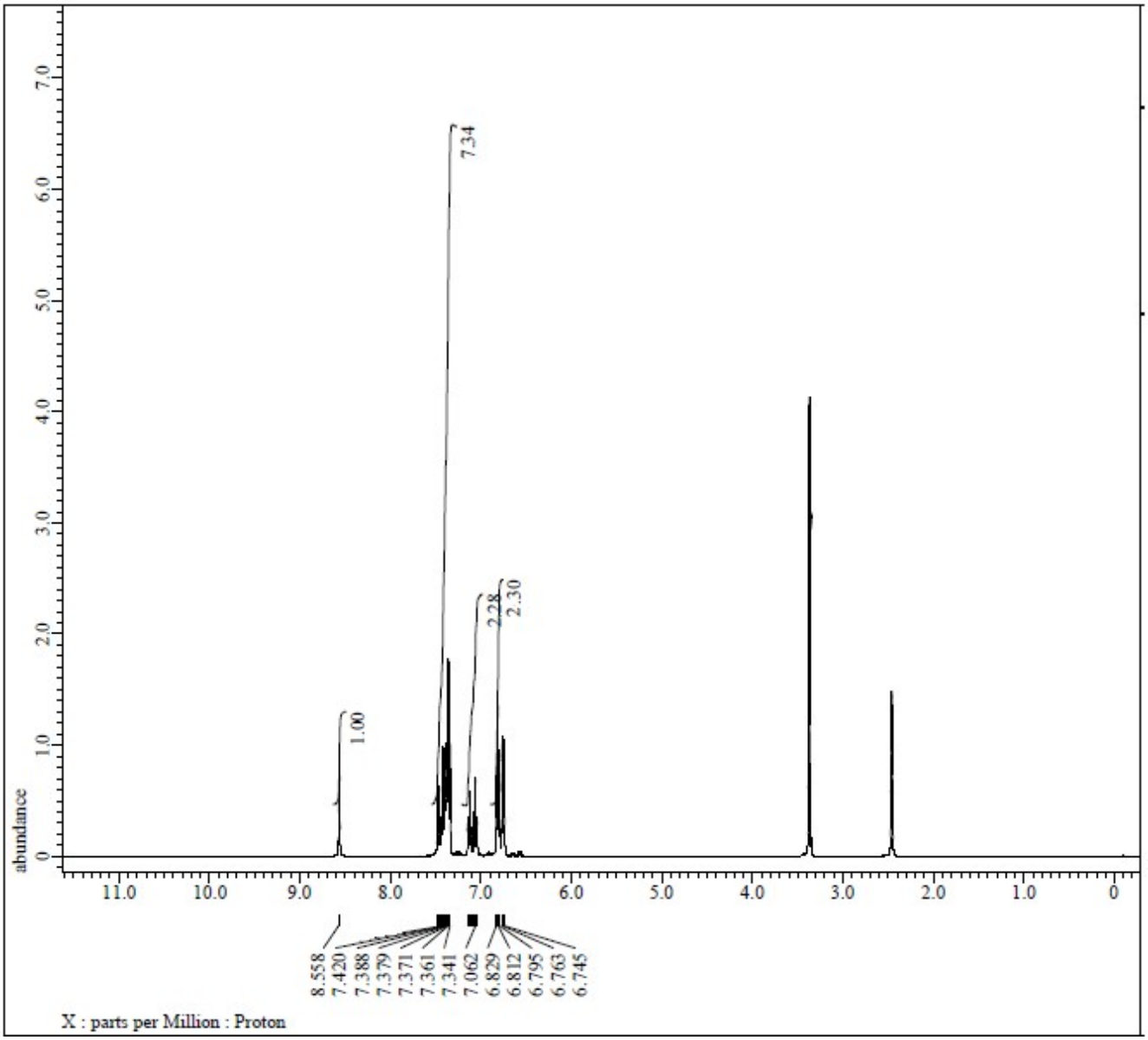

Figure S10(**a**) ^{1}H NMR spectrum of the synthesized compound **4j**

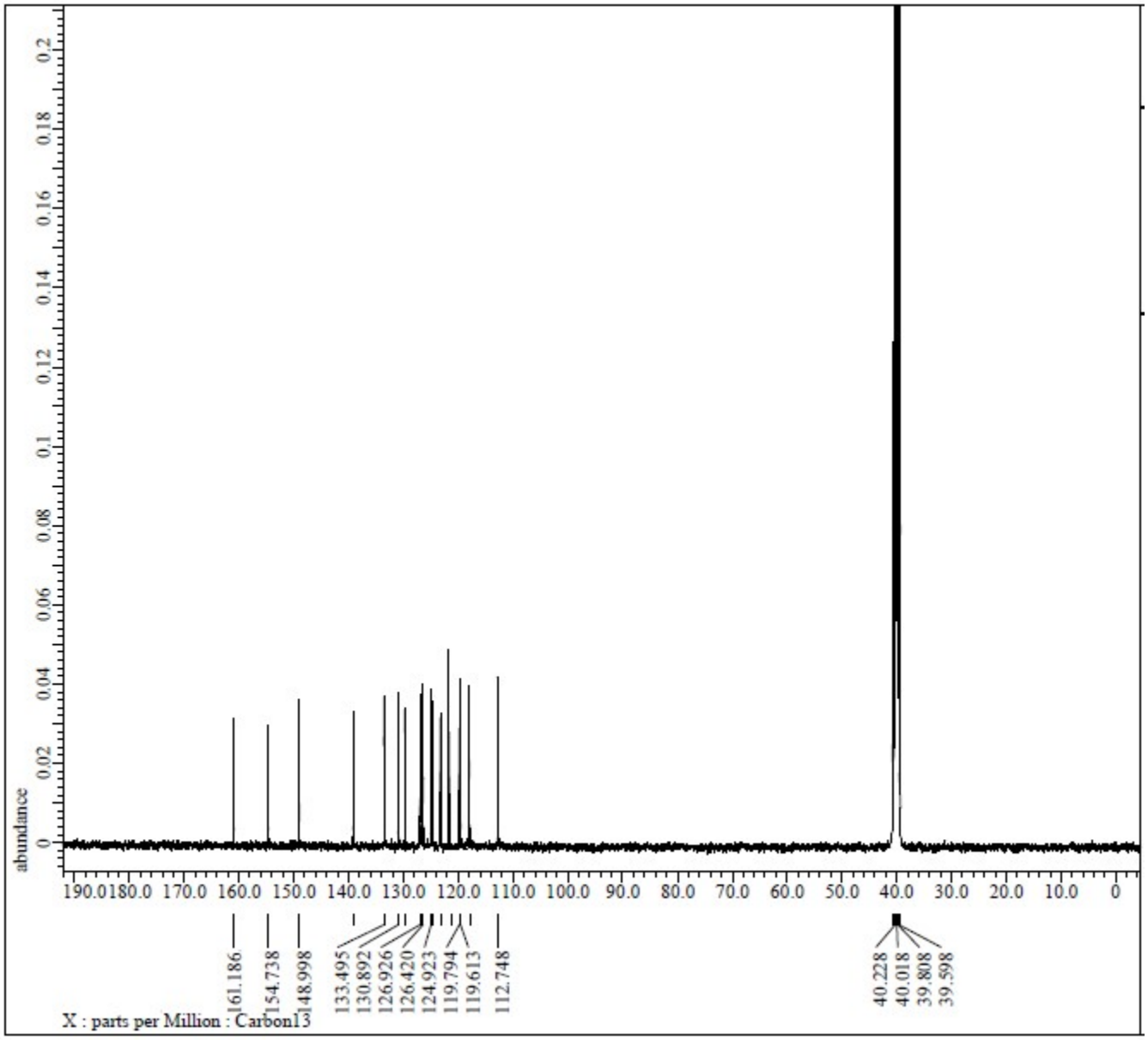

Figure S10(b) ^{13}C NMR spectrum of the synthesized compound **4j**

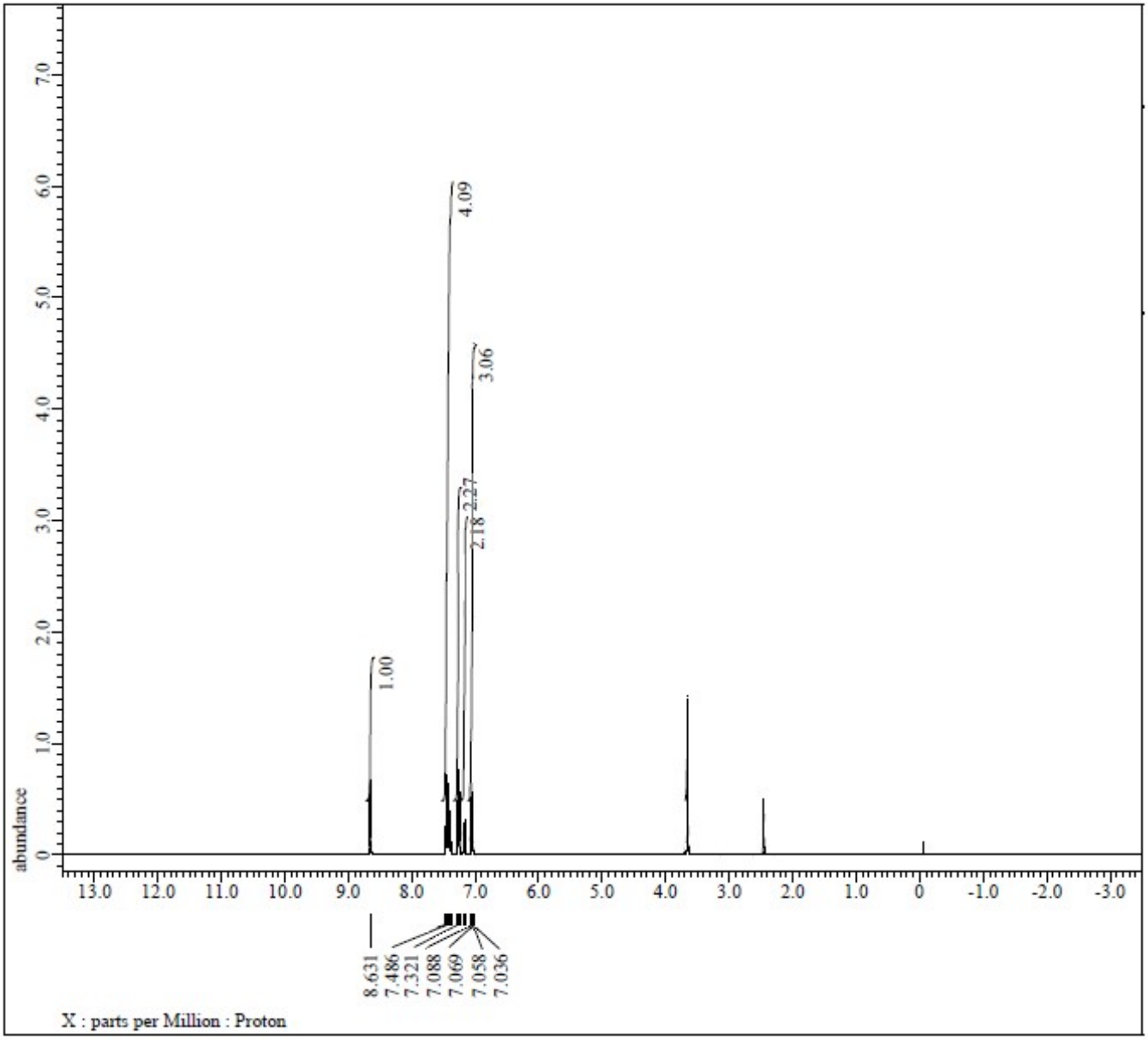

Figure S11(a) ^{1}H NMR spectrum of the synthesized compound **4k**

