# Electronic Supporting Information

# Analytical determination of heroin, fentanyl and fentalogues using High-Performance Liquid Chromatography with Diode Array and Amperometric Detection

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**Instrumentation**

Voltammetric measurements were conducted using a 'μAutolab type III' (MetrohmAutolab, The Netherlands) potentiostat /galvanostat interfaced to a PC loaded with NOVA 2.1 software. All measurements were performed using a 10 mL voltammetric cell and a conventional three-electrode system. A platinum wire and Ag/AgClwere used as counter and reference electrodes, respectively. Screen-printed graphite macroelectrodes (SPEs), with a 3.1 mm diameter, were used as working electrodes, they were fabricated in-house as previously reported [9, 25]. Note that due to their scales of economy and reproducibility, a new SPE was used for each experiment performed.

*Preparation of Standard Stock Solutions and Working Solutions for Cyclic Voltammetry*

12.5 mg of each of HRN, cocaine (COC), fentanyl hydrochloride (**2c**) and its derivatives (**2a**, **2b**, **2d** – **2k**) were weighted separately into thirteen 25.0 mL glass volumetric flasks and diluted with ultrapure deionized water to obtain stock solutions of 0.5 mg $mL^{-1}$of each. Working solutions were prepared as follows: 0.5 mL of each drug stock solution were transferred separately into 5.0 mL volumetric flasks, the volume was made to the mark using 0.04 M Britton-Robinson buffer (B-R buffer, pH 2.0) to obtain solutions of 50 μg $mL^{-1}$of each drug. Each solution was transferred quantitatively to an electrochemical cell, degassed with pure nitrogen for 10 minutes, and cyclic voltammograms were recorded between +0.6 to +1.3 V (*vs*. Ag/AgCl) using the following scan rates: 5, 15, 25, 50, 100, 250 and 500 mV $s^{-1}$. Similarly, working solutions in 0.04 M B-R buffer pHs 7.0 and 10.0 were prepared for each drug at a concentration level of 50 μg $mL^{-1}$. Cyclic voltammograms were recorded for each drug at three different pHs: 2.0, 7.0 and 10.0, using scan rates t: 5, 15, 25, 50, 100, 250 and 500 mV $s^{-1}$. Three new SPEs were used for each measurement and the average of the three anodic peak currents ($I_{Pa}$) and the three anodic peak potentials ($E_{Pa}$) were recorded. All solutions were protected from light by aluminum foil and the stock solutions were refrigerated at 4 °C for two weeks.

*System suitability parameters*

System suitability parameters are listed within **Tables 2** and **3** (within the main paper) which include: (i) retention time in minutes ($t_R$) for each drug eluting from the chromatographic column (**Method I**); (ii) Relative retention time (*RRT*), which is determined with respect to fentanyl retention time obtained from **Method I**; (iii) Retention time (in minutes) for drugs eluted from the flow-cell system (**Method II**); (iv) Relative retention time (RRT) determined with respect to fentanyl retention time obtained from **Method II**; (v) Capacity factor (*k′*),ideally *k′* value is > 2; (vi) Number of theoretical plates expressed in plates per m (*N*), generally *N* is > 2000; (vii) Height equivalent to theoretical plate expressed in m (HETP); (viii) Resolution between two successive eluted peaks ($R_s$),ideally $R_s$ is > 2; (ix) Asymmetry factor ($A_s$) which indicates how symmetrical is the shape of the eluted peak and it is important factor

in quantification of peak areas. $A_s$has to be between 0.8 – 1.2; (x) Relative retention factor (α) which should be > 1.

**Table S1.** Comparison of the peak potential ($E_p$ *vs.* Ag/AgCl) of the investigated drugs in 0.04 M B-R Buffer at three different pH's over a range of scan rates.

| Analyte / Scan rate (mV $s^{-1}$) | HRN[a] | COC[a] | (2c)[a] | (2a)[a] | (2b)[a] | (2d)[a] | (2e)[a] | (2f)[a] | (2g)[a] | (2h)[a] | (2i)[a] | (2j)[a] | (2k)[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **pH 2.0** | | | | | | | | | | | | | |
| No peak for all the target analytes in all the studied scan rates at this pH. | | | | | | | | | | | | | |
| **pH 7.0** | | | | | | | | | | | | | |
| **5** | 0.87 ± 0 | 1.00 ± 0.01 | 0.89 ± 0.01 | 0.87 ± 0 | 0.88 ± 0.01 | 0.85 ± 0.02 | 0.87 ± 0.01 | 0.86 ± 0.01 | 0.85 ± 0 | 0.89 ± 0.01 | 0.87 ± 0.01 | 0.87 ± 0.02 | 0.85 ± 0.01 |
| **15** | 0.89 ± 0 | 1.03 ± 0.01 | 0.90 ± 0 | 0.87 ± 0 | 0.88 ± 0 | 0.86 ± 0.02 | 0.88 ± 0.01 | 0.87 ± 0.01 | 0.88 ± 0.01 | 0.89 ± 0.01 | 0.90 ± 0 | 0.90 ± 0 | 0.88 ± 0.01 |
| **25** | 0.89 ± 0.01 | 1.05 ± 0 | 0.91 ± 0.01 | 0.87 ± 0.01 | 0.89 ± 0 | 0.87 ± 0.01 | 0.88 ± 0.01 | 0.87± 0.02 | 0.86 ± 0.02 | 0.89 ± 0.01 | 0.91 ± 0.01 | 0.90 ± 0.01 | 0.89 ± 0.01 |
| **50** | **0.91 ± 0** | **1.06 ± 0.01** | **0.91 ± 0.01** | **0.88 ± 0.01** | **0.89 ± 0.01** | **0.88 ± 0.01** | **0.90 ± 0.01** | **0.89 ± 0** | **0.89± 0.01** | **0.92 ± 0.01** | **0.91 ± 0.01** | **0.92 ± 0.01** | **0.90 ± 0** |
| **100** | 0.92 ± 0.01 | 1.08 ± 0 | 0.92 ± 0 | 0.90 ± 0 | 0.89 ± 0.01 | 0.90 ± 0 | 0.90 ± 0.01 | 0.91 ± 0.01 | 0.90 ± 0.01 | 0.92 ± 0 | 0.93 ± 0.01 | 0.92 ± 0 | 0.92 ± 0.01 |
| **250** | 0.94 ± 0 | 1.11 ± 0 | 0.96 ± 0.01 | 0.92 ± 0.01 | 0.91 ± 0 | 0.92 ± 0.01 | 0.93 ± 0.01 | 0.93 ± 0.01 | 0.93 ± 0.01 | 0.95 ± 0.01 | 0.95 ± 0 | 0.94± 0 | 0.94 ± 0 |
| **500** | 0.95 ± 0 | 1.13 ± 0.01 | 0.99 ± 0.02 | 0.94 ± 0.01 | 0.95 ± 0 | 0.95 ± 0.02 | 0.95 ± 0.01 | 0.96 ± 0.01 | 0.95 ± 0.01 | 0.97 ± 0 | 0.98 ± 0.01 | 0.96 ± 0.01 | 0.97 ± 0.01 |
| **pH 10.0** | | | | | | | | | | | | | |
| **5** | No peak | 0.87 ± 0.01 | 0.75 ± 0.01 | 0.76 ± 0 | 0.74 ± 0.02 | 0.78 ± 0.01 | No peak | No peak | No peak | 0.80 ± 0.03 | 0.79 ± 0.02 | 0.77 ± 0 | No peak |
| **15** | No peak | 0.90 ± 0.01 | 0.77 ± 0.01 | 0.77 ± 0 | 0.79 ± 0.01 | 0.79 ± 0 | No peak | No peak | No peak | 0.84 ± 0.01 | 0.85 ± 0.04 | 0.84 ± 0.01 | 0.78 ± 0 |
| **25** | 0.78 ± 0.01 | 0.91 ± 0 | 0.78 ± 0.02 | 0.79 ± 0 | 0.82 ± 0.01 | 0.81 ± 0.01 | No peak | No peak | No peak | 0.86 ± 0.01 | 0.86 ± 0.02 | 0.87 ± 0.01 | 0.81 ± 0.02 |
| **50** | 0.80 ± 0.01 | 0.94 ± 0 | 0.79 ± 0.02 | 0.81 ± 0 | 0.85 ± 0 | 0.84 ± 0.01 | No peak | 0.83 ± 0.01 | 0.83 ± 0.01 | 0.88 ± 0.02 | 0.88 ± 0.02 | 0.90 ± 0.02 | 0.85 ± 0.01 |
| **100** | 0.82 ± 0.01 | 0.95 ± 0 | 0.82 ± 0 | 0.83 ± 0 | 0.87 ± 0 | 0.84 ± 0.02 | 0.84 ± 0 | 0.83 ± 0 | 0.82 ± 0 | 0.91 ± 0.01 | 0.90 ± 0.01 | 0.93 ± 0 | 0.86 ± 0 |
| **250** | 0.85 ± 0 | 0.97 ± 0 | 0.86 ± 0 | 0.86 ± 0 | 0.89 ± 0 | 0.85 ± 0.01 | 0.85 ± 0 | 0.85 ± 0.01 | 0.82 ± 0 | 0.93 ± 0.01 | 0.94 ± 0.02 | 0.92 ± 0.03 | 0.87 ± 0.01 |
| **500** | 0.87 ± 0 | 1.00 ±0 | 0.89 ± 0 | 0.90 ± 0 | 0.93 ± 0 | 0.87 ± 0 | 0.86 ± 0 | 0.87 ± 0 | 0.85 ± 0 | 0.97 ± 0 | 0.97 ± 0.02 | 0.97 ± 0.03 | 0.87 ± 0.01 |

[a] Mean ± SD of peak potential ($E_p$) of each drug at the studied scan rate. ($n$=3)

**Table S2.** Evaluation of the robustness of the proposed HPLC-DAD Method (**Method I**) for the determination of HRN, fentanyl and its 10 fentalogues.

| Analyte / Parameters | HRN | (2a) | (2b) | (2c) | (2d) | (2e) | (2f) | (2g) | (2h) | (2i) | (2j) | (2k) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Temperature (25 ± 2 °C)** | 100.58 ± 0.33 | 100.61 ± 0.31 | 100.03 ± 0.33 | 100.63 ± 0.42 | 100.81 ± 0.20 | 100.10 ± 0.64 | 99.83 ± 0.58 | 100.60 ± 0.84 | 100.27 ± 0.36 | 100.97 ± 0.49 | 99.67 ± 0.48 | 99.99 ± 0.62 |
| **Molarity of buffer (20 ± 2.0 mM)** | 100.82 ± 1.16 | 100.56 ± 1.00 | 100.51 ± 0.99 | 100.15 ± 1.04 | 100.98 ± 0.89 | 100.19 ± 1.24 | 100.43 ± 0.86 | 100.44 ± 0.45 | 99.36 ± 0.17 | 100.64 ± 0.79 | 100.27 ± 0.69 | 100.42 ± 1.07 |
| **pH of buffer (7.0 ± 0.2 pH units)** | 100.47 ± 0.53 | 100.66 ± 0.67 | 100.14 ± 0.98 | 100.08 ± 0.84 | 100.76 ± 0.54 | 100.24 ± 0.65 | 100.02 ± 1.26 | 100.40 ± 0.75 | 100.68 ± 0.98 | 100.23 ± 0.91 | 100.91 ± 0.66 | 100.19 ± 0.77 |
| **RSD%[b]** | | | | | | | | | | | | |
| **Temperature (25 ± 2 °C)** | 0.33 | 0.31 | 0.33 | 0.42 | 0.20 | 0.64 | 0.58 | 0.83 | 0.36 | 0.49 | 0.48 | 0.62 |
| **Molarity of buffer (20 ± 2.0 mM)** | 1.15 | 0.99 | 0.98 | 1.04 | 0.88 | 1.24 | 0.86 | 0.45 | 0.17 | 0.78 | 0.69 | 1.07 |
| **pH of buffer (7.0 ± 0.2 pH units)** | 0.53 | 0.67 | 0.98 | 0.84 | 0.54 | 0.65 | 1.26 | 0.75 | 0.97 | 0.91 | 0.65 | 0.77 |
| **$t_R$ ± SD[c]** | | | | | | | | | | | | |
| **Temperature (25 ± 2 °C)** | 2.79 ± 0.02 | 4.09 ± 0.01 | 4.79 ± 0.02 | 8.10 ± 0.04 | 10.79 ± 0.08 | 13.20 ± 0.05 | 14.26 ± 0.07 | 18.08 ± 0.13 | 20.65 ± 0.29 | 25.50 ± 0.15 | 27.64 ± 0.20 | 29.42 ± 0.22 |
| **Molarity of buffer (20 ± 2.0 mM)** | 2.79 ± 0.05 | 4.09 ± 0.04 | 4.79 ± 0.04 | 8.10 ± 0.09 | 10.79 ± 0.14 | 13.20 ± 0.17 | 14.26 ±0.18 | 18.08 ± 0.24 | 20.65 ± 0.31 | 25.50 ± 0.36 | 27.64 ± 0.38 | 29.42 ±0.41 |
| **pH of buffer (7.0 ± 0.2 pH units)** | 2.79 ± 0.20 | 4.09 ± 0.39 | 4.79 ± 0.48 | 8.10 ± 0.94 | 10.79 ± 1.34 | 13.20 ± 1.69 | 14.26 ± 1.84 | 18.08 ± 2.43 | 20.65 ± 2.99 | 25.50 ± 3.55 | 27.64 ± 3.83 | 29.42 ± 4.17 |

