Characterization of NM2201 and AM2201 8-quinolinyl carboxamide

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Christian C. Matchett, Defense Forensic Science Center – USACIL, Forest Park, Georgia 30297

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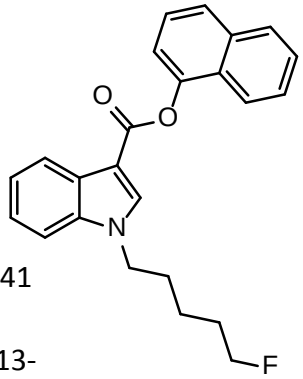
Part 1. Cayman Chemical Company Data

Compound Information



Name: NM2201
Synonyms: naphthalen-1-yl 1-(5-fluoropentyl)-1H-indole-3-carboxylate
CAS#: N/A
MF: $C_{24}H_{22}FNO_2$
FW: 375.4
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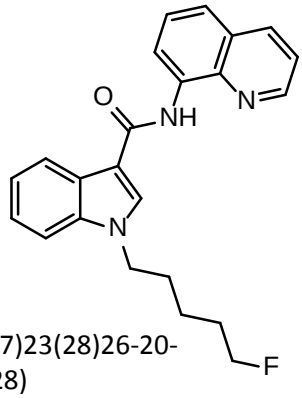

Name: AM2201 8-quinolinyl carboxamide
Synonyms: 1-(5-fluoropentyl)-N-(quinolin-8-yl)-1H-indole-3-carboxamide
CAS#: N/A
MF: $C_{23}H_{22}FN_3O$
FW: 375.4
SMILES: O=C(Nc2cccc1cccnc12)c4cn(CCCCCF)c3ccccc34
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Background

NM-2201

NM-2201 is a synthetic cannabinoid similar in structure to AM-2201, differing by an ester linking the 3' position to the naphthyl group. The physiological and toxicological properties of this compound are not currently known.

1.) Makriyannis, A., Deng, H., Cannabinimetic Indole Derivatives. US patent 6,900,236 B1, May 21, 2005.

AM2201 8-quinolinyl carboxamide

AM2201 8-quinolinyl carboxamide is an analog of AM2201 where an 8-aminoquinolyl amide replaces the naphthoyl group. This compound is also similar to 5-fluoro PB-22 which differs by replacement of the ester linkage with an amide. The physiological and toxicological properties of this compound are not currently known.

Figure 1. Liquid Chromatography/Mass Spectrometry of NM-2201

Experiment Parameters:
Thermo Scientific LTQ Orbitrap XL mass spectrometer
Flow injection with an eluent of methanol
Atmospheric Pressure Chemical ionization (APCI) in positive mode
Resolution setting of 30 000 (FWHM) at m/z 400 and internal lock mass of 391.2843 for the $[M+H]^+$ for dioctyl phthalate
Full scan: 250-500 m/z