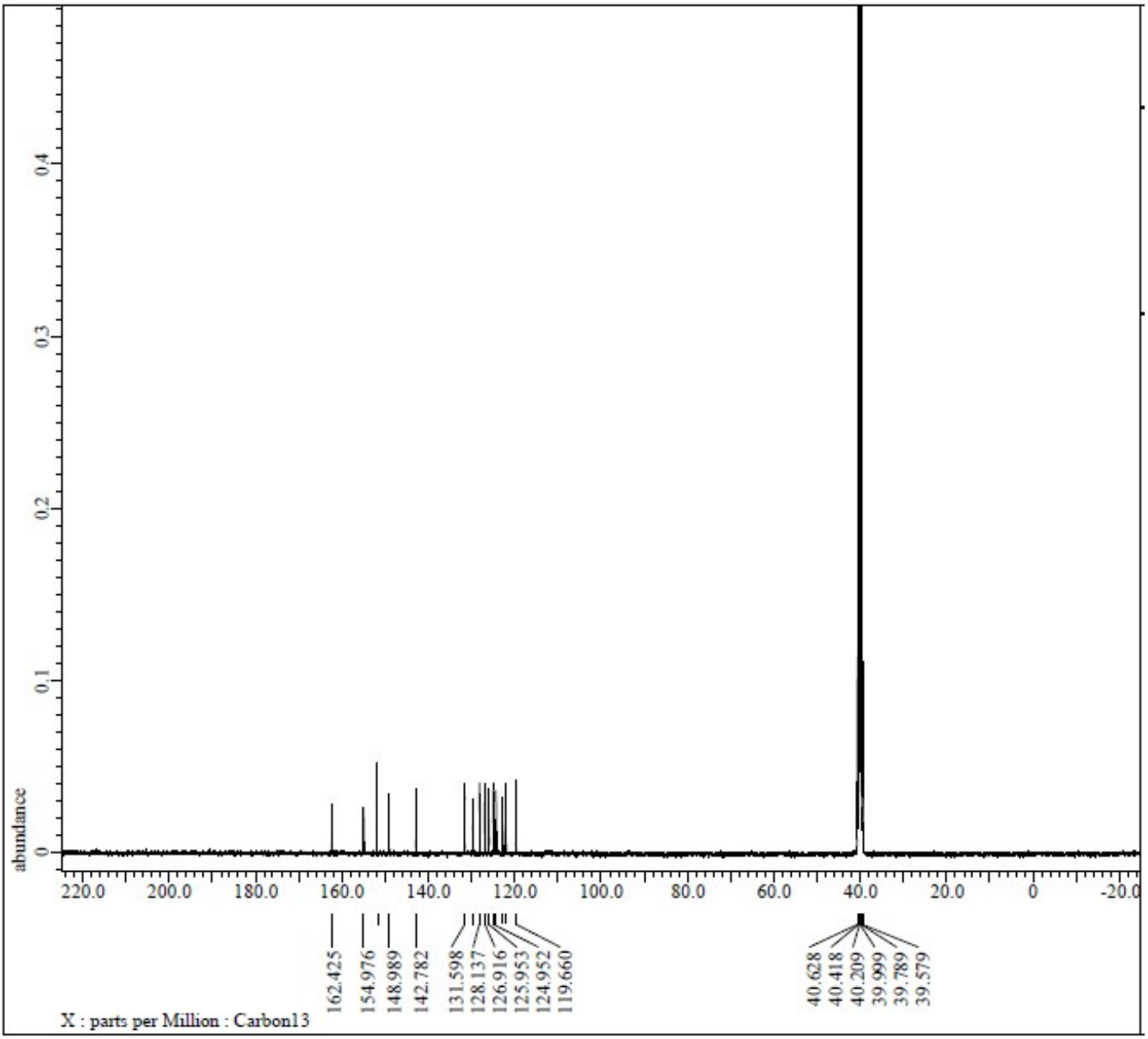

Figure S11(b) ^{13}C NMR spectrum of the synthesized compound **4k**

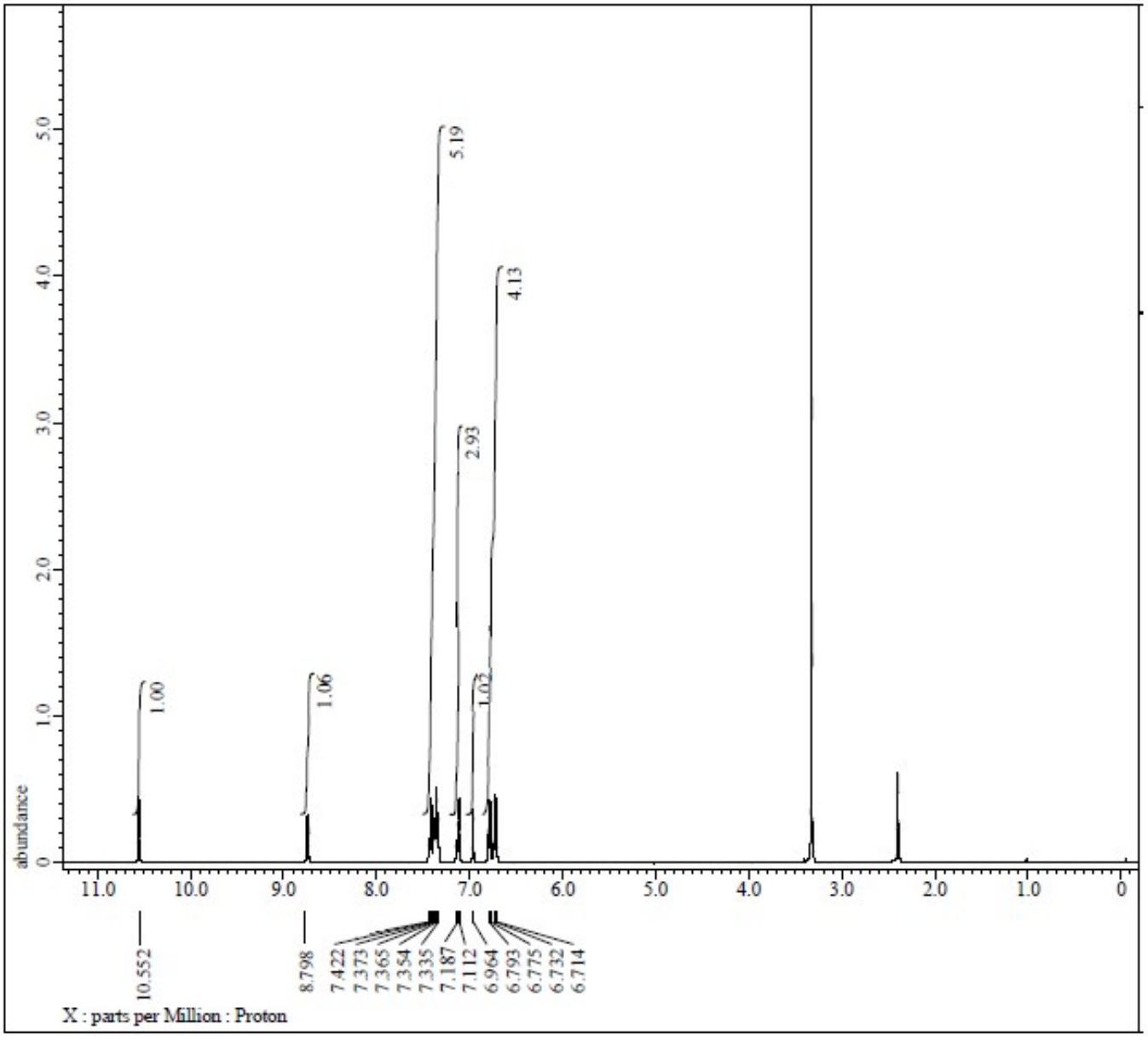

Figure S12(a) ^{1}H NMR spectrum of the synthesized compound **4l**

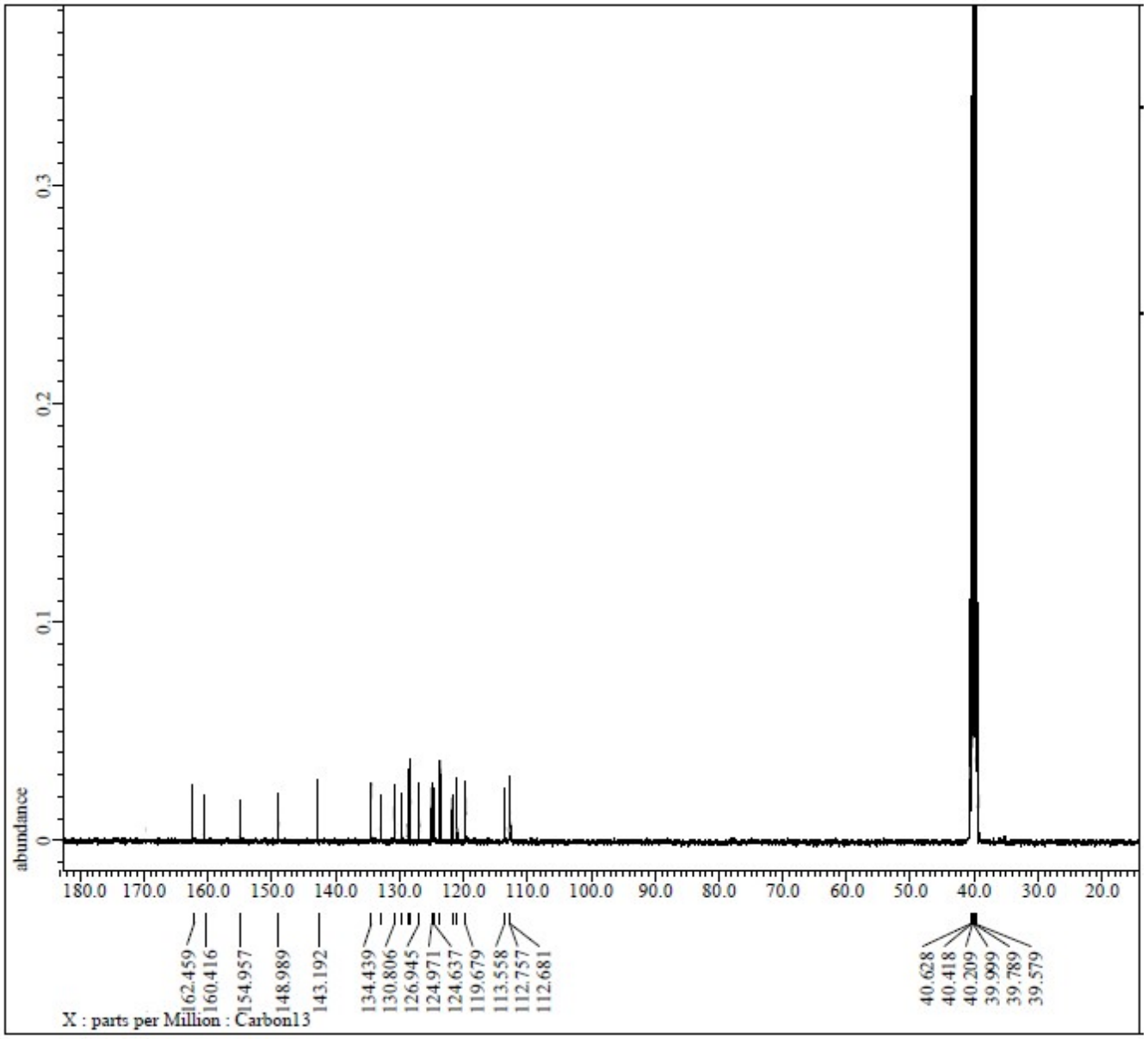