[a] Mean ± SD of percentage recoveries of peak areas of each drug at the three studied parameters. (*n*=3)
[b] Percentage relative standard deviation of peak areas of each drug at the three studied parameters.
[c] Mean ± SD of retention time of each drug at the three studied parameters. (*n*=3)

**Table S3.** Evaluation of the robustness of the proposed HPLC-AD Method (**Method II**) for the determination of HRN, fentanyl and its 10 fentalogues.

| Analyte / Parameters | Mean % recovery ± SD[a] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **HRN** | **(2a)** | **(2b)** | **(2c)** | **(2d)** | **(2e)** | **(2f)** | **(2g)** | **(2h)** | **(2i)** | **(2j)** | **(2k)** |
| **Temperature (25 ± 2 °C)** | 99.48 ± 0.82 | 99.73 ± 0.66 | 100.38 ± 0.66 | 100.52 ± 0.73 | 100.30 ± 0.98 | 100.47 ± 0.63 | 100.07 ± 0.75 | 99.76 ± 1.34 | 99.73 ± 0.53 | 100.39 ± 0.76 | 100.56 ± 0.75 | 100.10 ± 0.64 |
| **Molarity of buffer (20 ± 2.0 mM)** | 100.39 ± 0.73 | 100.50 ± 0.72 | 100.37 ± 0.65 | 100.50 ± 0.58 | 100.51 ± 0.80 | 100.43 ± 0.59 | 101.12 ± 1.18 | 100.30 ± 0.60 | 99.65 ± 0.48 | 100.09 ± 0.81 | 100.53 ± 0.63 | 100.39 ± 0.75 |
| **pH of buffer (7.0 ± 0.2 pH units)** | 99.75 ± 0.51 | 100.56 ± 0.63 | 100.42 ± 0.65 | 100.62 ± 1.06 | 100.36 ± 0.60 | 100.54 ± 0.58 | 100.30 ± 0.92 | 100.28 ± 0.55 | 99.66 ± 0.40 | 100.51 ± 0.58 | 100.20 ± 0.93 | 99.94 ± 0.97 |
| **RSD%[b]** | | | | | | | | | | | | |
| **Temperature (25 ± 2 °C)** | 0.82 | 0.66 | 0.66 | 0.73 | 0.98 | 0.63 | 0.75 | 1.34 | 0.53 | 0.76 | 0.75 | 0.64 |
| **Molarity of buffer (20 ± 2.0 mM)** | 0.73 | 0.72 | 0.65 | 0.58 | 0.80 | 0.59 | 1.17 | 0.60 | 0.48 | 0.81 | 0.63 | 0.75 |
| **pH of buffer (7.0 ± 0.2 pH units)** | 0.51 | 0.63 | 0.65 | 1.05 | 0.60 | 0.58 | 0.92 | 0.55 | 0.40 | 0.58 | 0.93 | 0.97 |

[a] Mean ± SD of percentage recoveries of peak heights (current, µA) of each drug at the three studied parameters. (*n*=3)

[b]Percentage relative standard deviation of peak heights (current, µA) of each drug at the three studied parameters.

**Figure S1.** Overlay of cyclic voltammograms (CV) for 50 µg $mL^{-1}$ of HRN, COC, fentanyl and its 10 fentalogues in 0.04 MB-R buffer in 3 different pHs: **(A)** pH2.0, **(B)** pH10.0, and **(C)** pH 7.0;Scan rate: 50 mV $s^{-1}$.

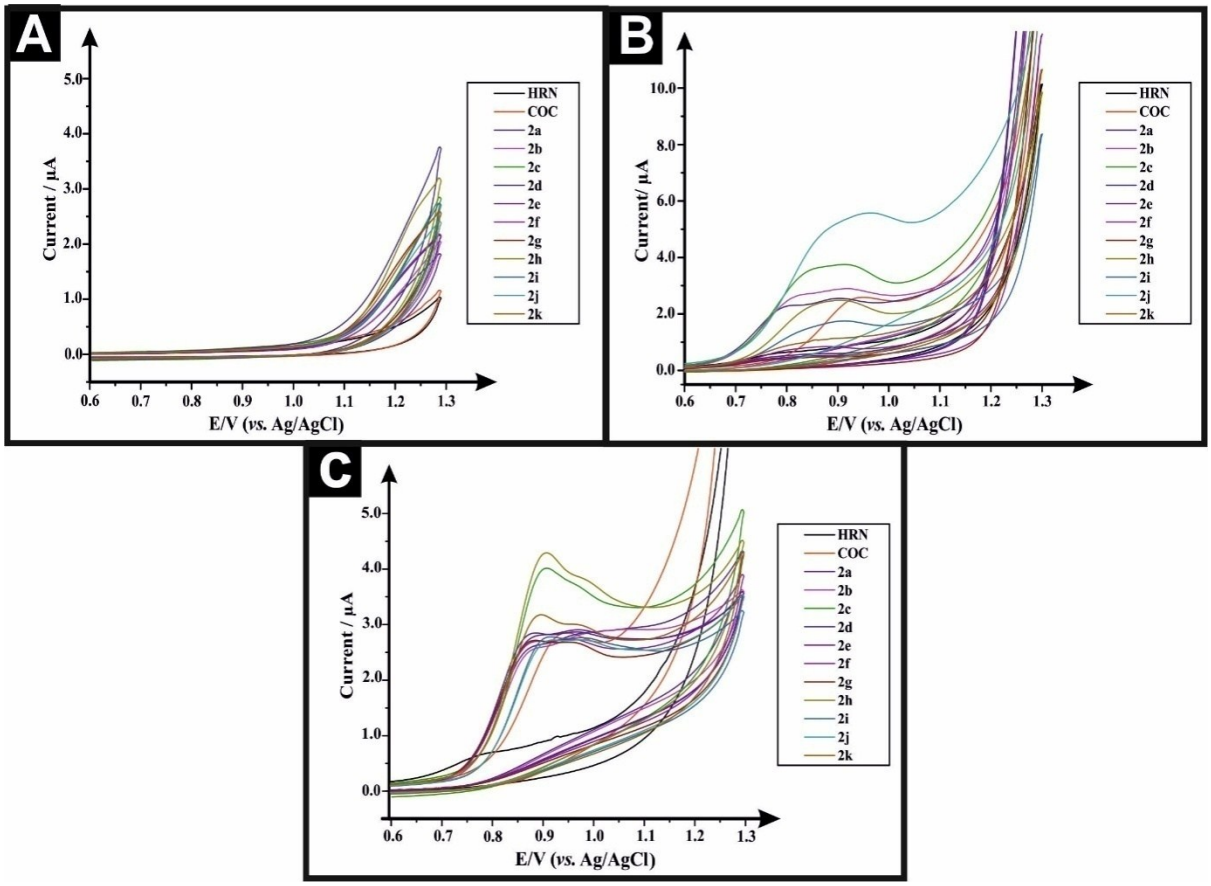


**Figure S2.** UV absorption spectrum of **(A)** 10 µg $mL^{-1}$fentanyl and **(B)** 20 µg $mL^{-1}$ HRN in solution of the mobile phase showing their $\lambda_{max}$ at 205 nm.

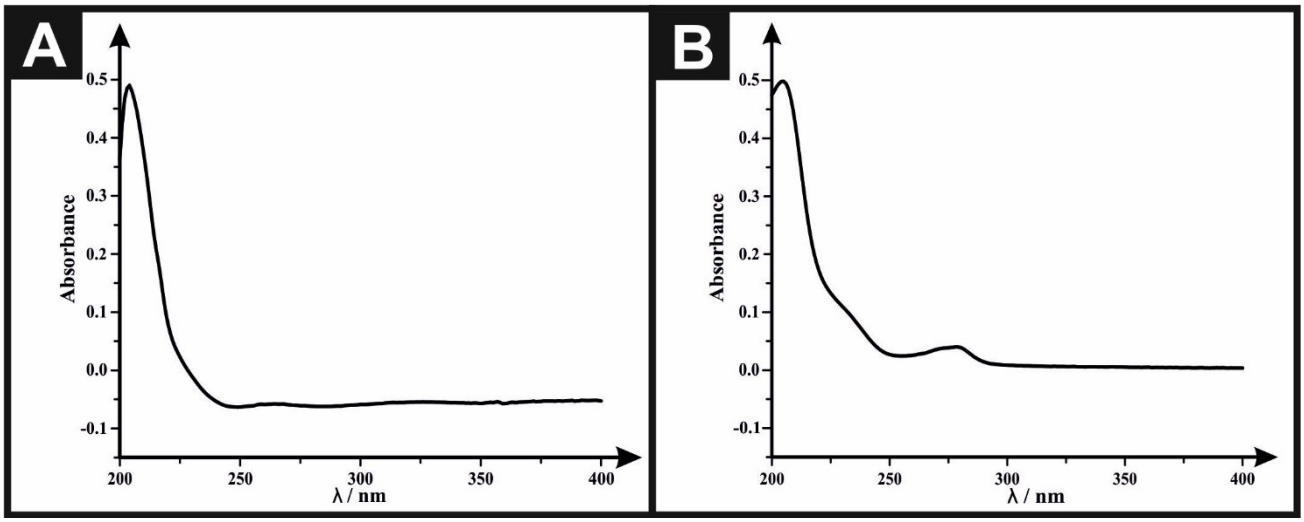


**Figure S3.** Effect of **(A)** flow rate and **(B)** potential (E $V^{-1}$) on current intensity in HPLC-AD flow cell system.

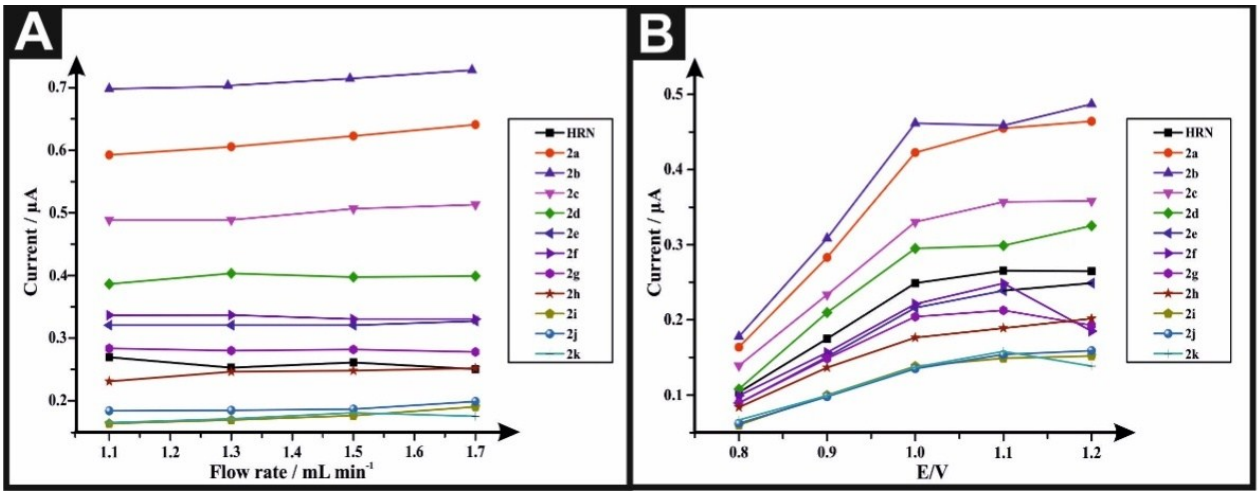


**Figure S4. (A)** Representative HPLC-DAD chromatogram **(B)** Representative amperogram for a solution containing 300 µg $mL^{-1}$ of each of d-glucose, d-fructose, sucrose, lactose, starch, aerosil 200, sodium lauryl sulfate, stearic acid and sodium carboxymethyl cellulose using Eclipse XDB-C8 column (150 x 4.6 mm, i.d. 5 µm); mobile phase: acetonitrile : 20 mM ammonium formate –100 mM potassium chloride buffer (pH 7.0) (30 : 70% v/v); flow rate 1.5 mL $min^{-1}$, detector wavelength (UV): 205 nm and column temperature 25 °C.