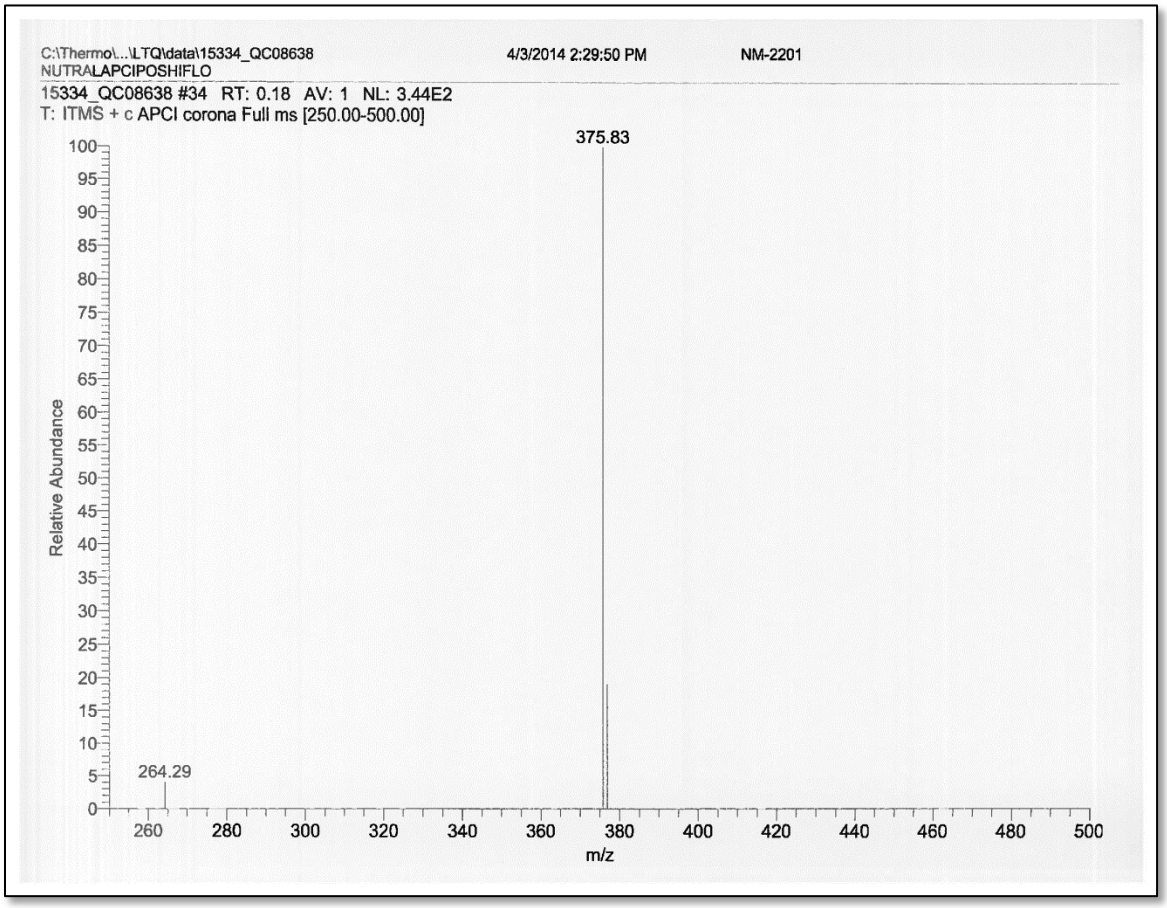


Figure 2. Liquid Chromatography/Mass Spectrometry of AM2201 8-quinolinyl carboxamide

Experiment Parameters:
Thermo Scientific LTQ Orbitrap XL mass spectrometer
Flow injection with an eluent of methanol
Atmospheric Pressure Chemical ionization (APCI) in positive mode
Resolution setting of 30 000 (FWHM) at m/z 400 and internal lock mass of 391.2843 for the $[M+H]^+$ for dioctyl phthalate
Full scan: 50-800 m/z