Figure S12(b) ^{13}C NMR spectrum of the synthesized compound **4l**

IV. ^{1}HNMR and ^{13}CNMR of synthesised compounds 6a-h

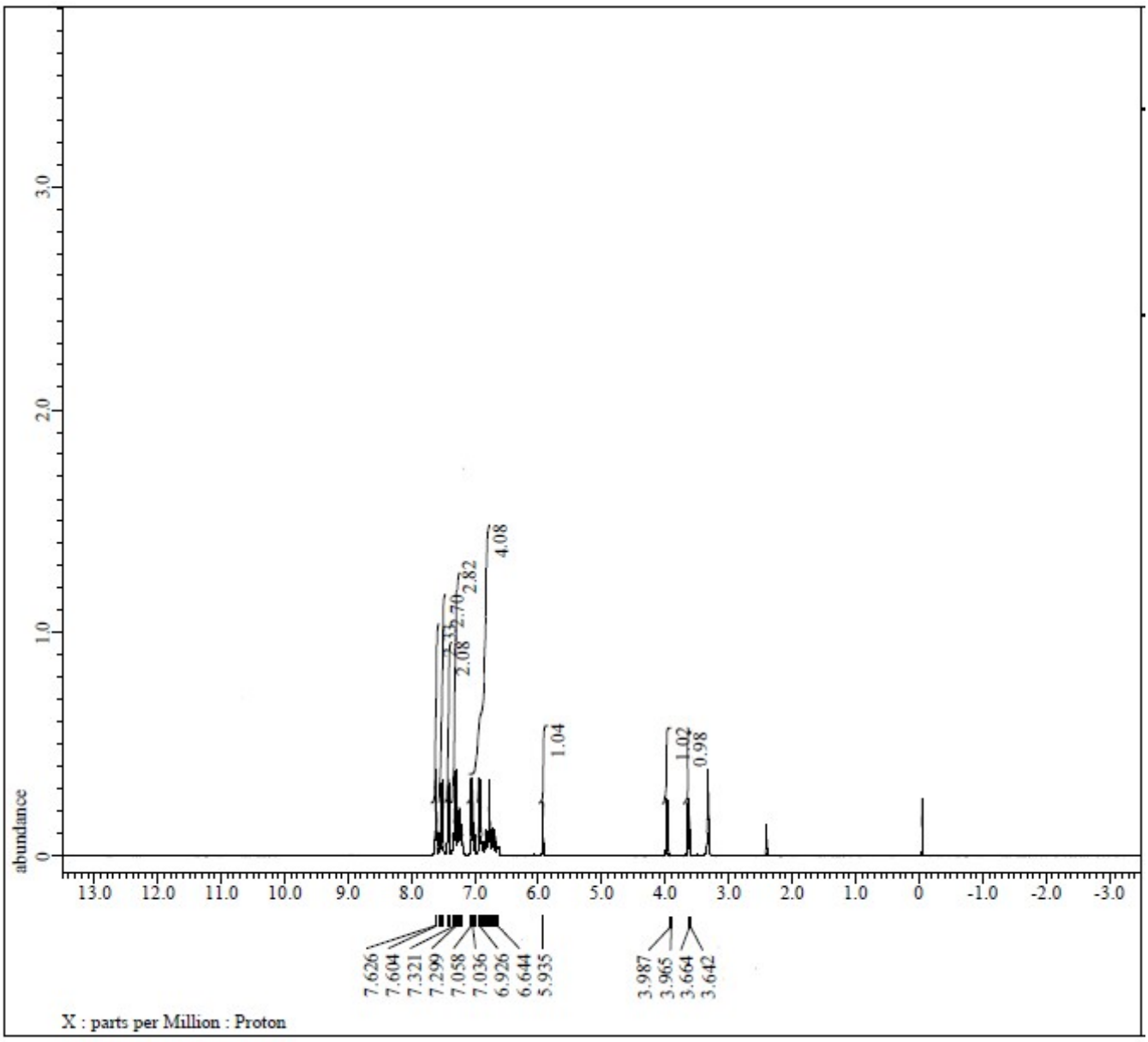

Figure S13(a) ^{1}H NMR spectrum of the synthesized compound **6a**

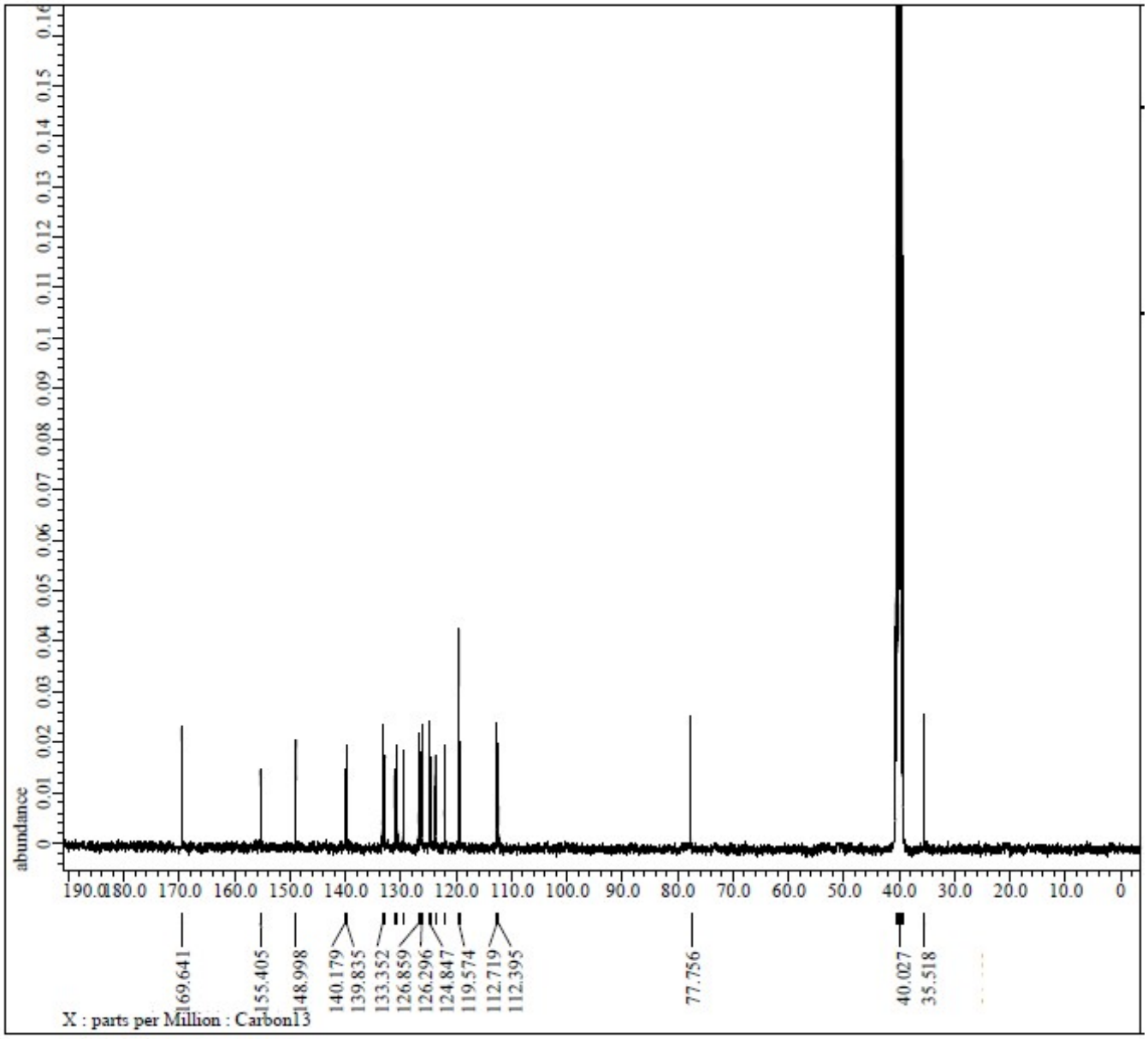

Figure S13(b) ^{13}C NMR spectrum of the synthesized compound **6a**