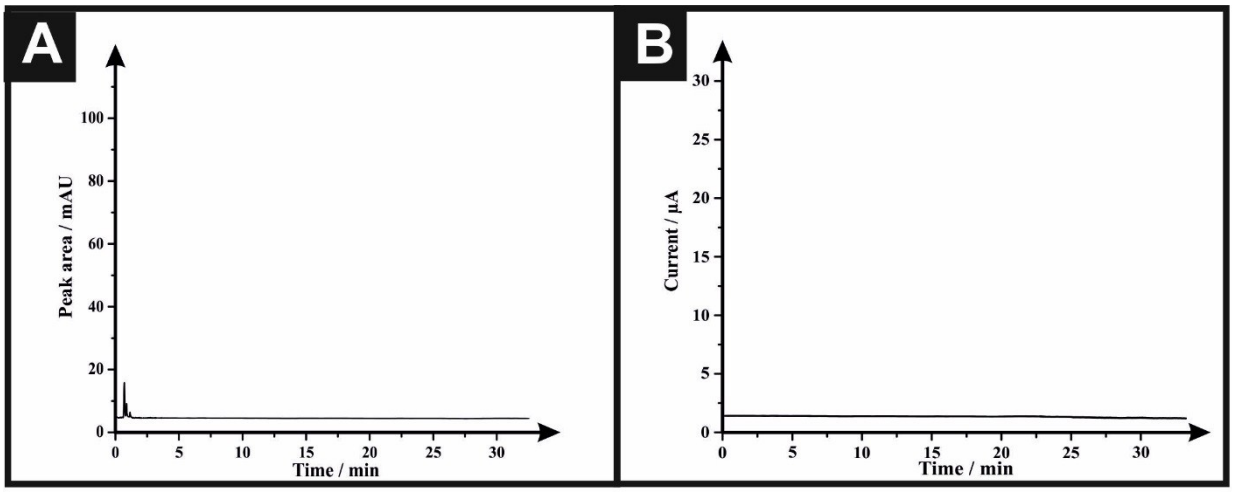
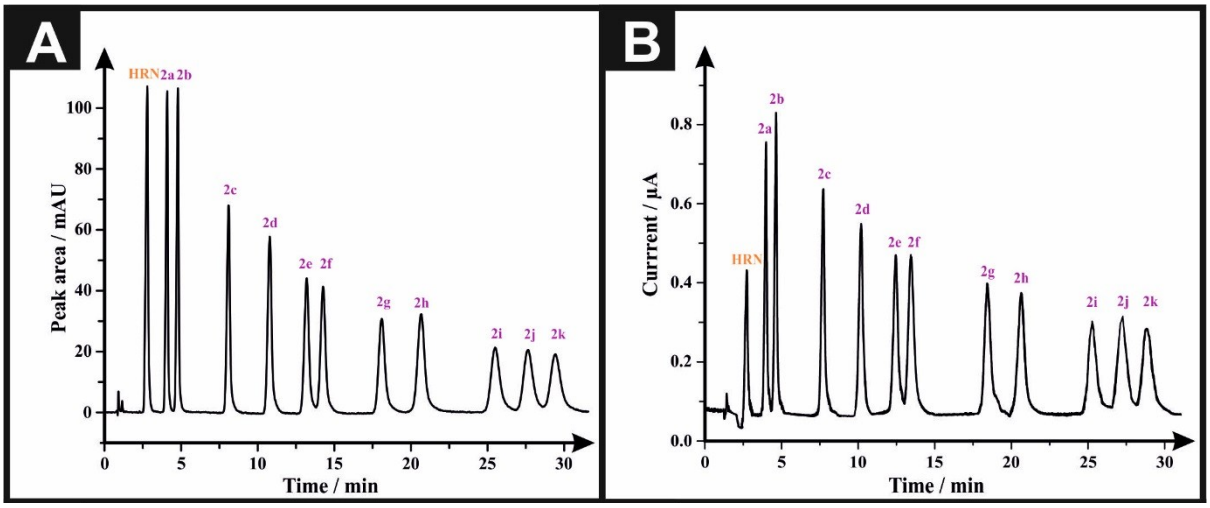
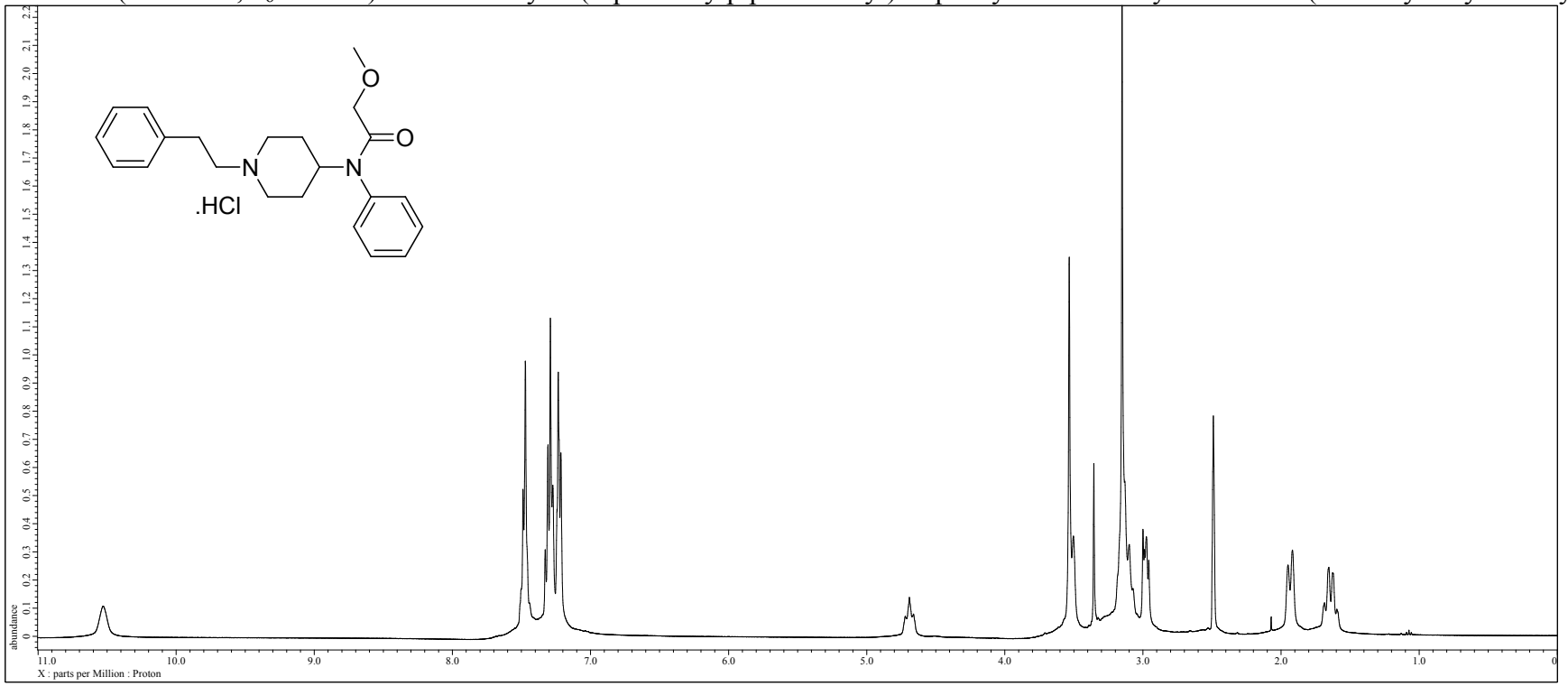


**Figure S5. (A)** Representative HPLC-DAD chromatogram **(B)** Representative amperogram for a solution containing 50 µg $mL^{-1}$ of each of HRN, fentanyl (2c), fentalogues (2a, 2b, 2d – 2k) and 300 µg $mL^{-1}$ of each of d-glucose, d-fructose, sucrose, lactose, starch, aerosil 200, sodium lauryl sulfate, stearic acid and sodium carboxymethyl cellulose using Eclipse XDB-C8 column (150 x 4.6 mm, i.d. 5 µm); mobile phase: acetonitrile : 20 mM ammonium formate –100 mM potassium chloride buffer (pH 7.0) (30 : 70% v/v); flow rate 1.5 mL $min^{-1}$, detector wavelength (UV): 205 nm and column temperature 25 °C.

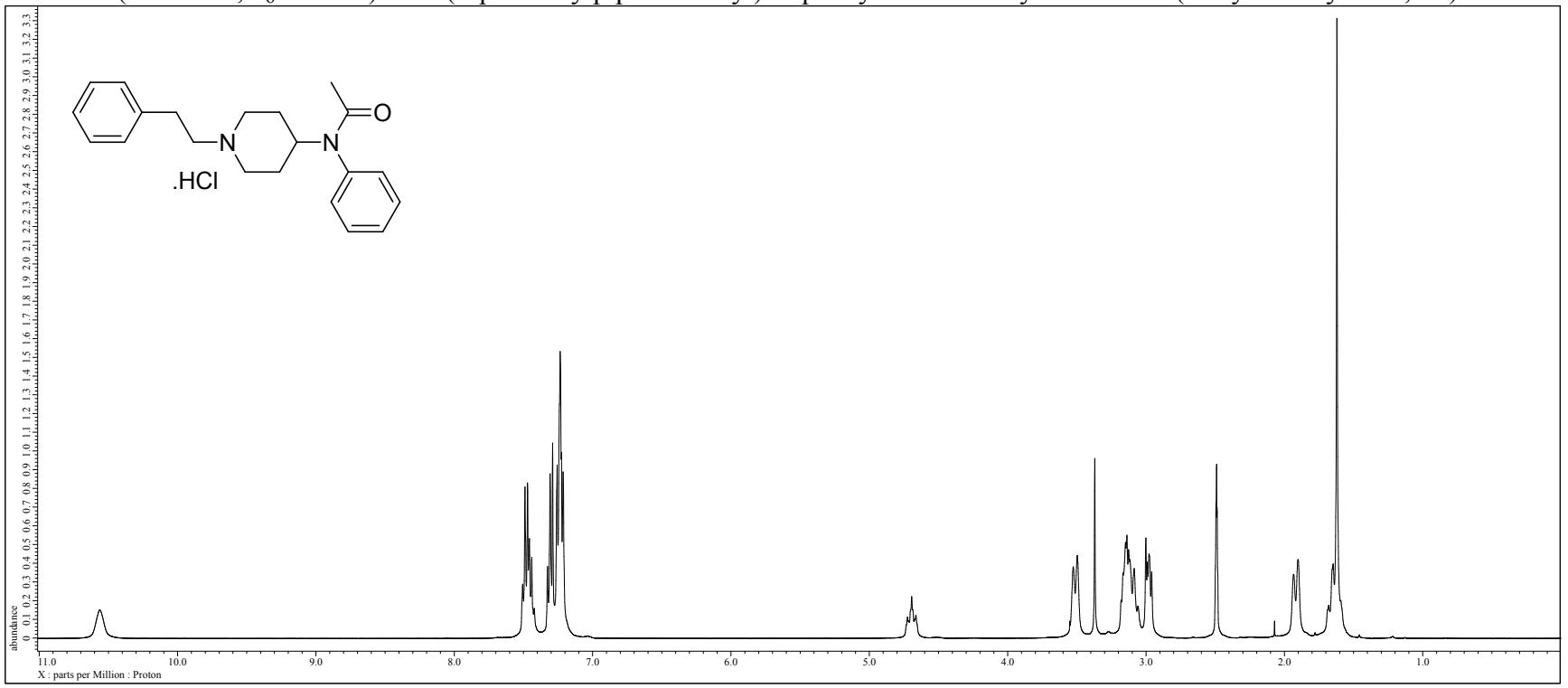


***H-NMR and C-NMR spectra of the fentalogues (2a-2k) utilised within the study are presented below.***

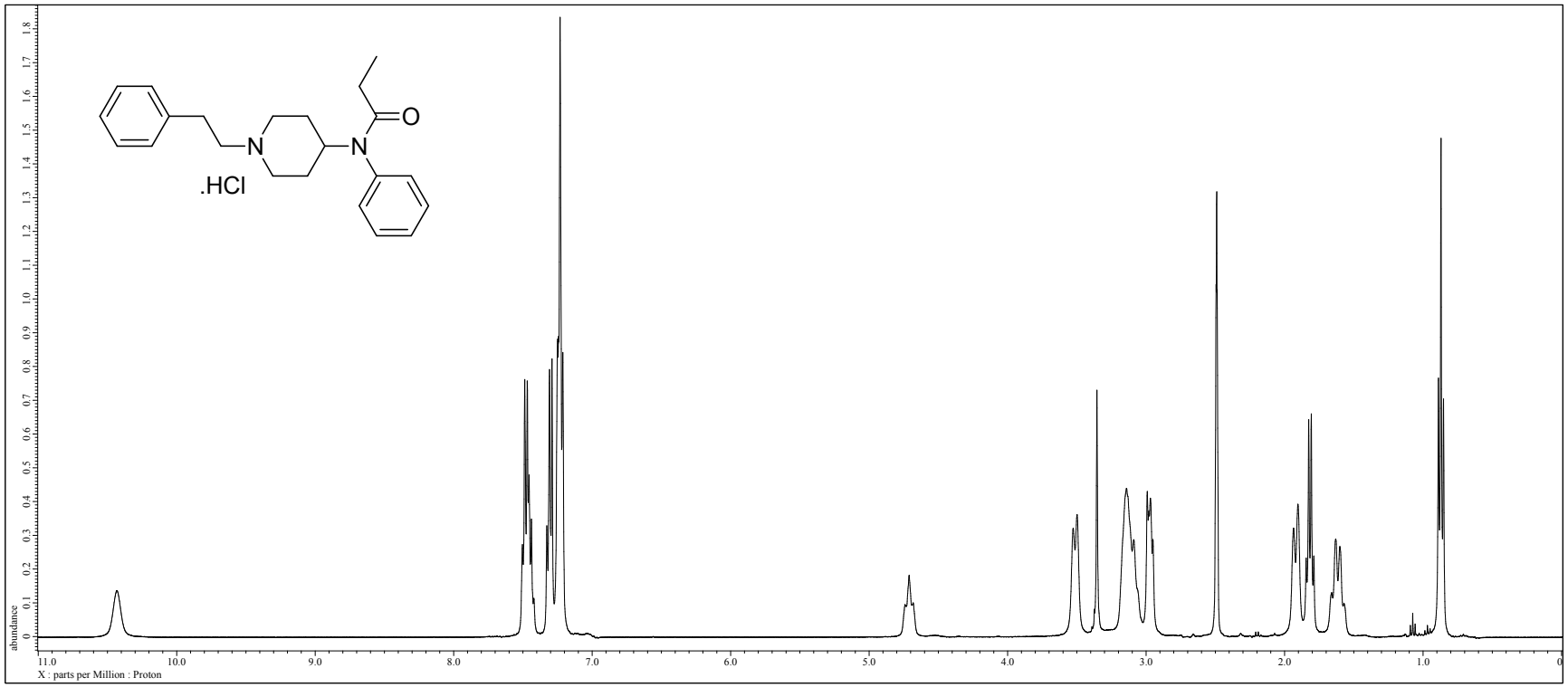
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of 2-methoxy-*N*-(1-phenethylpiperidin-4-yl)-*N*-phenylacetamide hydrochloride (methoxyacetylfentanyl.HCl, **2a**)