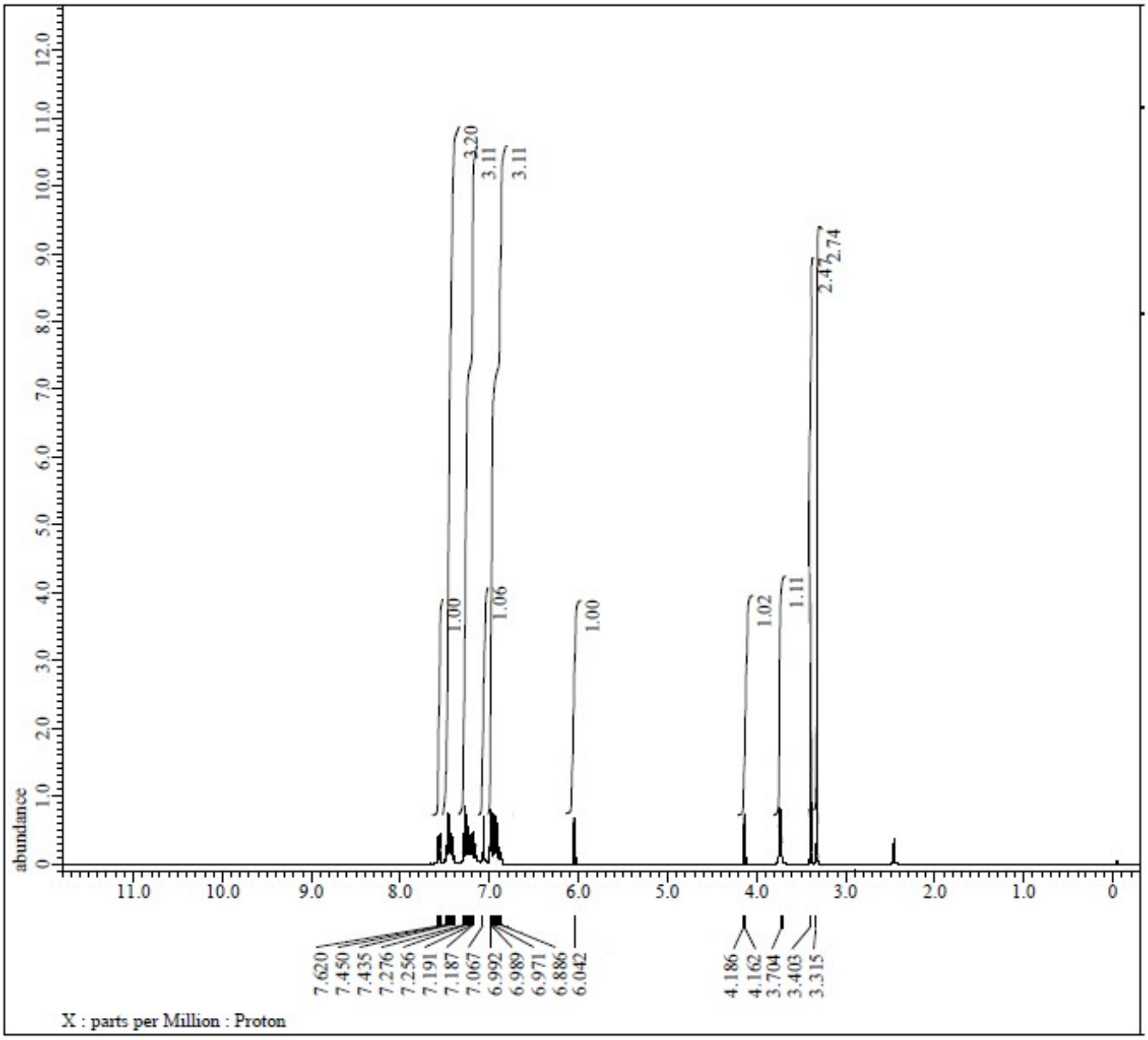

Figure S14(a) ^{1}H NMR spectrum of the synthesized compound **6b**

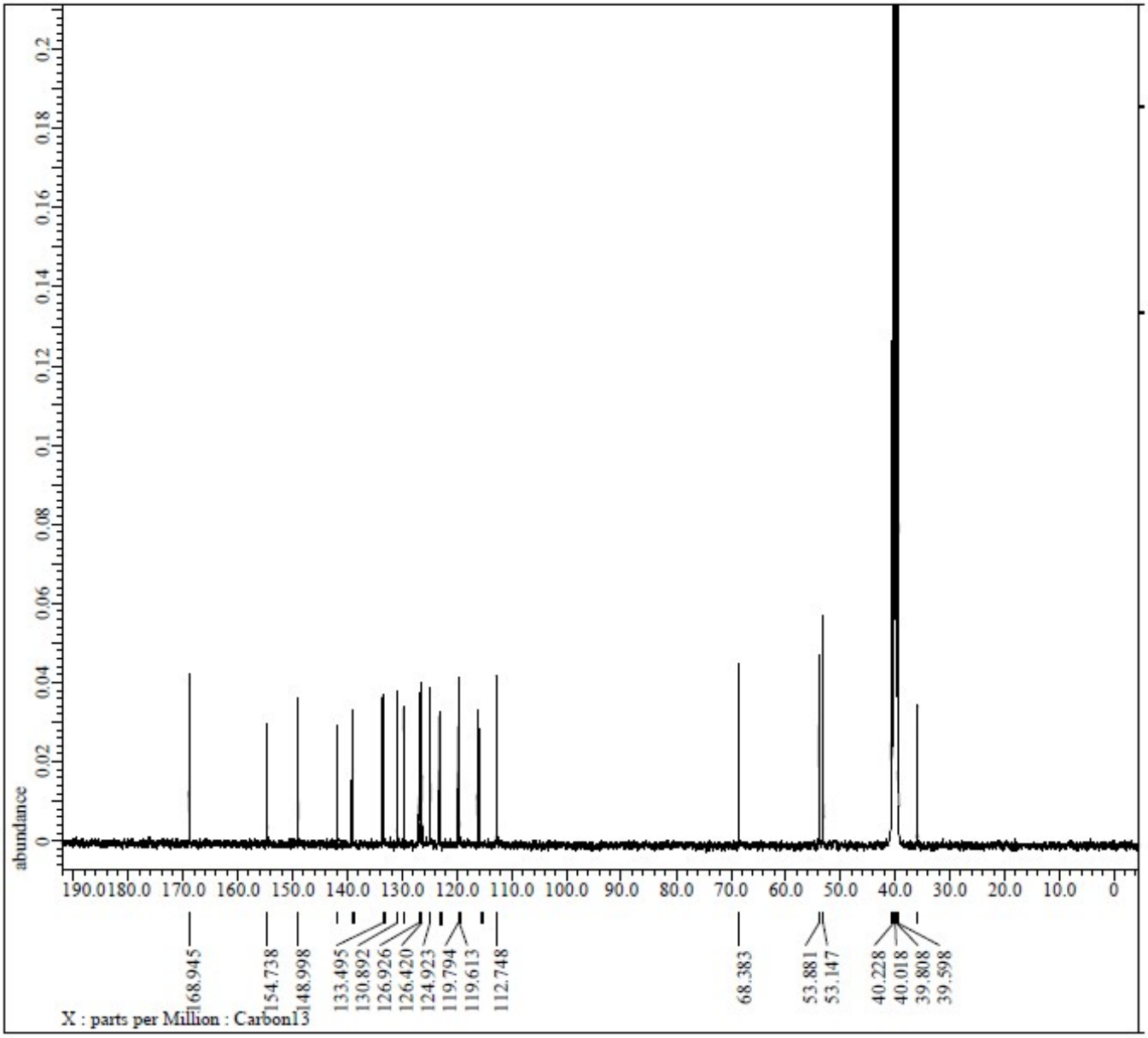

Figure S14(b) ^{13}C NMR spectrum of the synthesized compound **6b**

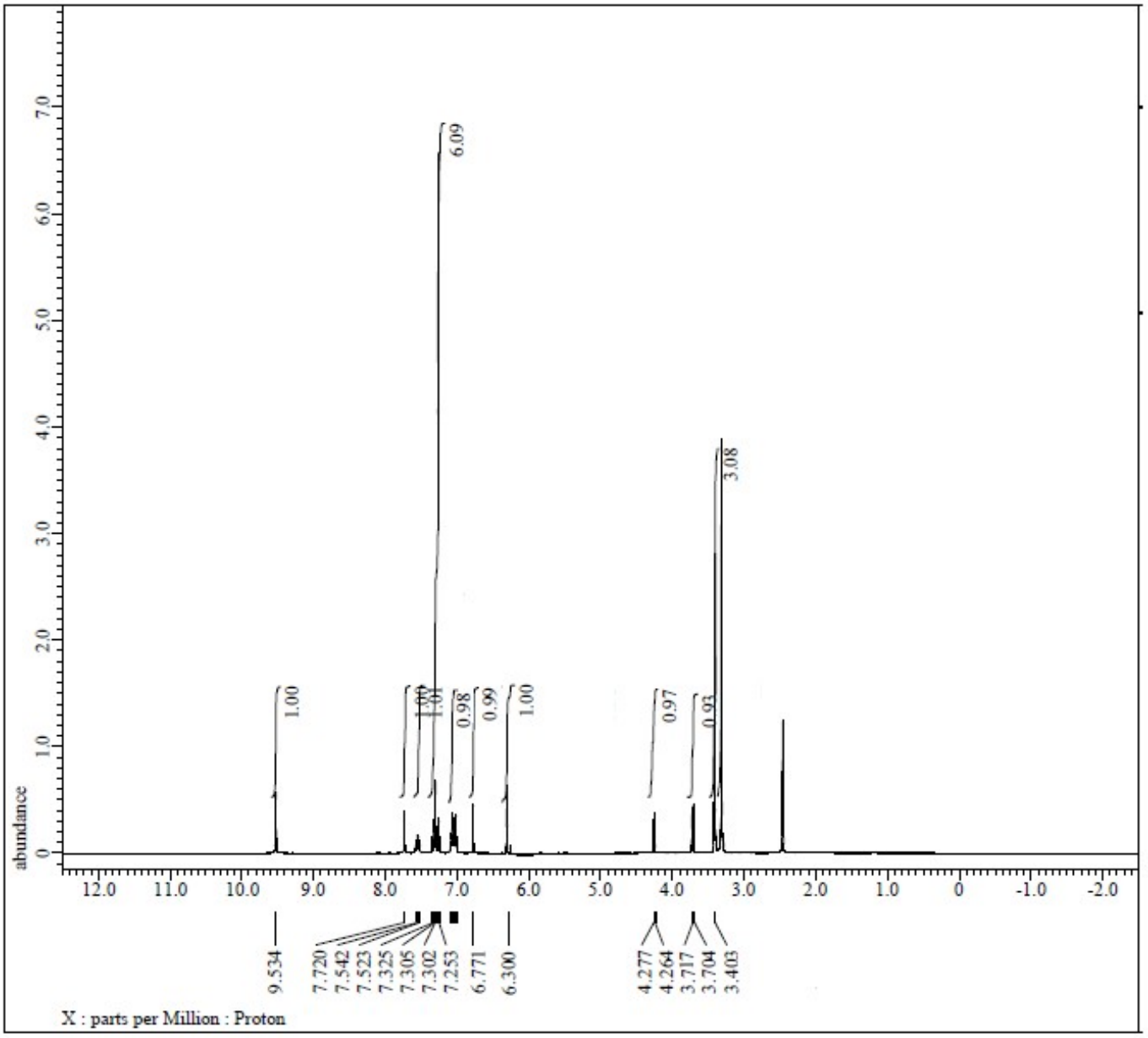

Figure S15(a) ^{1}H NMR spectrum of the synthesized compound **6c**

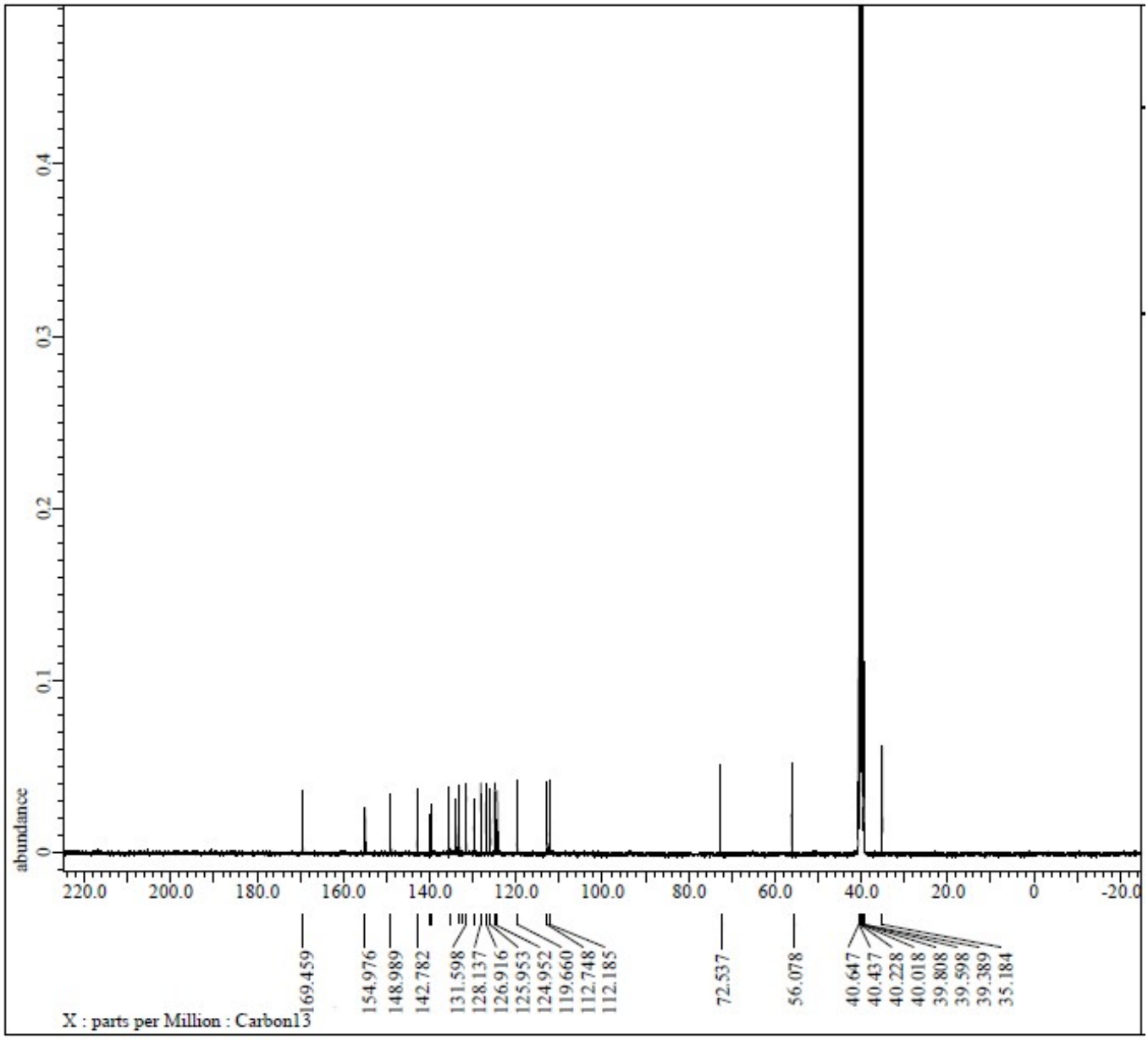

Figure S15(b) ^{13}C NMR spectrum of the synthesized compound **6c**

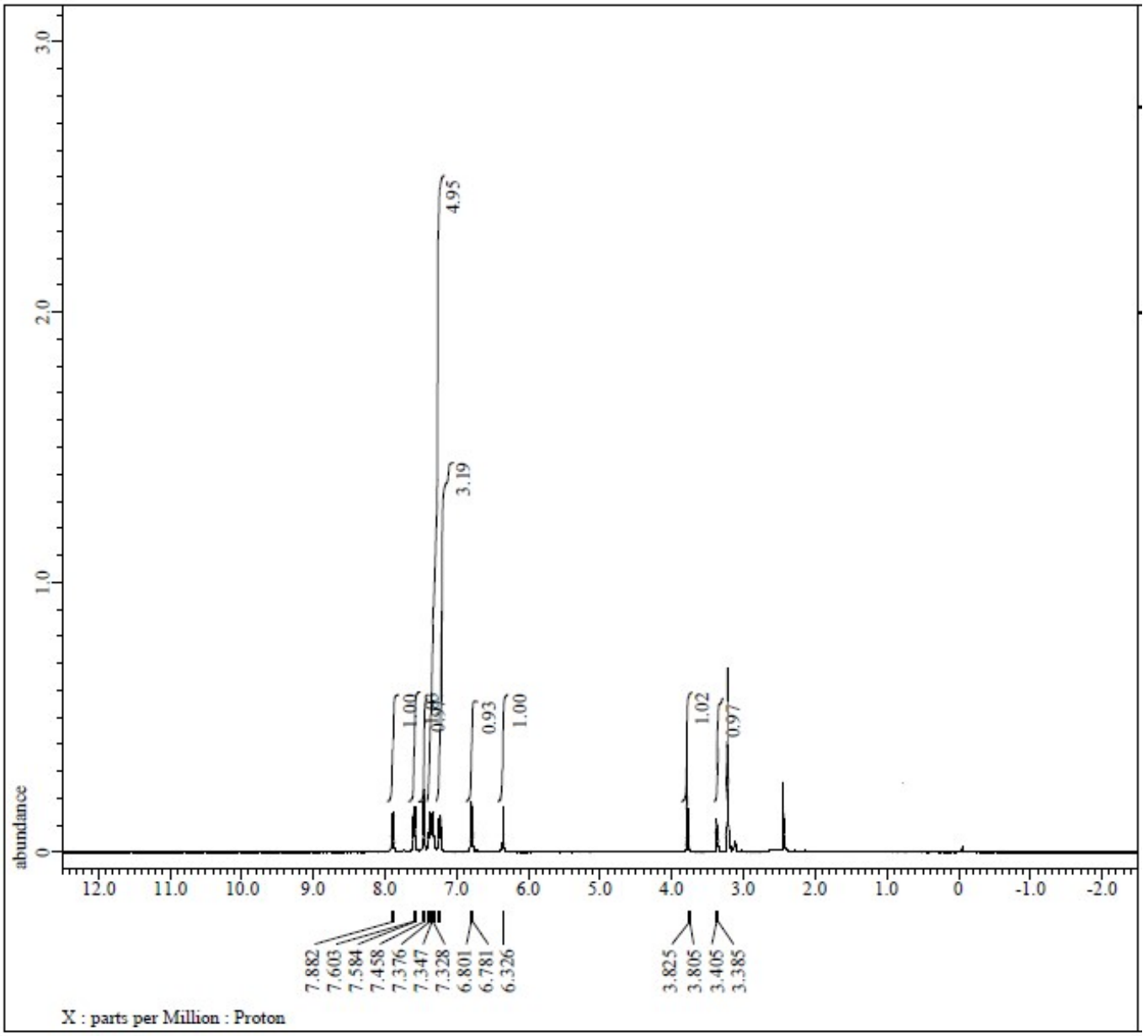

Figure S16(a) ^{1}H NMR spectrum of the synthesized compound **6d**

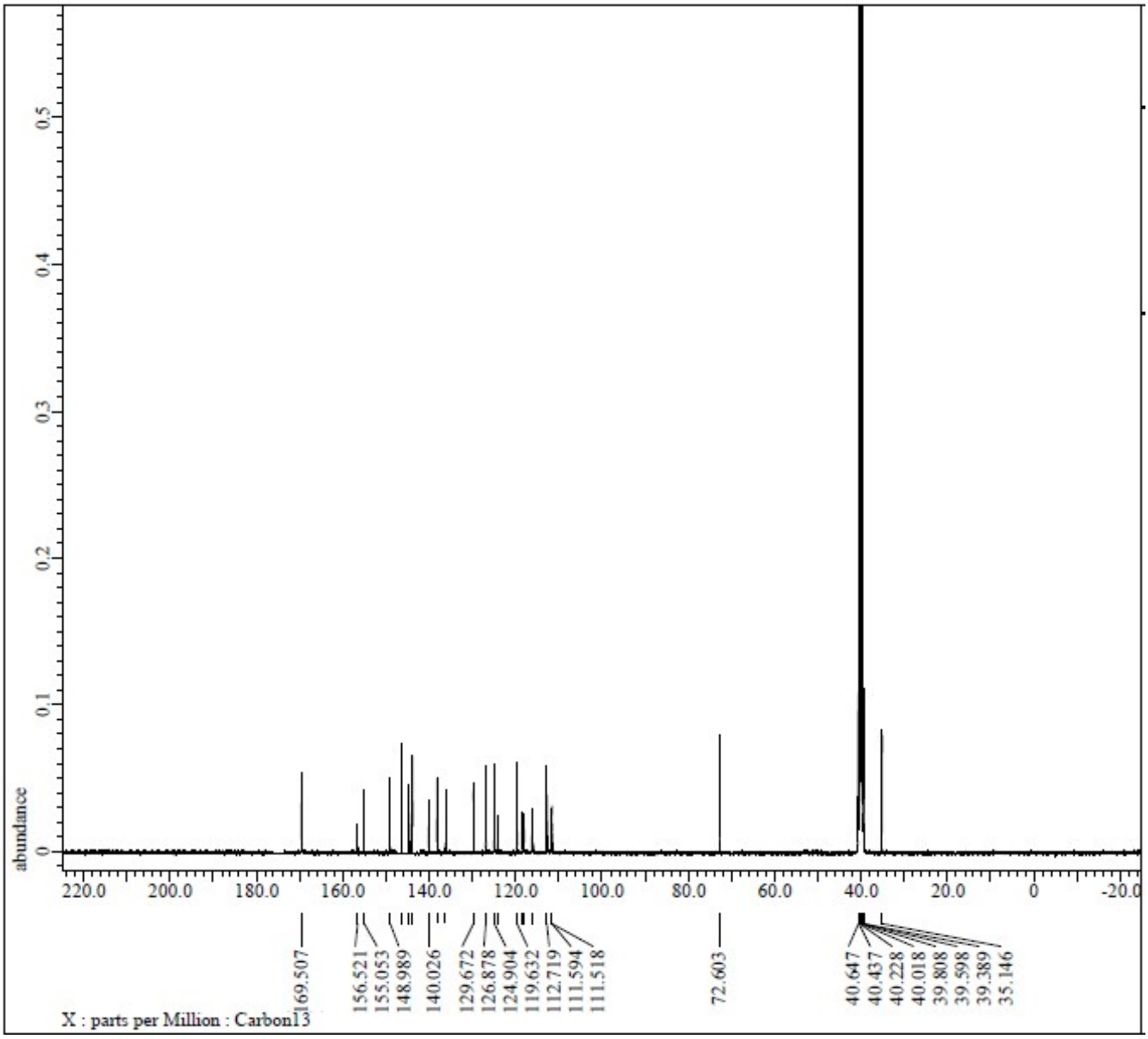