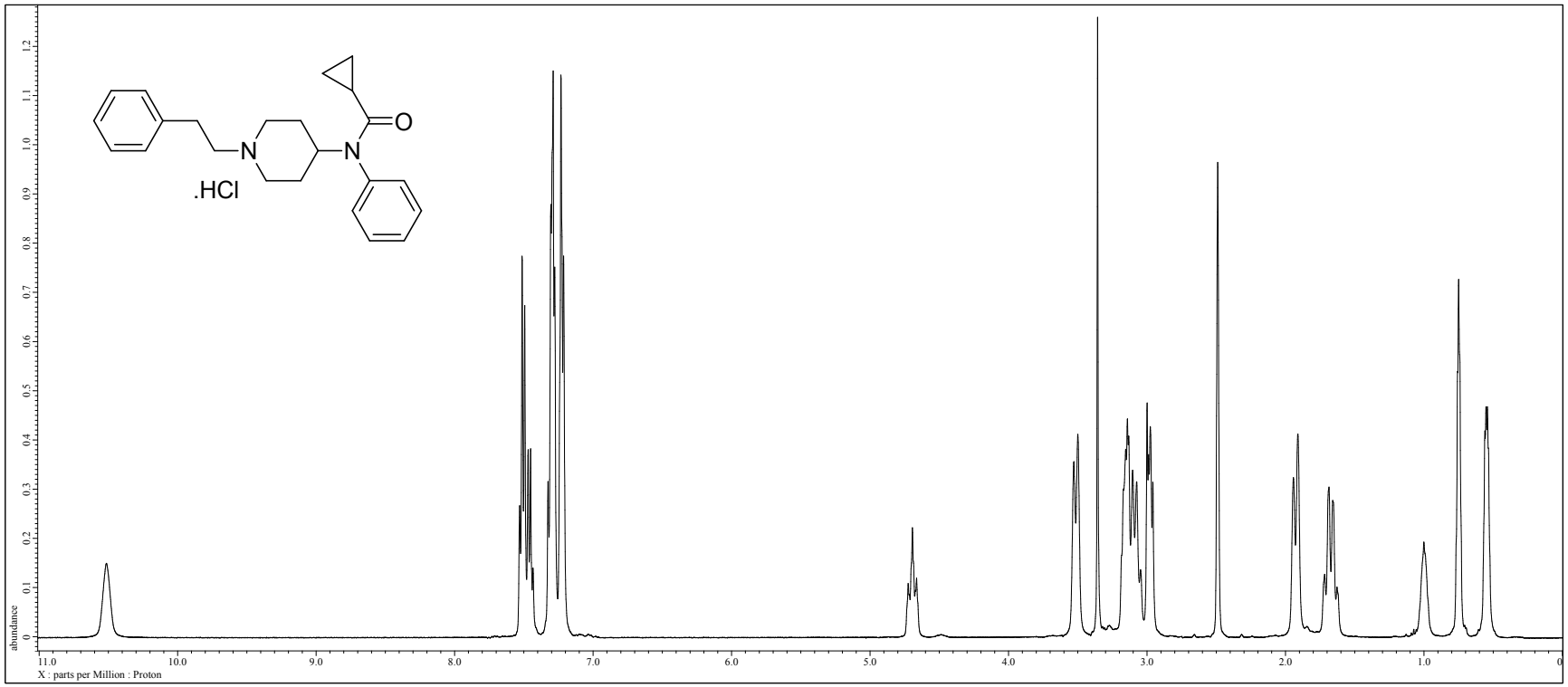
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylacetamide hydrochloride (acetylfentanyl.HCl, **2b**)



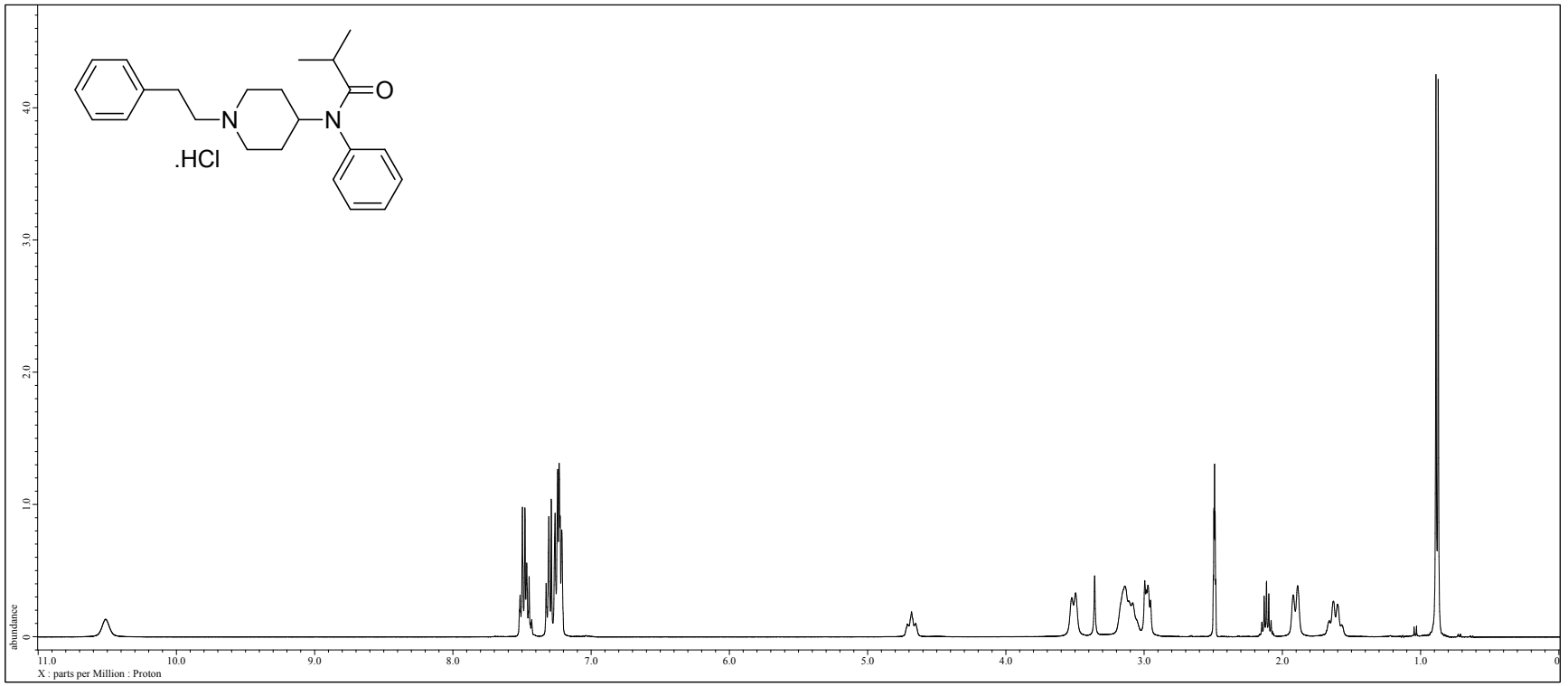
[1]H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylpropionamide hydrochloride (fentanyl.HCl, **2c**)



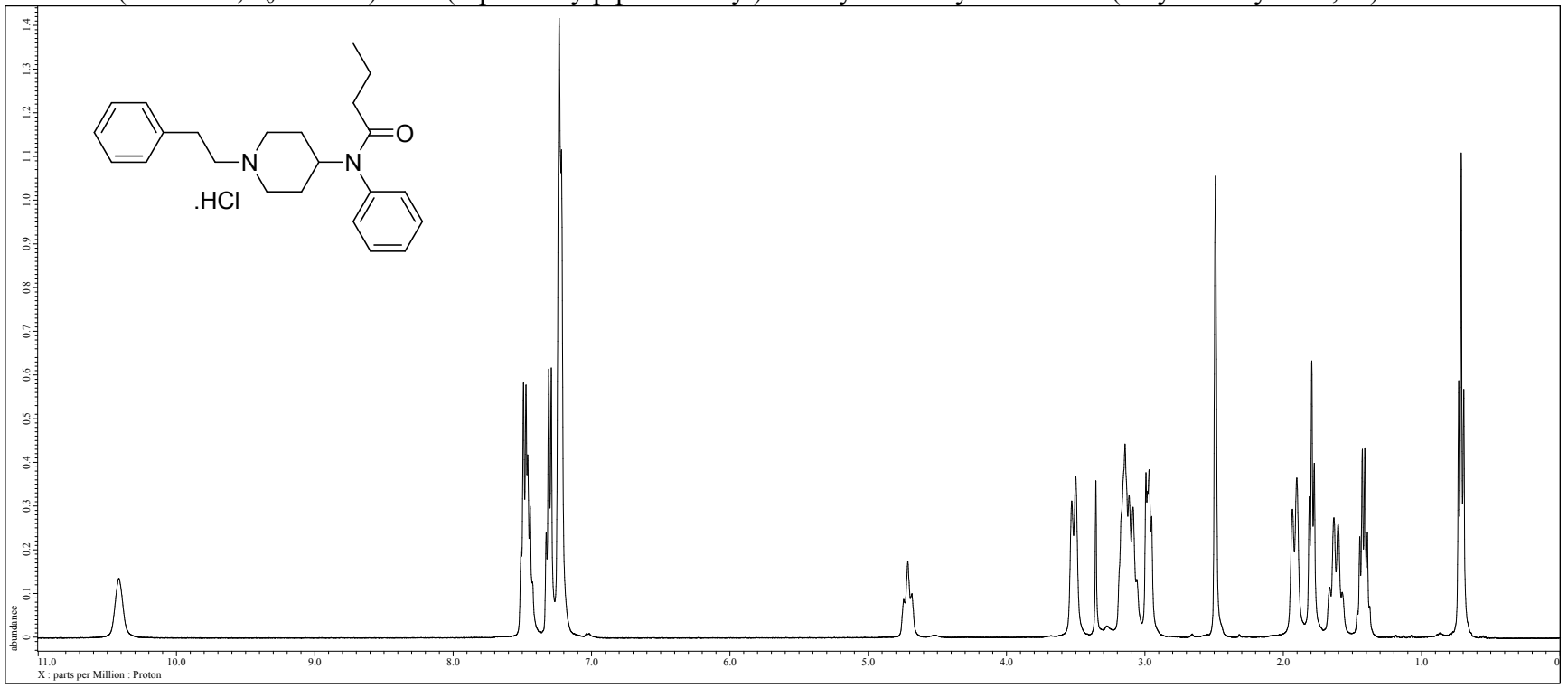
[1]H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclopropanecarboxamide hydrochloride (cyclopropylfentanyl.HCl, **2d**)



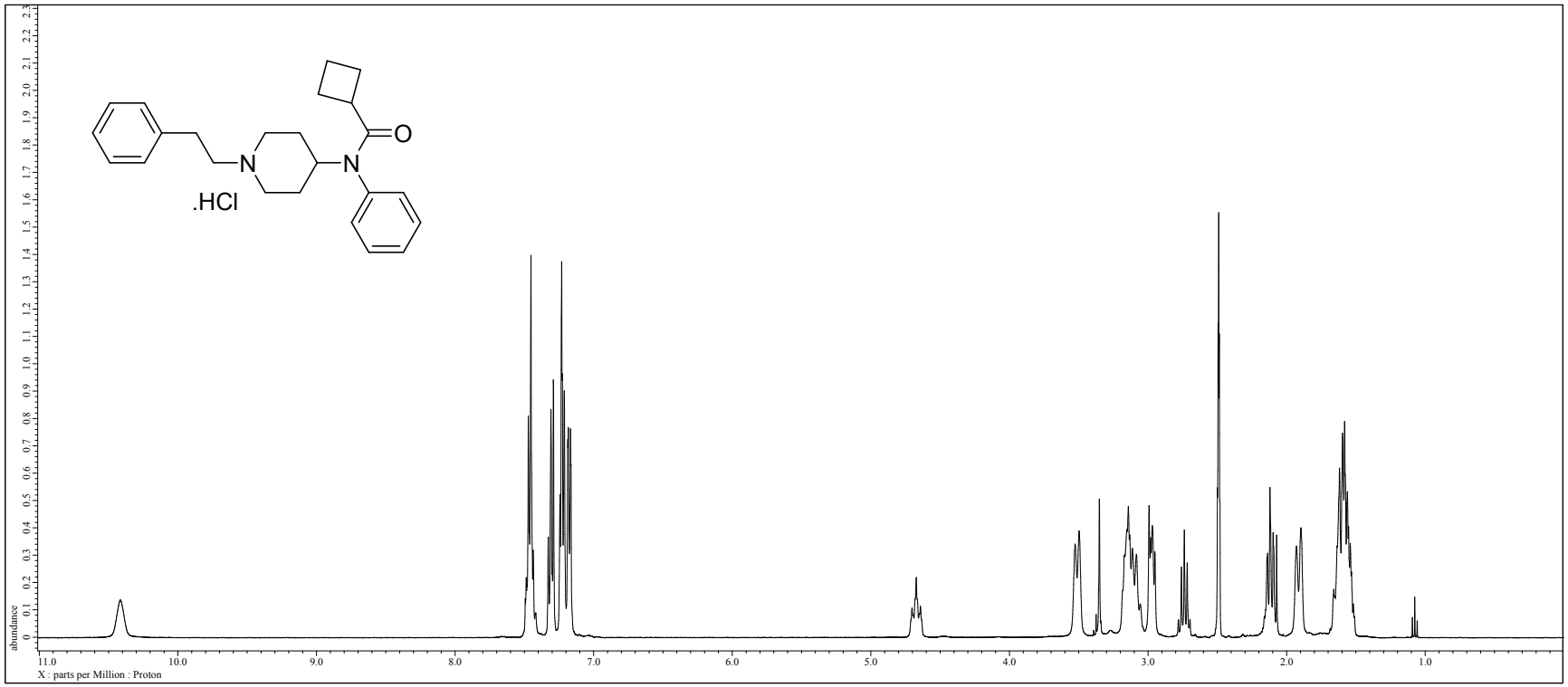
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylisobutyramide hydrochloride (isobutyrfentanyl.HCl, **2e**)