Figure S16(b) ^{13}C NMR spectrum of the synthesized compound **6d**

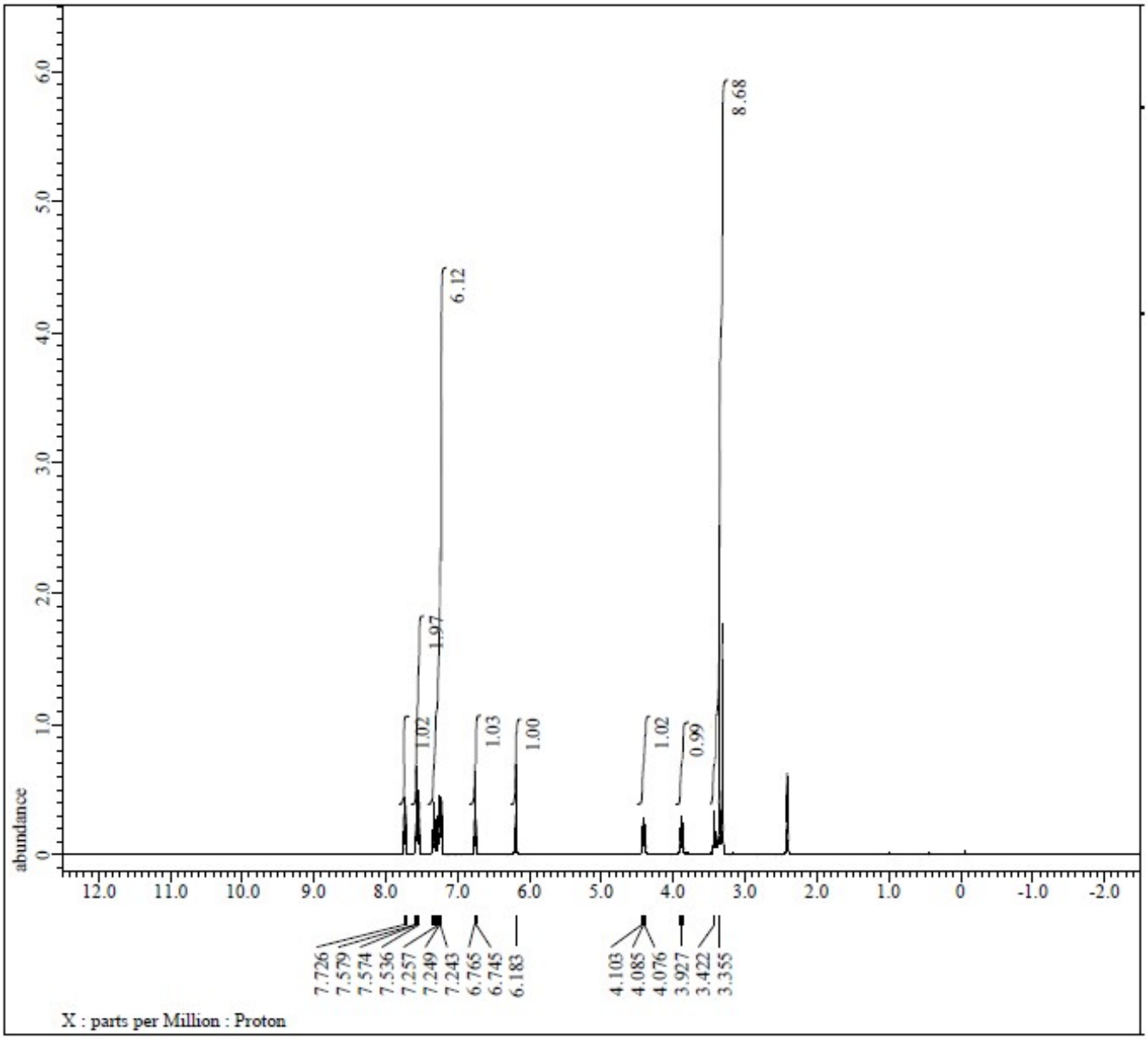

Figure S17(a) ^{1}H NMR spectrum of the synthesized compound **6e**

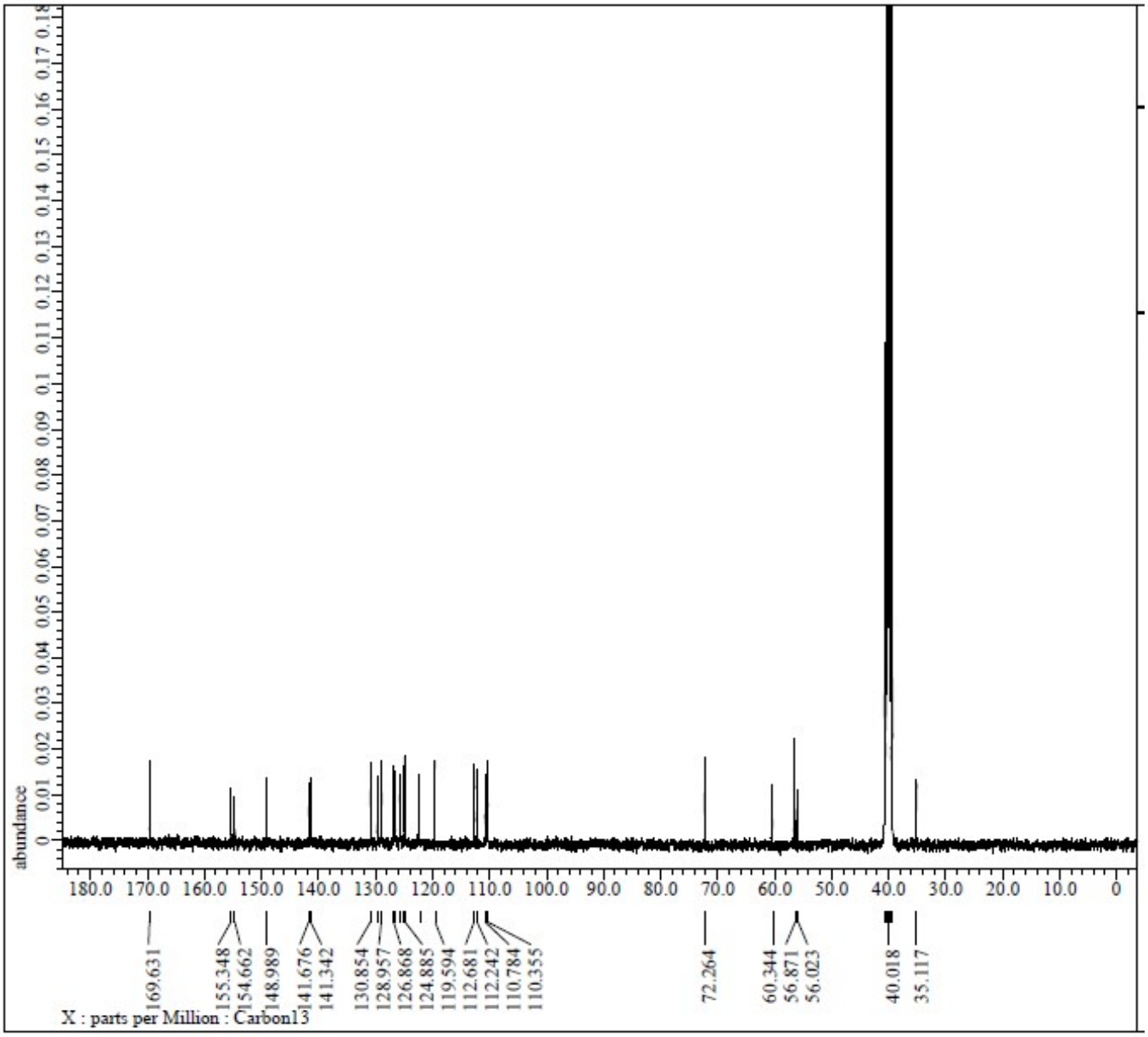

Figure S17(b) ^{13}C NMR spectrum of the synthesized compound **6e**

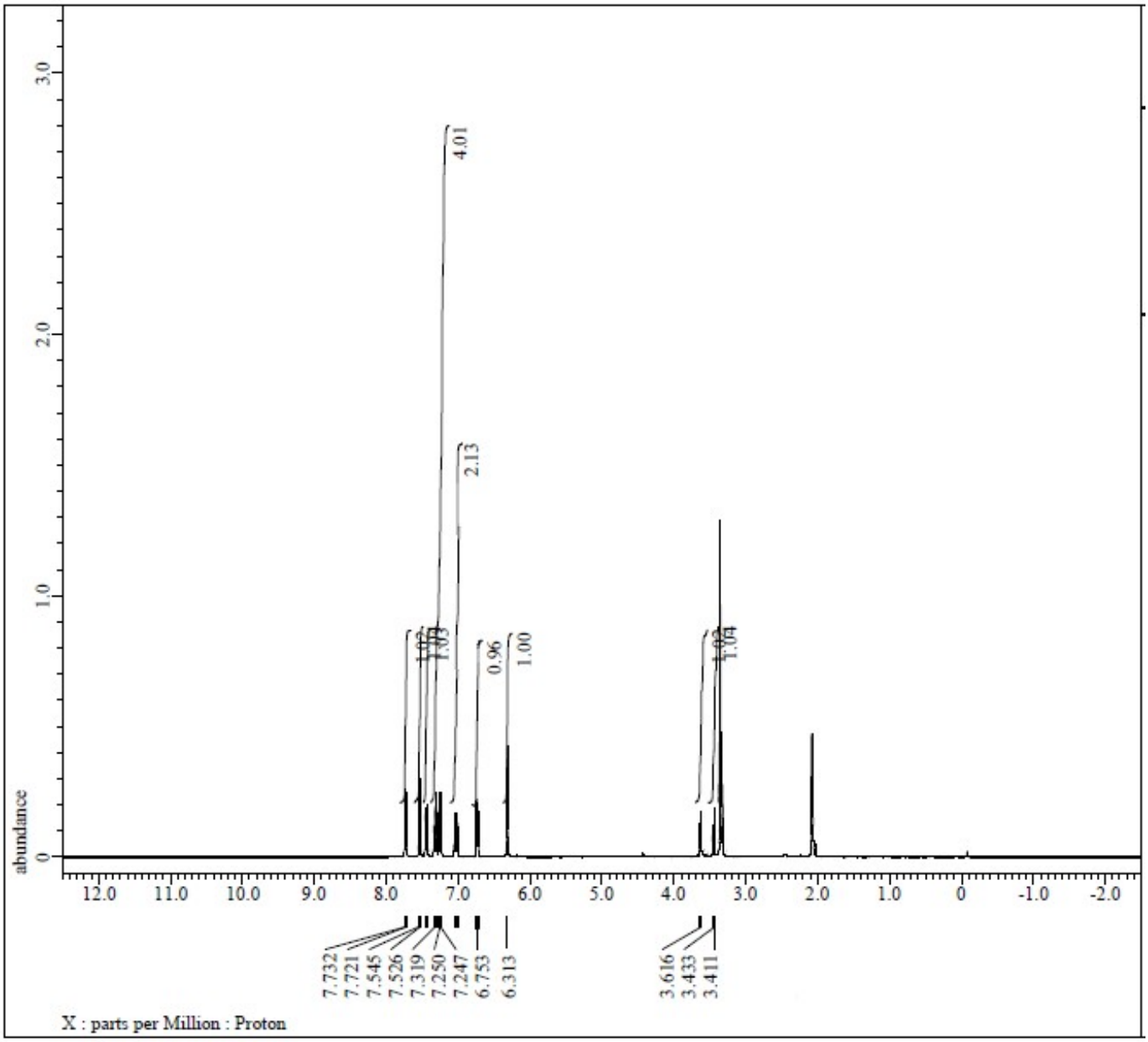

Figure S18(a) ^{1}H NMR spectrum of the synthesized compound **6f**

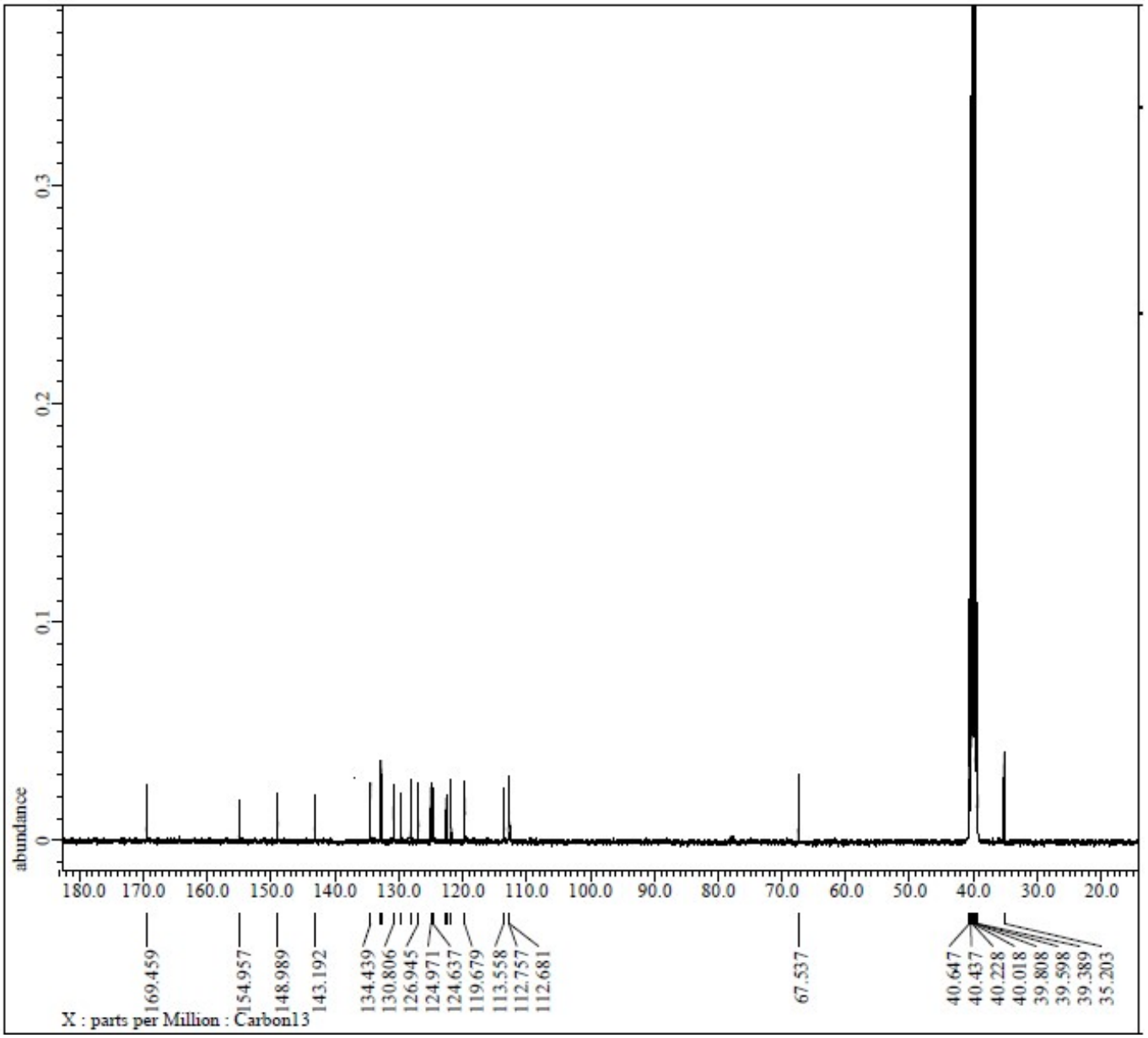

Figure S18(b) ^{13}C NMR spectrum of the synthesized compound **6f**

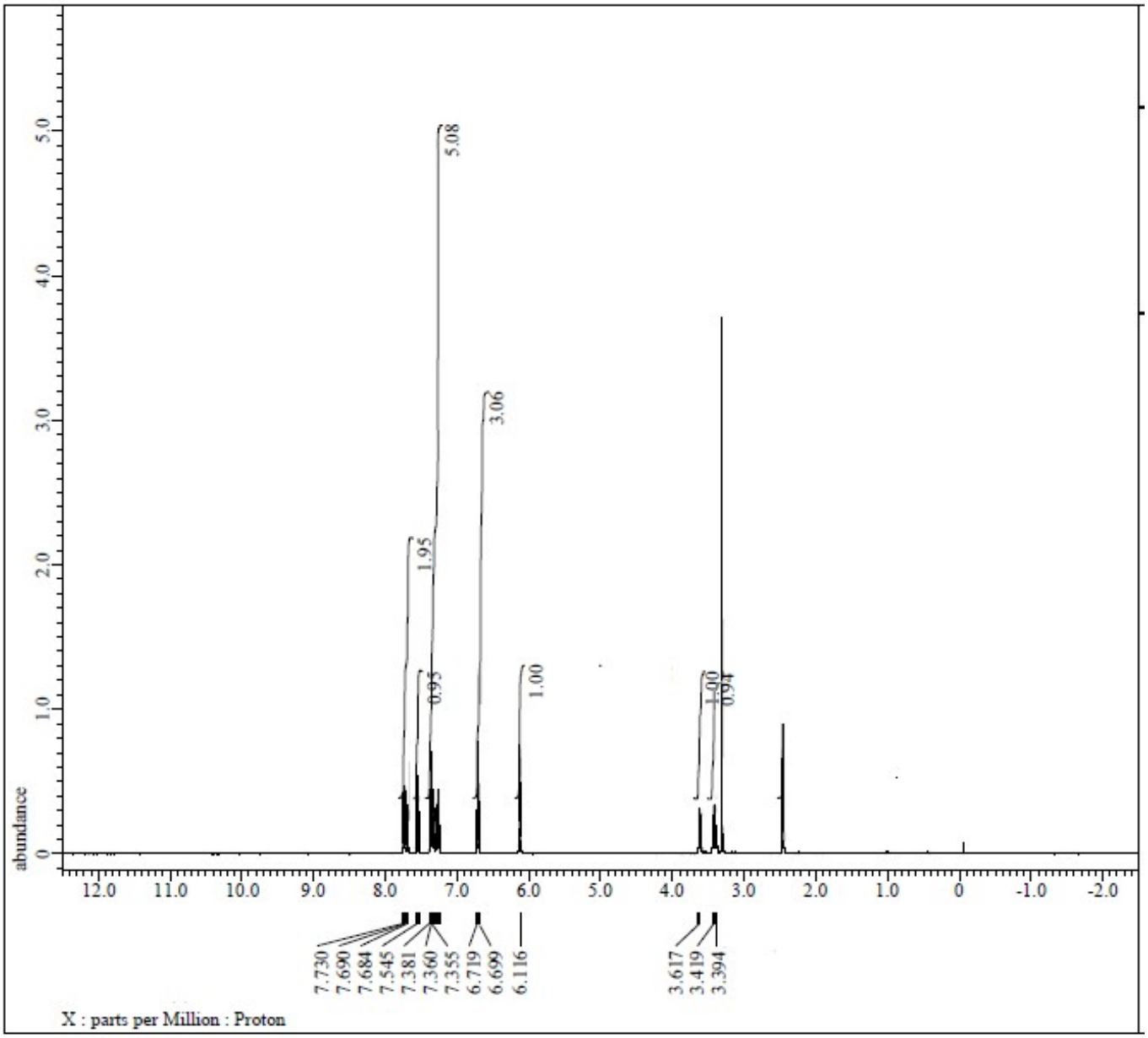

Figure S19(a) ^{1}H NMR spectrum of the synthesized compound **6g**