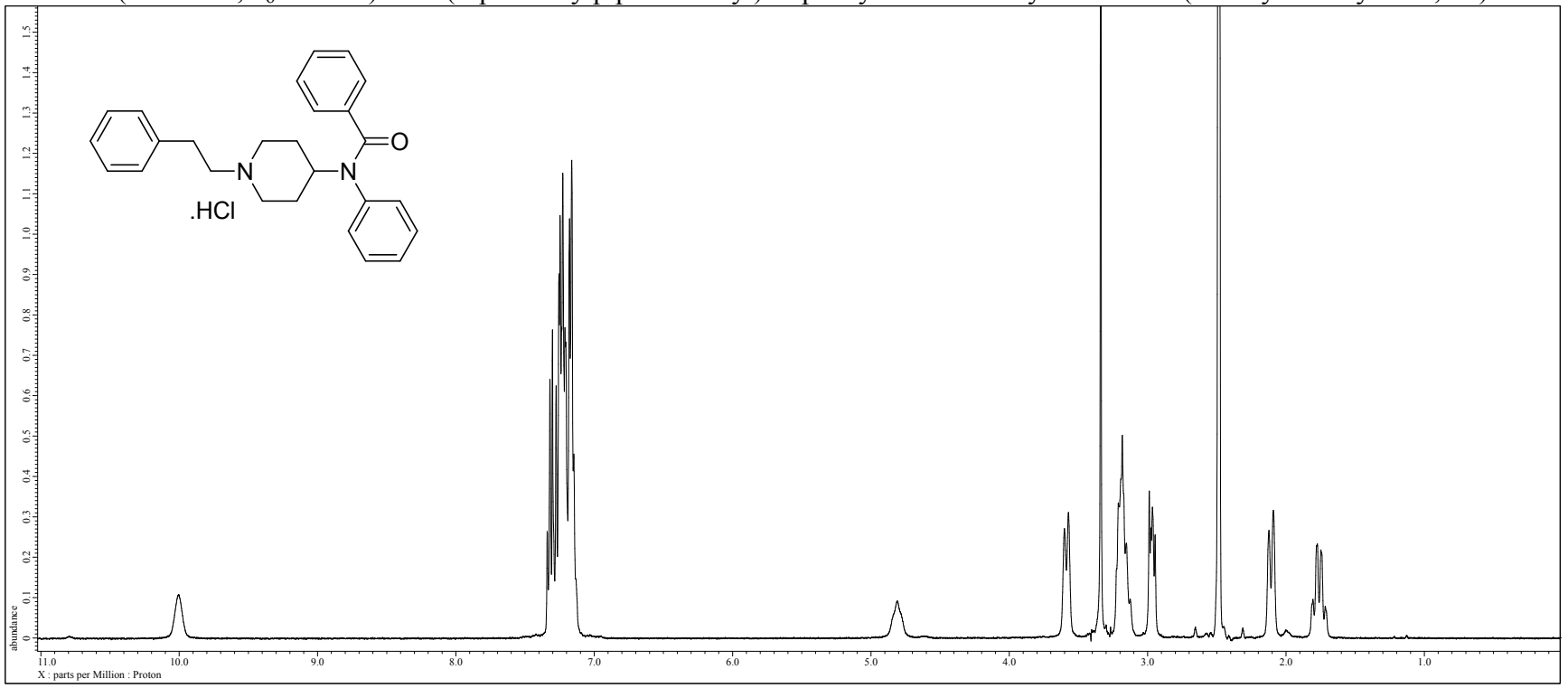
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-butyramide hydrochloride (butyrfentanyl.HCl, **2f**)



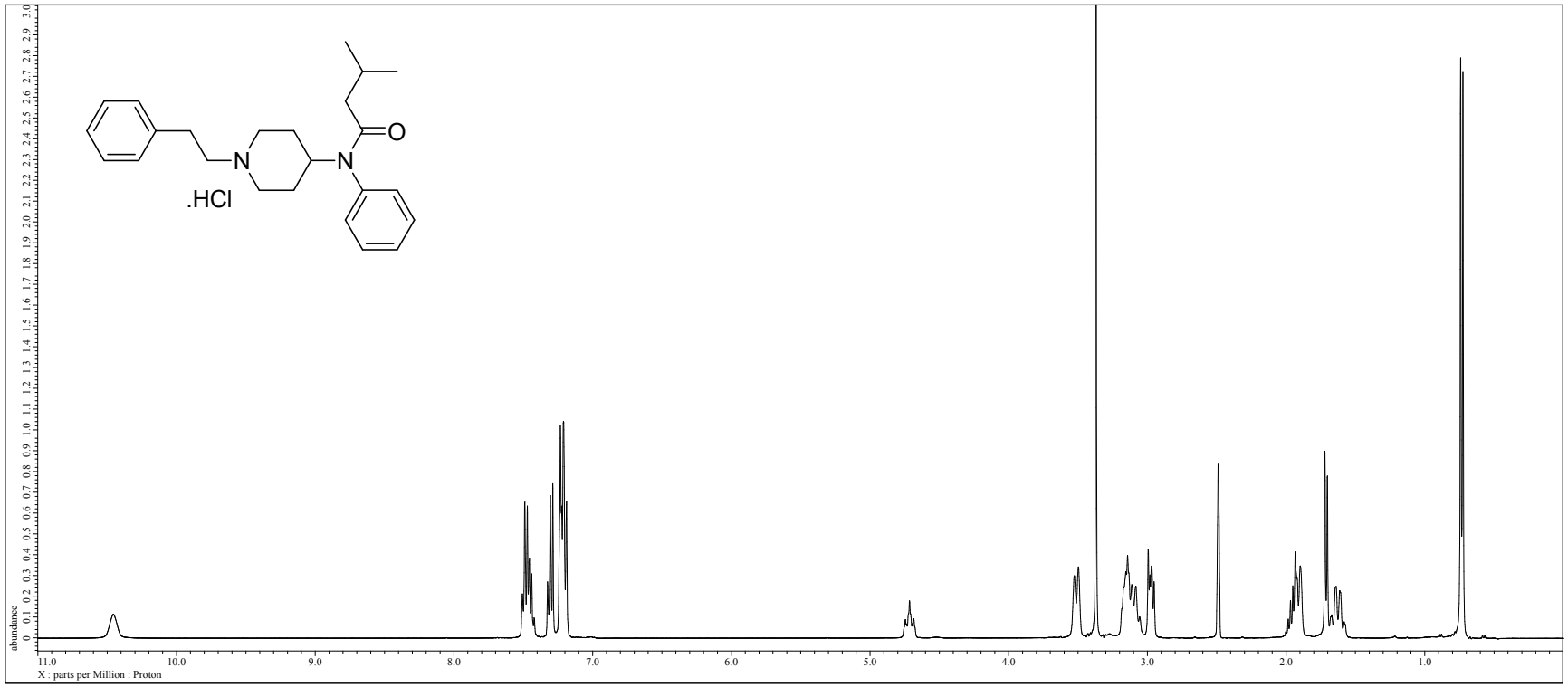
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclobutanecarboxamide hydrochloride (cyclobutylfentanyl.HCl, **2g**)



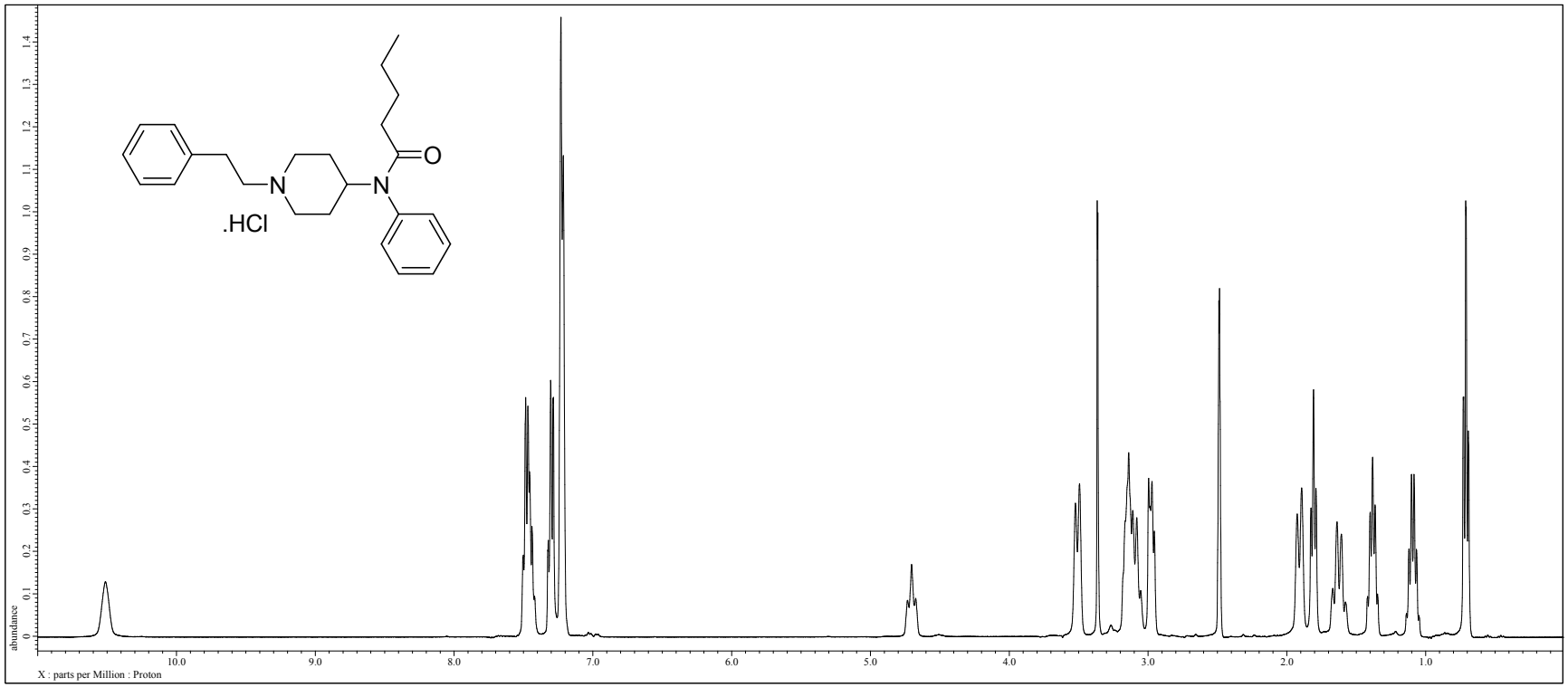
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylbenzamide hydrochloride (benzoylfentanyl.HCl, **2h**)



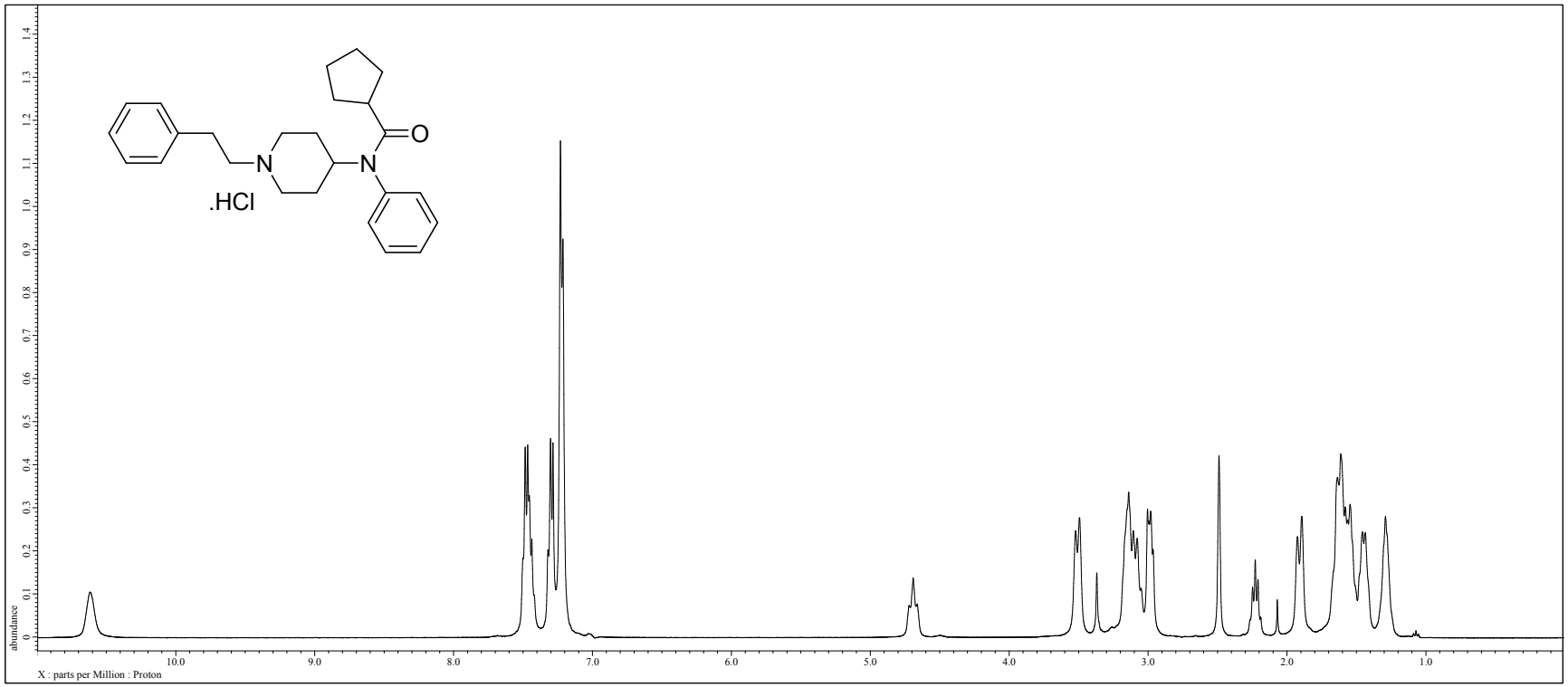
[1]H-NMR (400 MHz, $d_6$-DMSO) of 3-methyl-*N*-(1-phenethylpiperidin-4-yl)-*N*-phenylbutanamide hydrochloride (isovalerylfentanyl.HCl, **2i**)



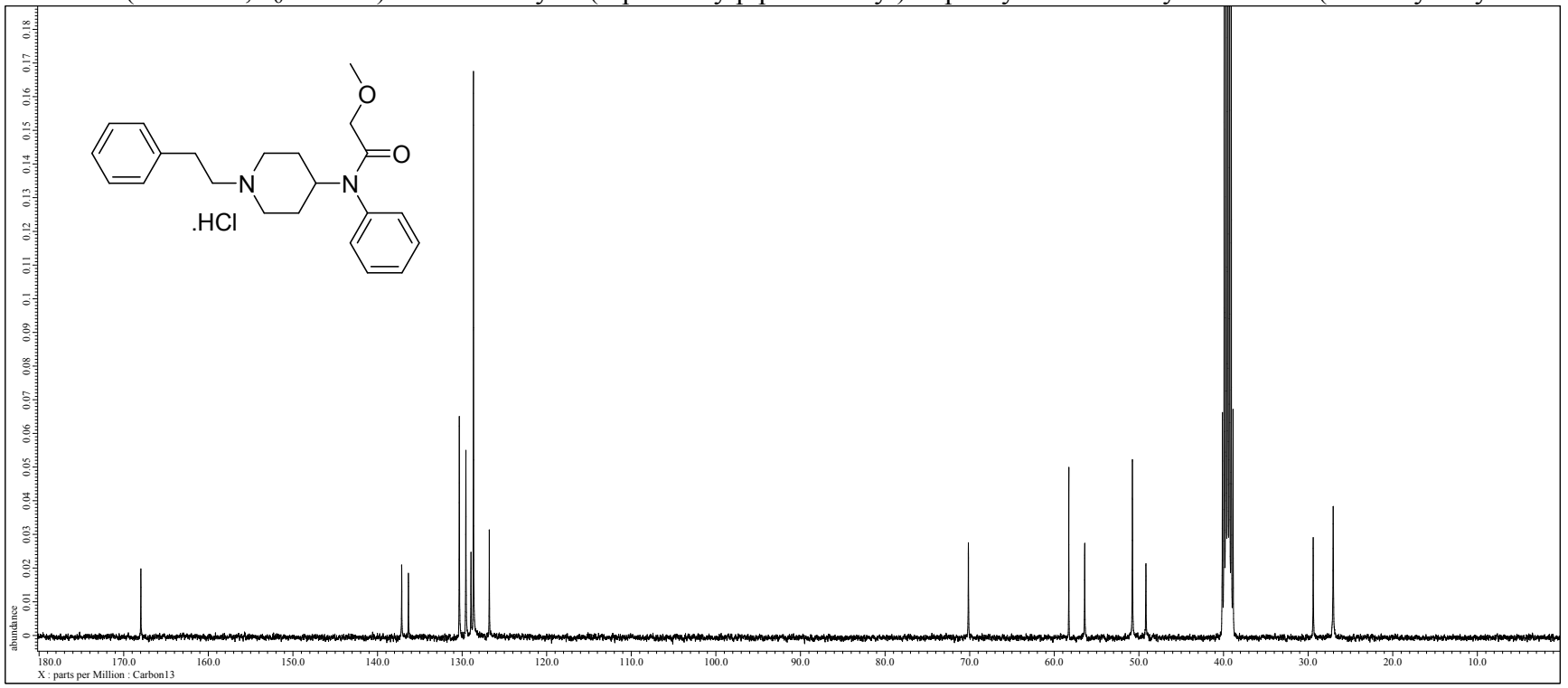
$^{1}$H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylpentanamide hydrochloride (valerylfentanyl.HCl, **2j**)



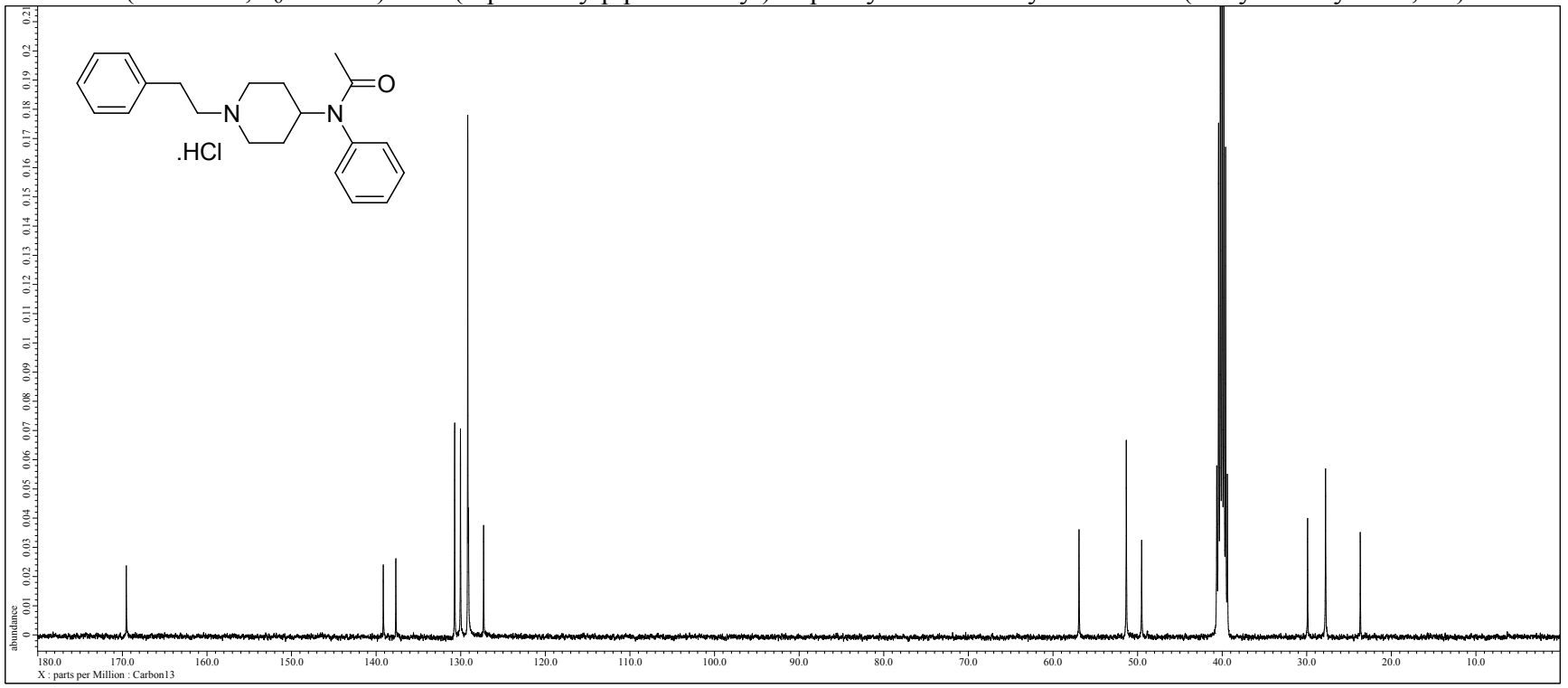
[1]H-NMR (400 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclopentanecarboxamide hydrochloride (cyclopentylfentanyl.HCl, **2k**)



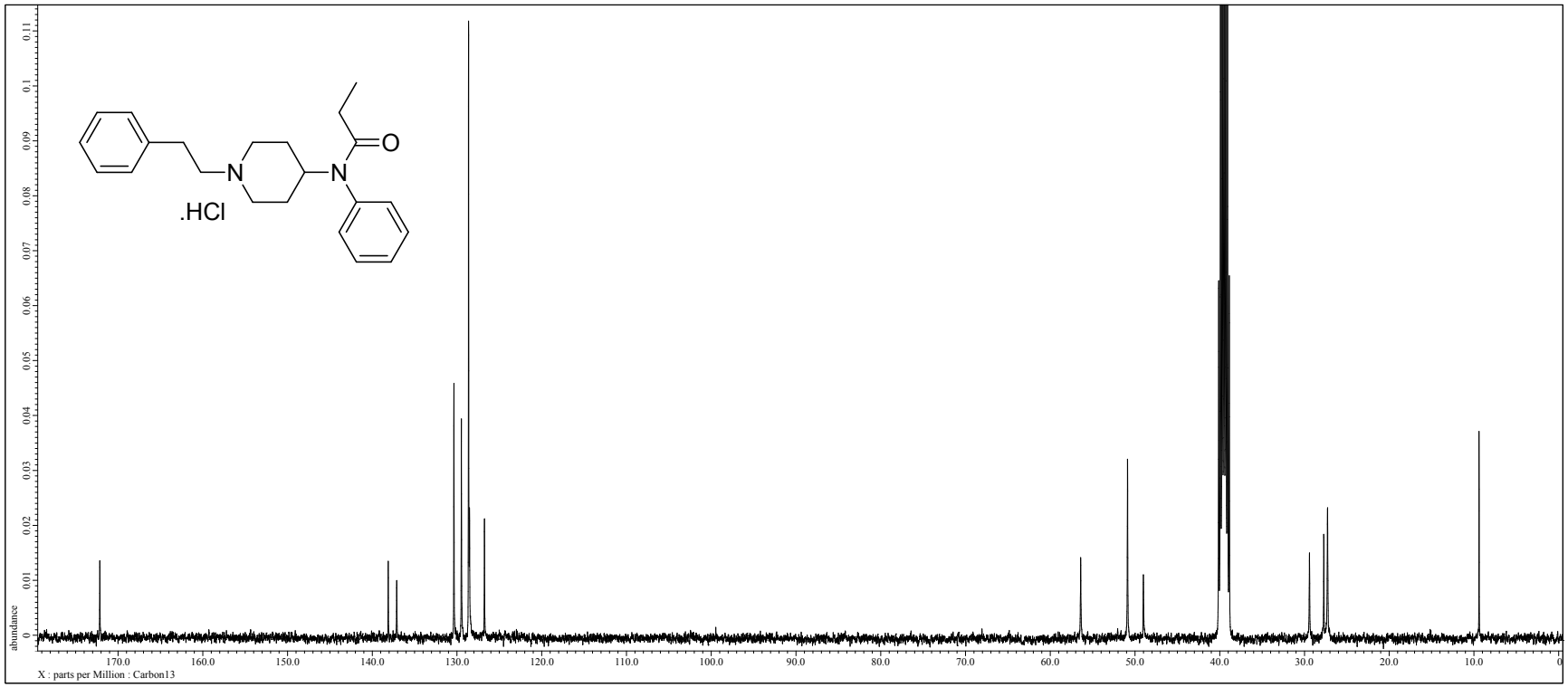
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of 2-methoxy-*N*-(1-phenethylpiperidin-4-yl)-*N*-phenylacetamide hydrochloride (methoxyacetylfentanyl.HCl, **2a**)