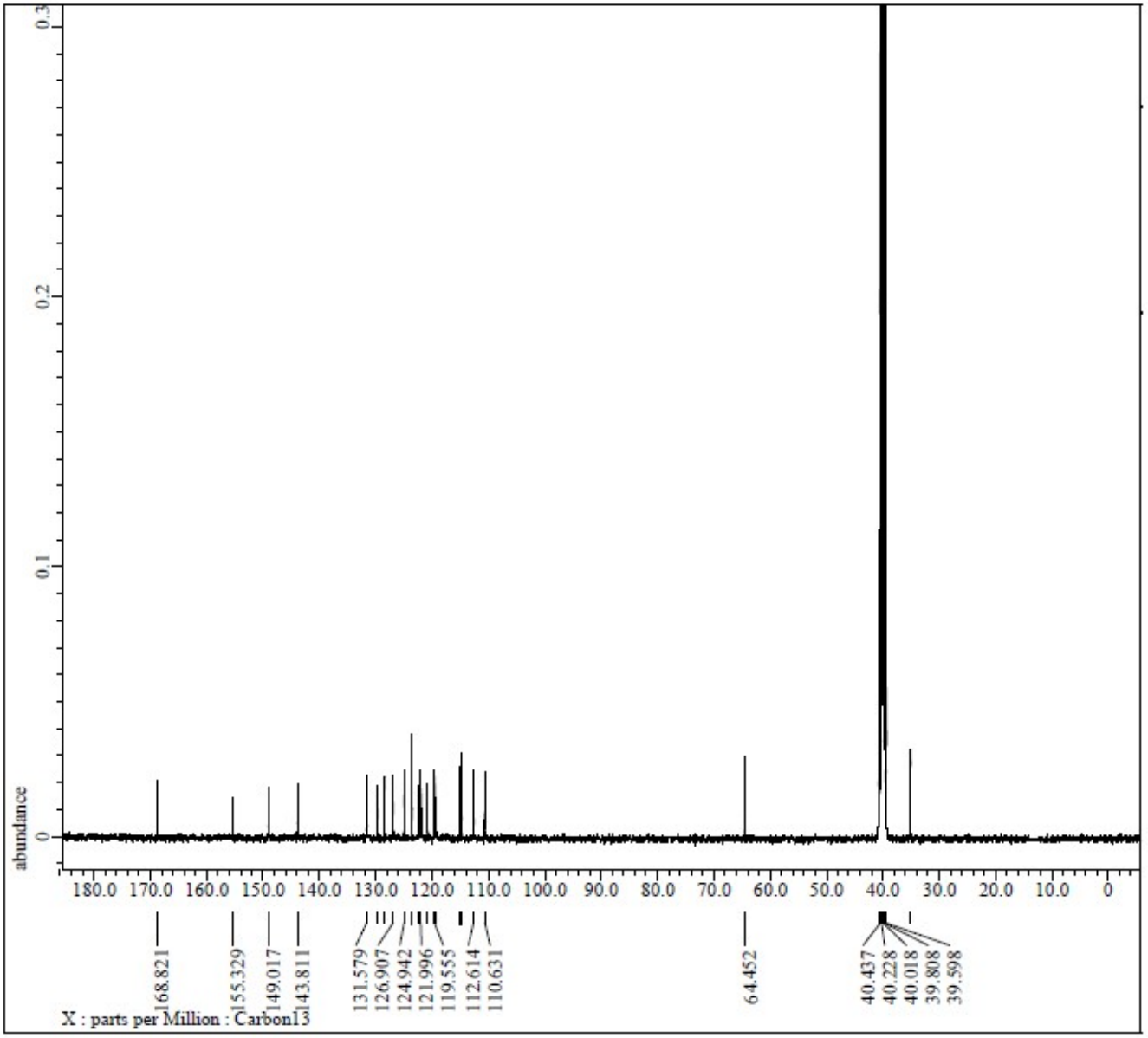

Figure S19(b) ^{13}C NMR spectrum of the synthesized compound **6g**

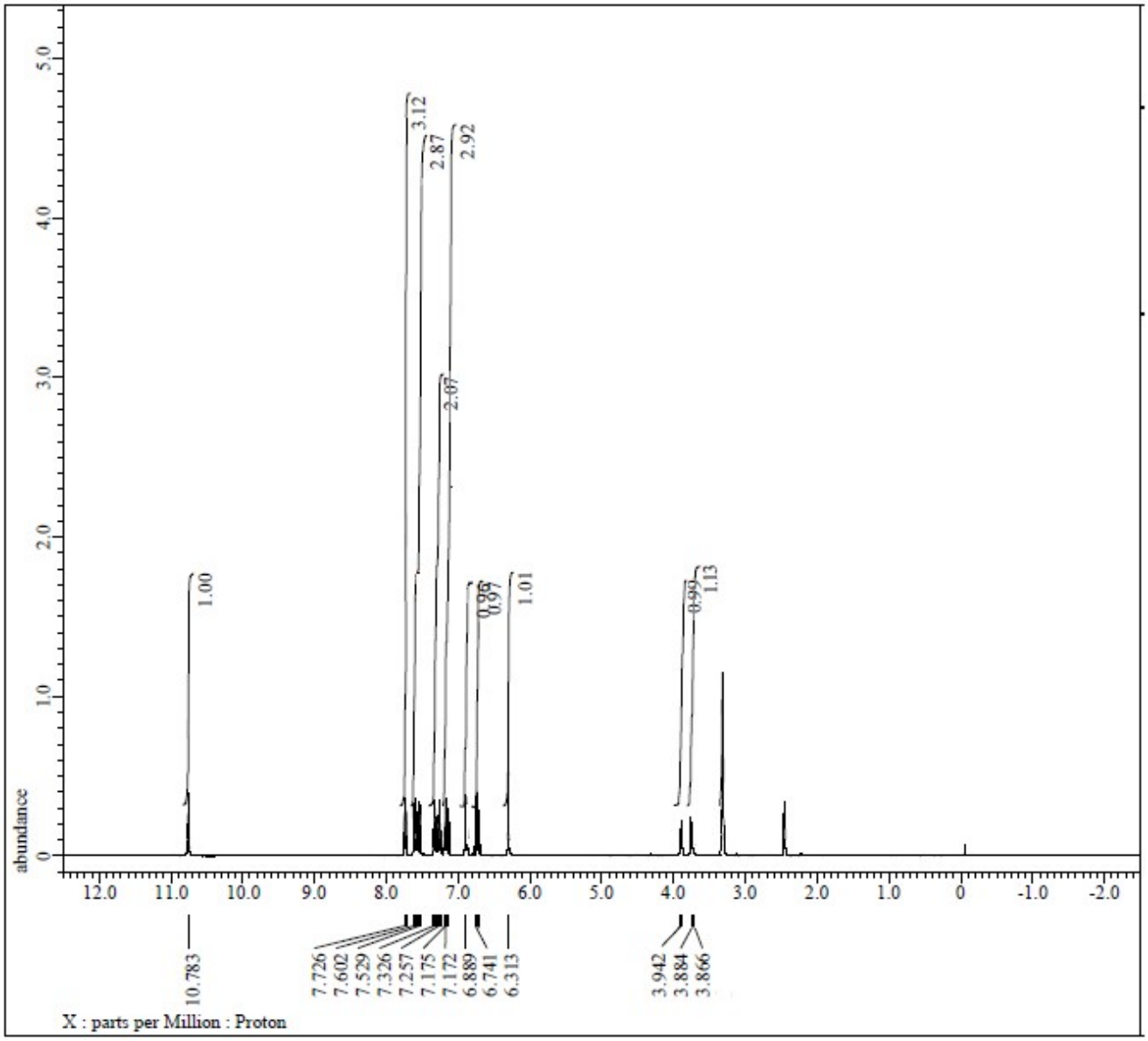

Figure S20(a) ^{1}H NMR spectrum of the synthesized compound **6h**

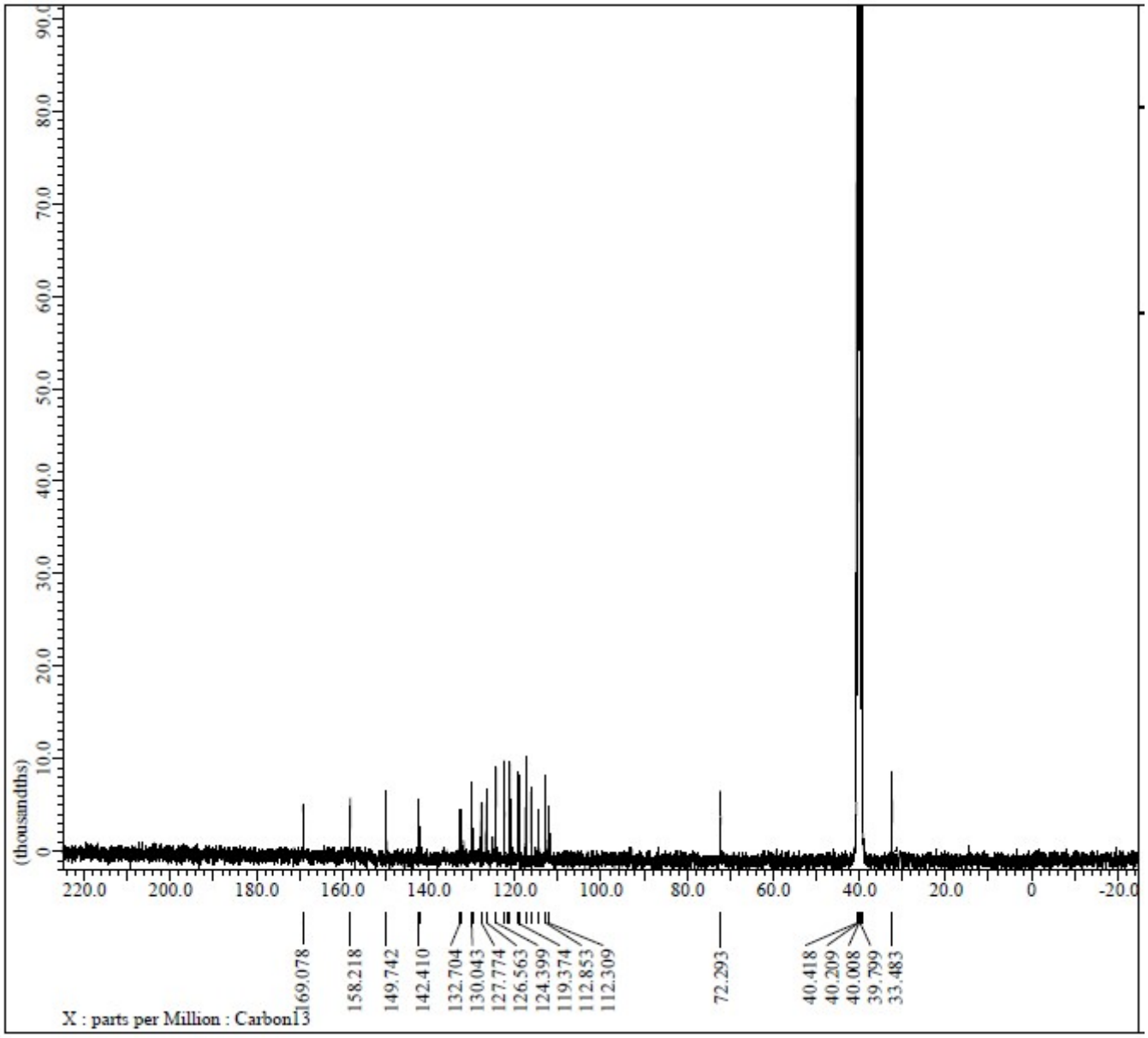

Figure S20(b) ^{13}C NMR spectrum of the synthesized compound **6h**