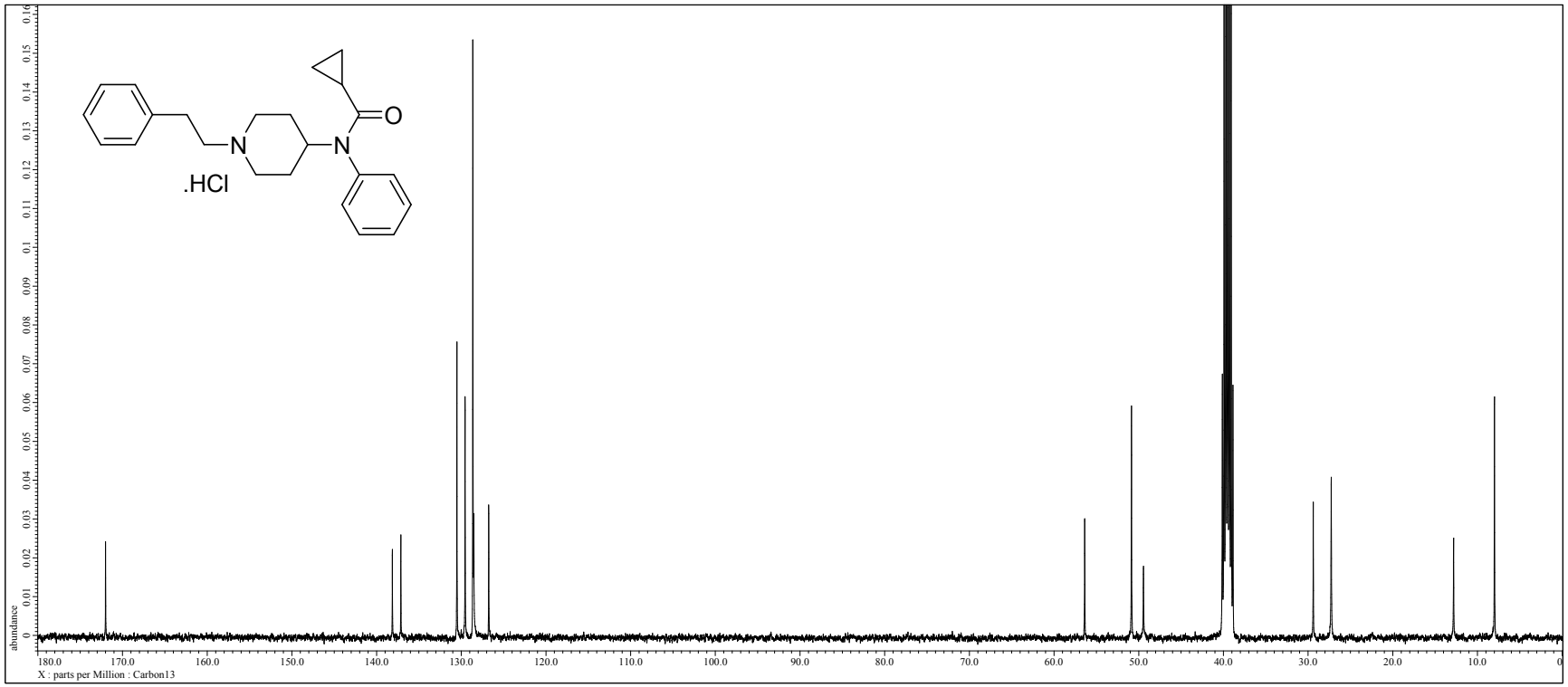
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylacetamide hydrochloride (acetylfentanyl.HCl, **2b**)



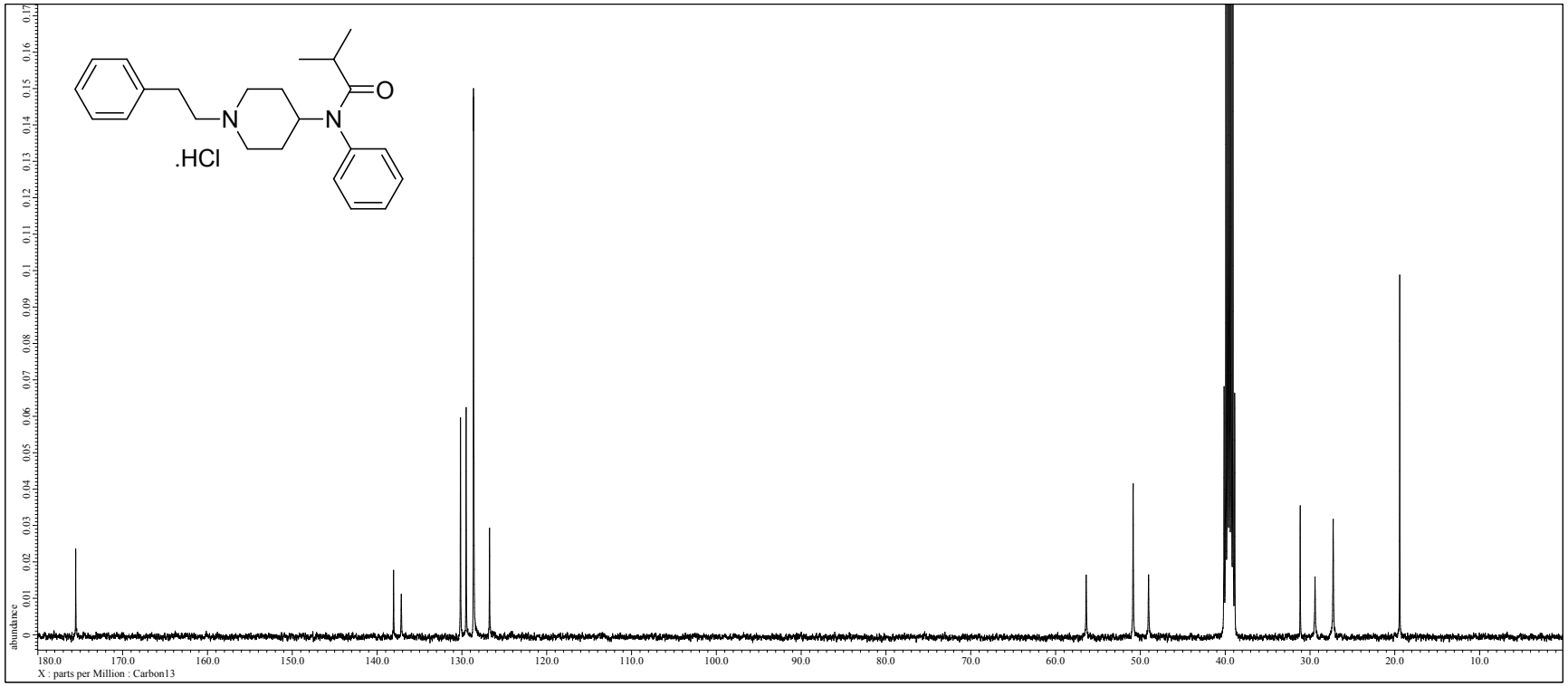
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylpropionamide hydrochloride (fentanyl.HCl, **2c**)



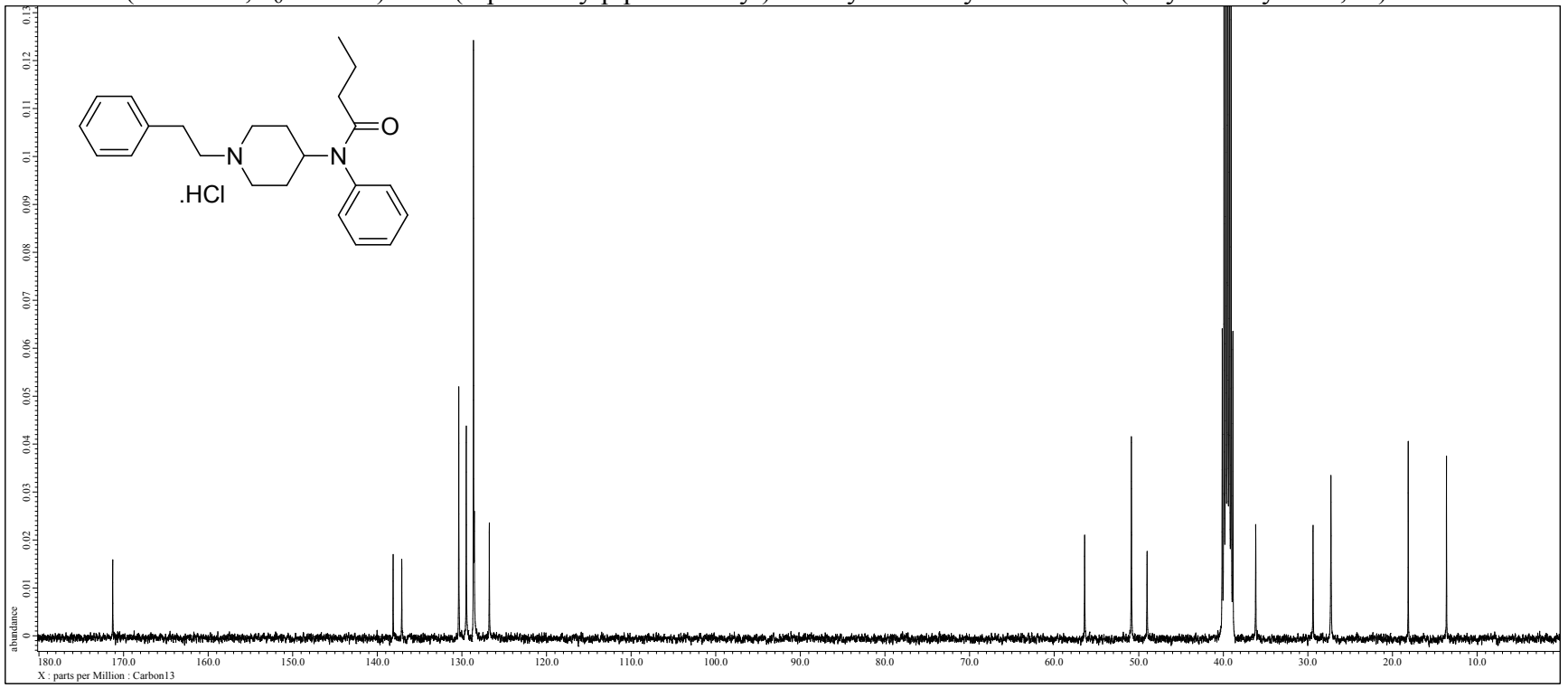
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclopropanecarboxamide hydrochloride (cyclopropylfentanyl.HCl, **2d**)



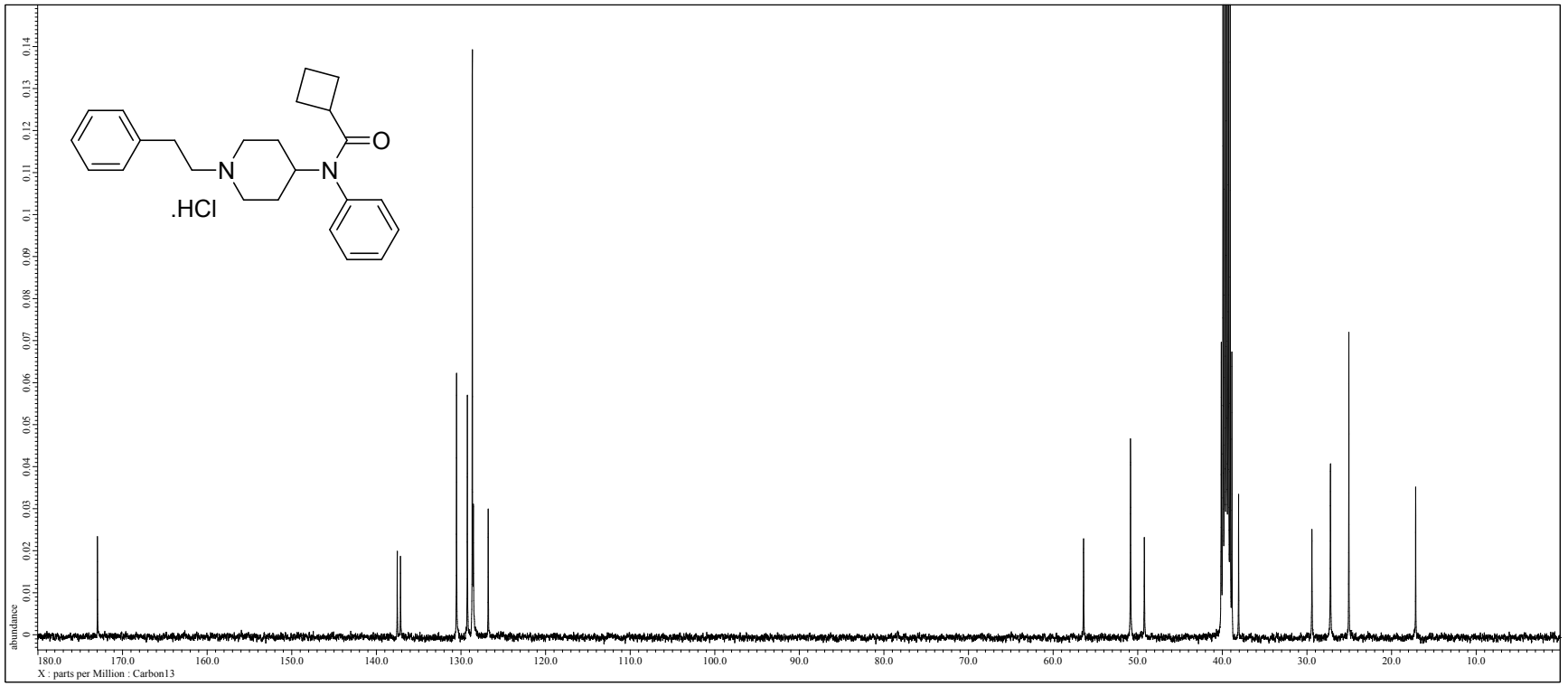
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylisobutyramide hydrochloride (isobutyrfentanyl,HCl, **2e**)



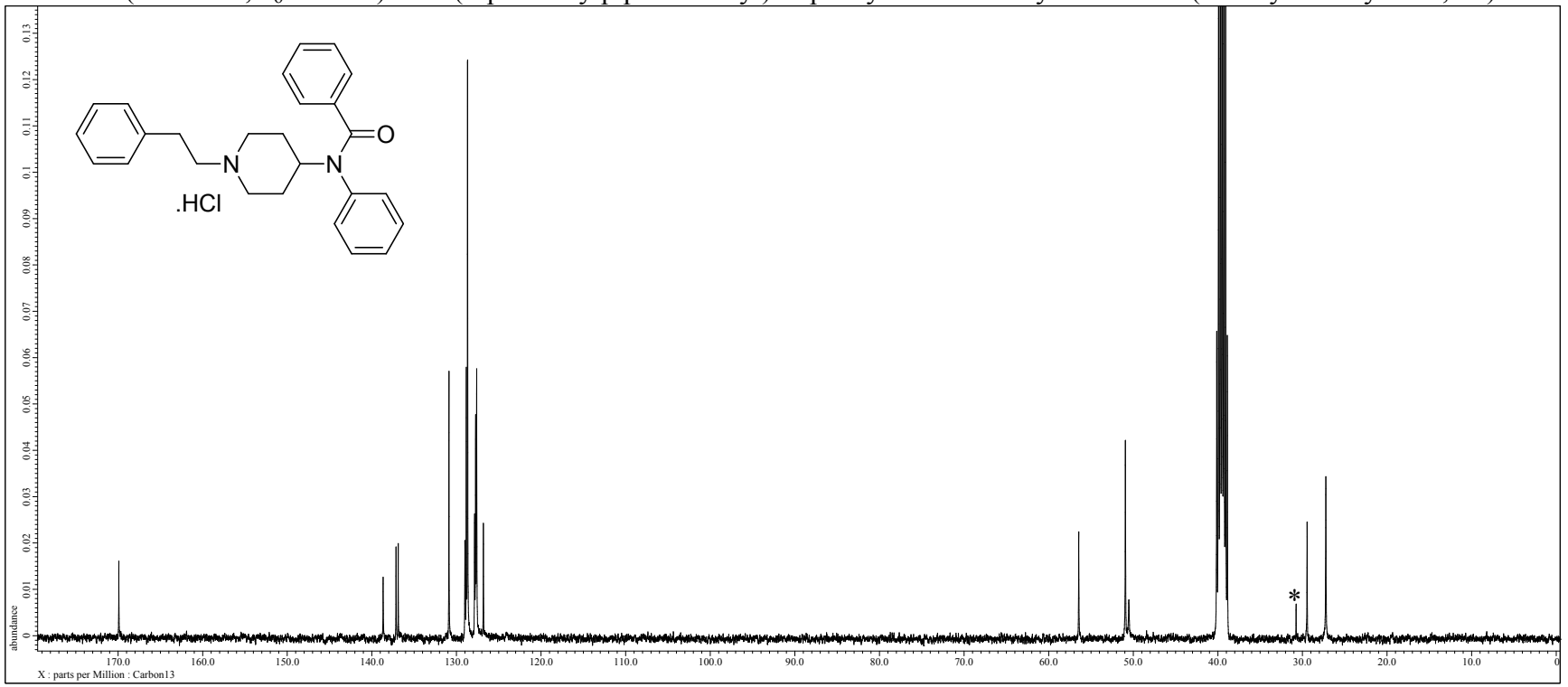
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-butyramide hydrochloride (butyrfentanyl.HCl, **2f**)



$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclobutanecarboxamide hydrochloride (cyclobutylfentanyl.HCl, **2g**)

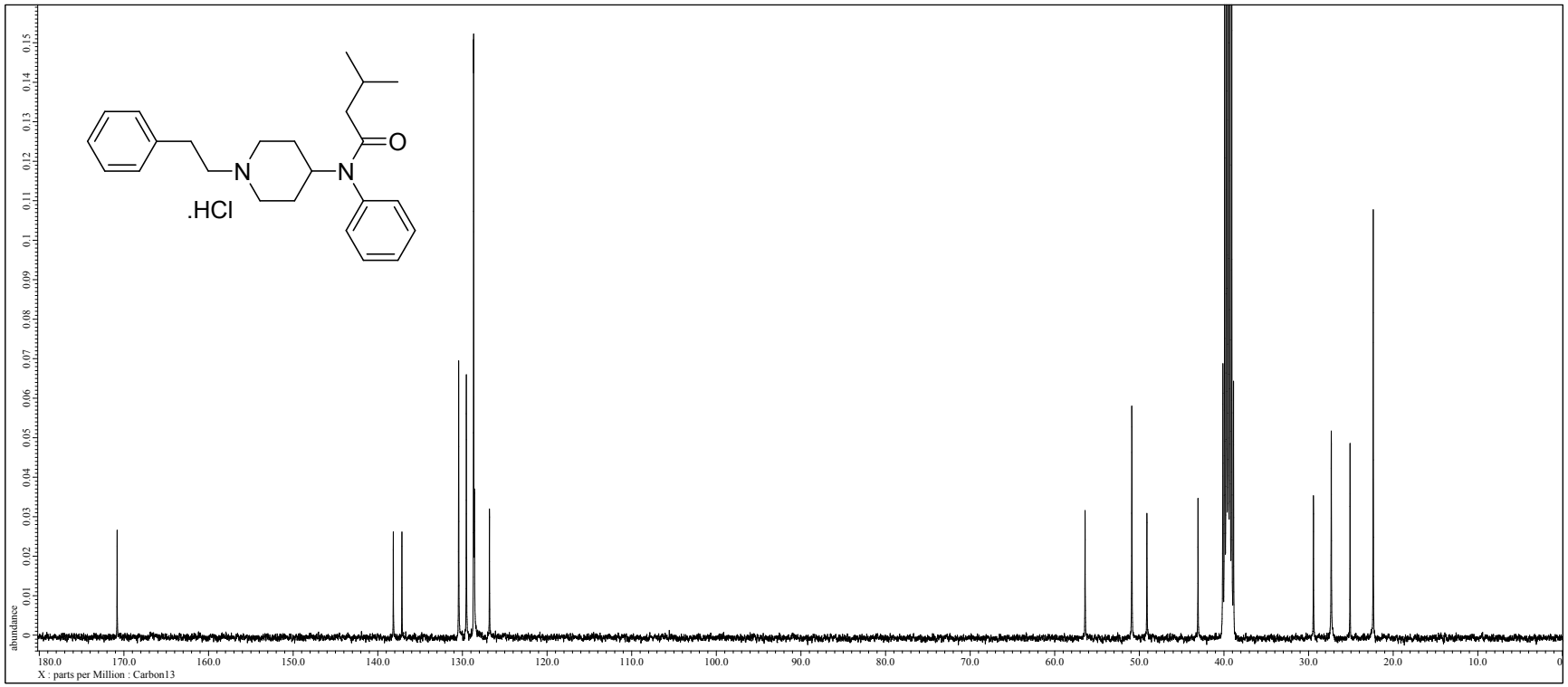


$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylbenzamide hydrochloride (benzoylfentanyl.HCl, **2h**)

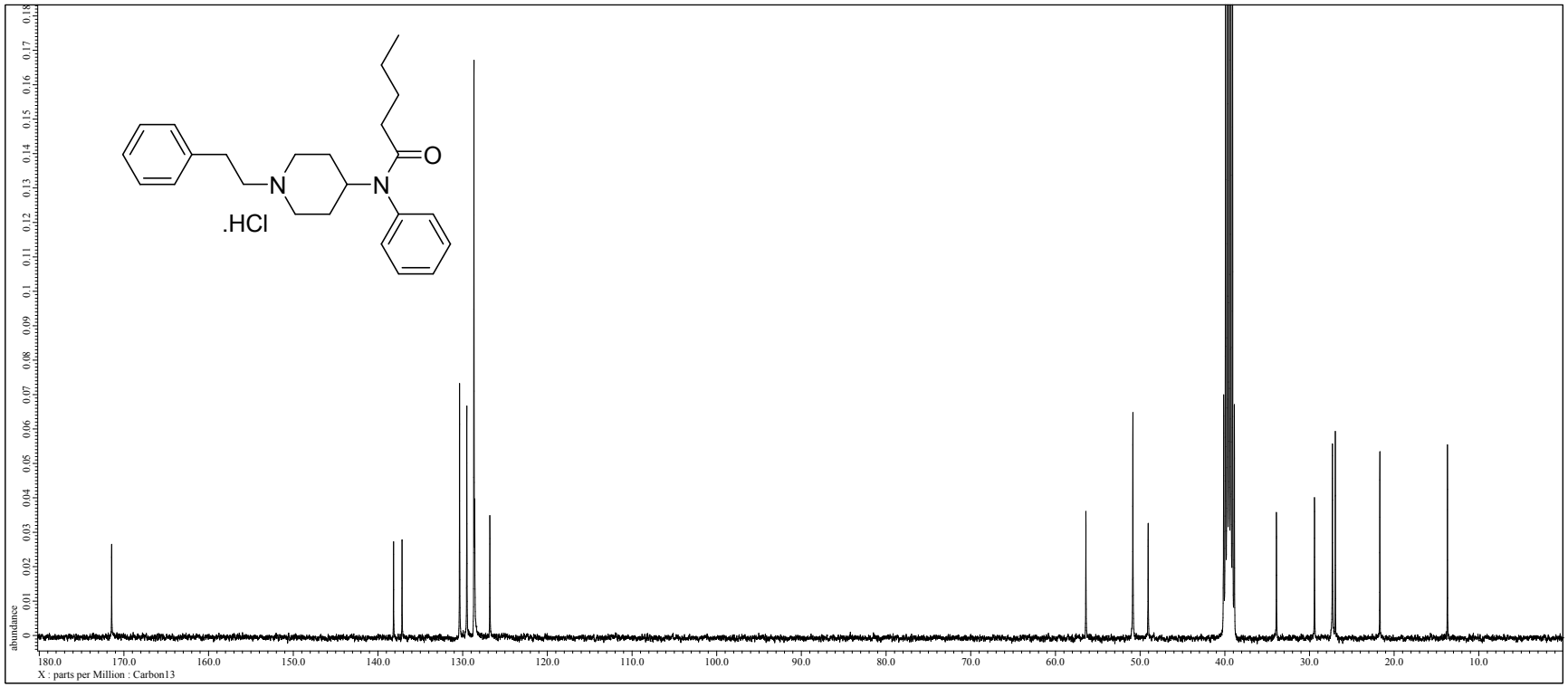



Peak denoted by (*) is residual acetone.

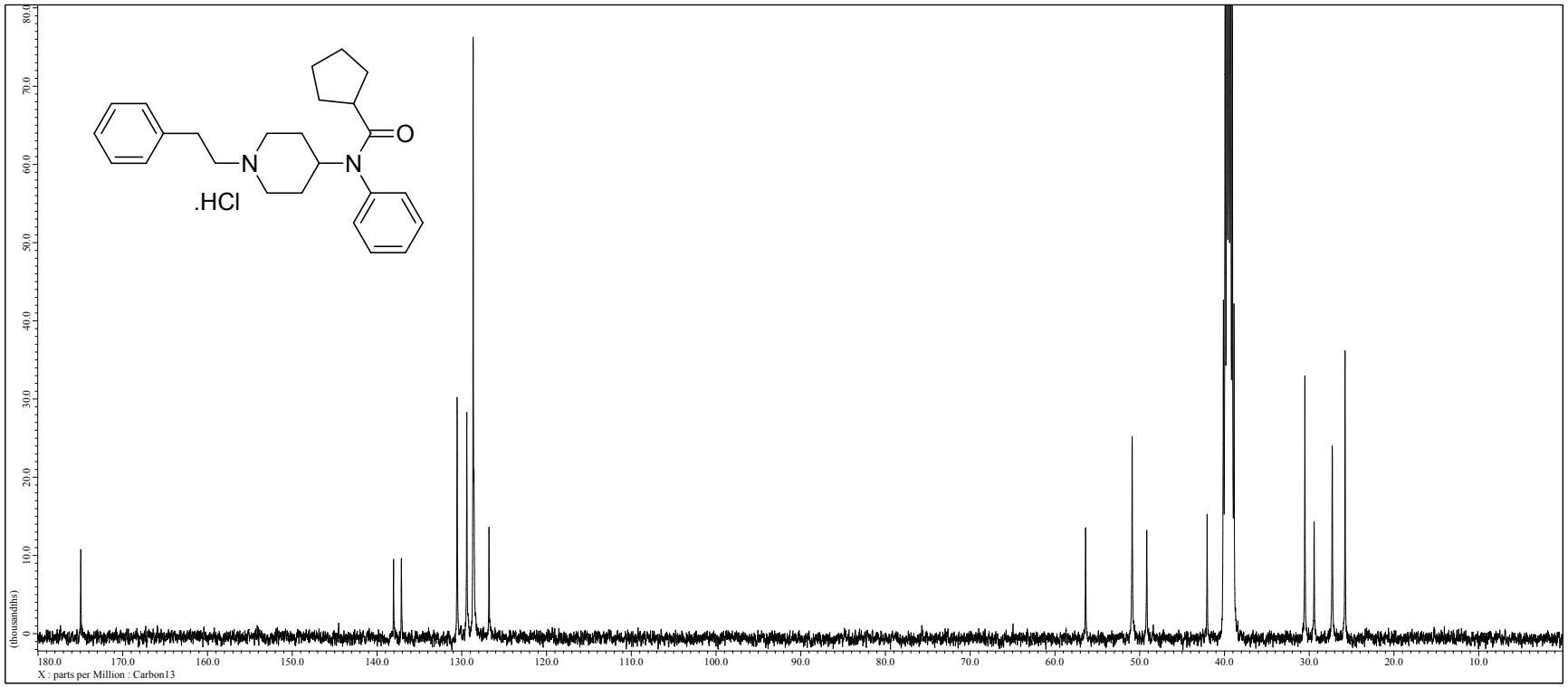
$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of 3-methyl-*N*-(1-phenethylpiperidin-4-yl)-*N*-phenylbutanamide hydrochloride (isovalerylfentanyl.HCl, **2i**)



$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylpentanamide hydrochloride (valerylfentanyl.HCl, **2j**)



$^{13}$C-NMR (100 MHz, $d_6$-DMSO) of *N*-(1-phenethylpiperidin-4-yl)-*N*-phenylcyclopentanecarboxamide hydrochloride (cyclopentylfentanyl.HCl, **2k**)



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