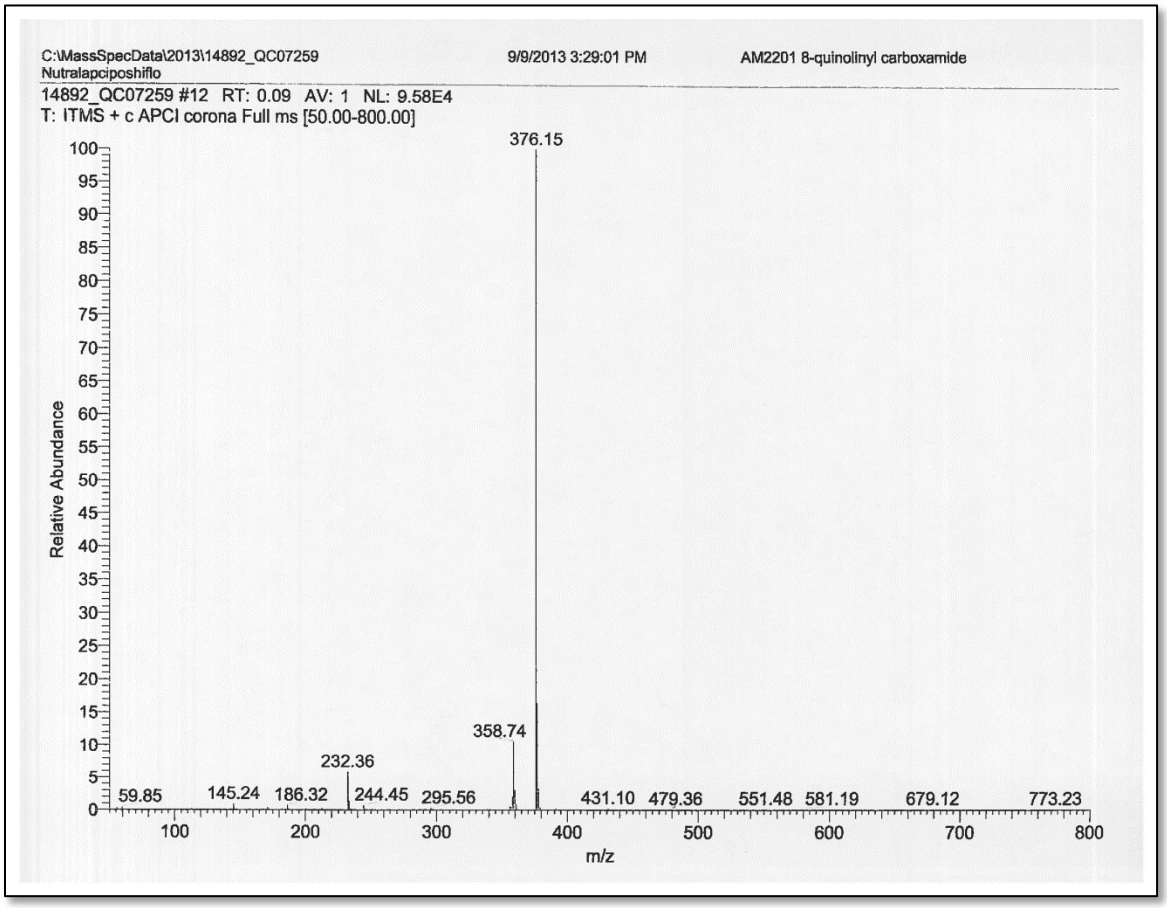


Figure 3. Gas Chromatography/Mass Spectrometry of NM2201

Experiment Parameters:
Agilent 6890 GC/5973 MSD
15:1 split, 20 mL/min He carrier gas
300°C inlet
30 m x 0.32 mm, 0.5 µm Rtx-5MS column
240°C, ramp 30°C/min to 300°C (hold for 1 min, ramp, hold for 25 min)

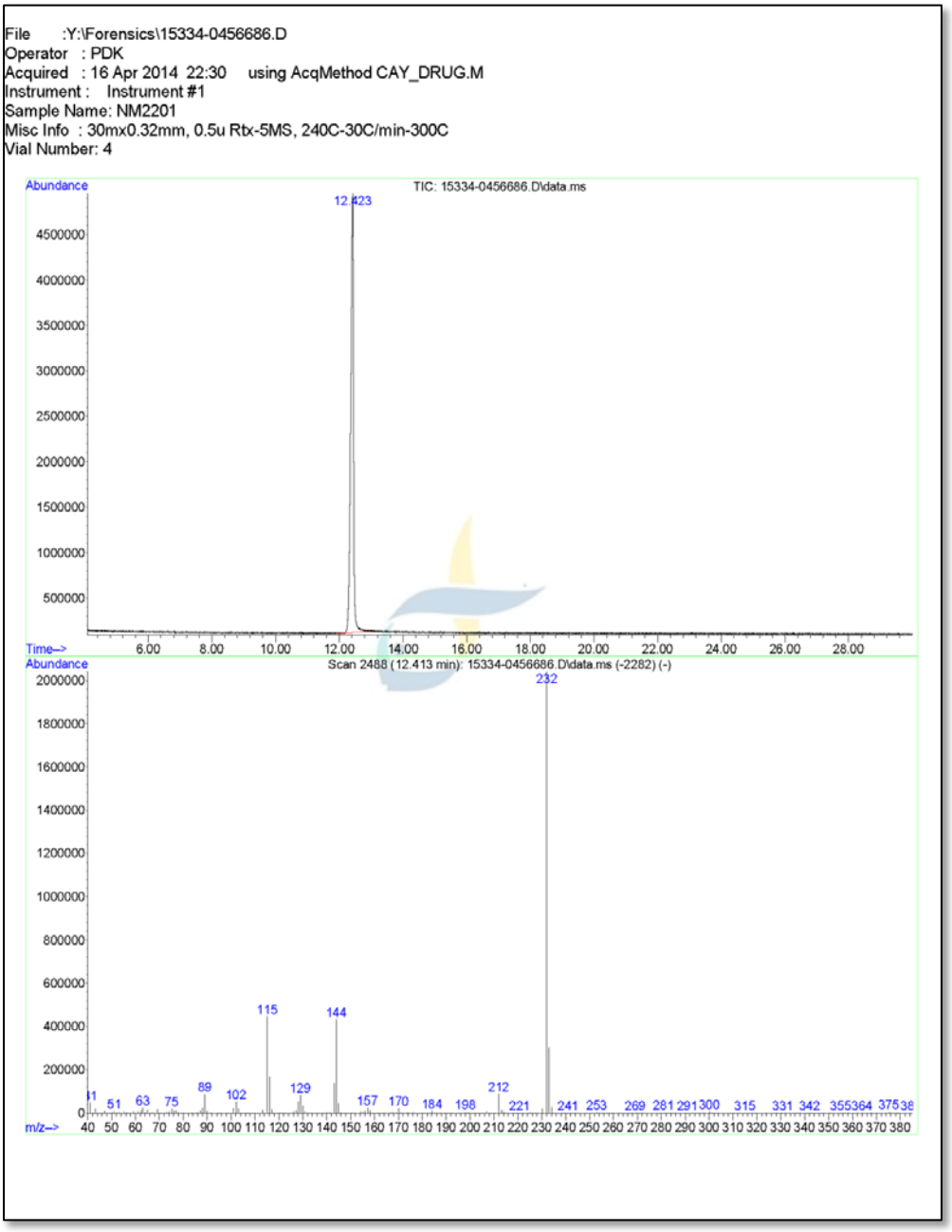


Figure 4. Gas Chromatography/Mass Spectrometry of AM2201 8-quinolinyl carboxamide

Experiment Parameters:
Agilent 6890 GC/5973 MSD
15:1 split, 20 mL/min He carrier gas
300°C inlet
30 m x 0.32 mm, 0.5 µm Rtx-5MS column
240°C, ramp 30°C/min to 300°C (hold for 1 min, ramp, hold for 25 min)

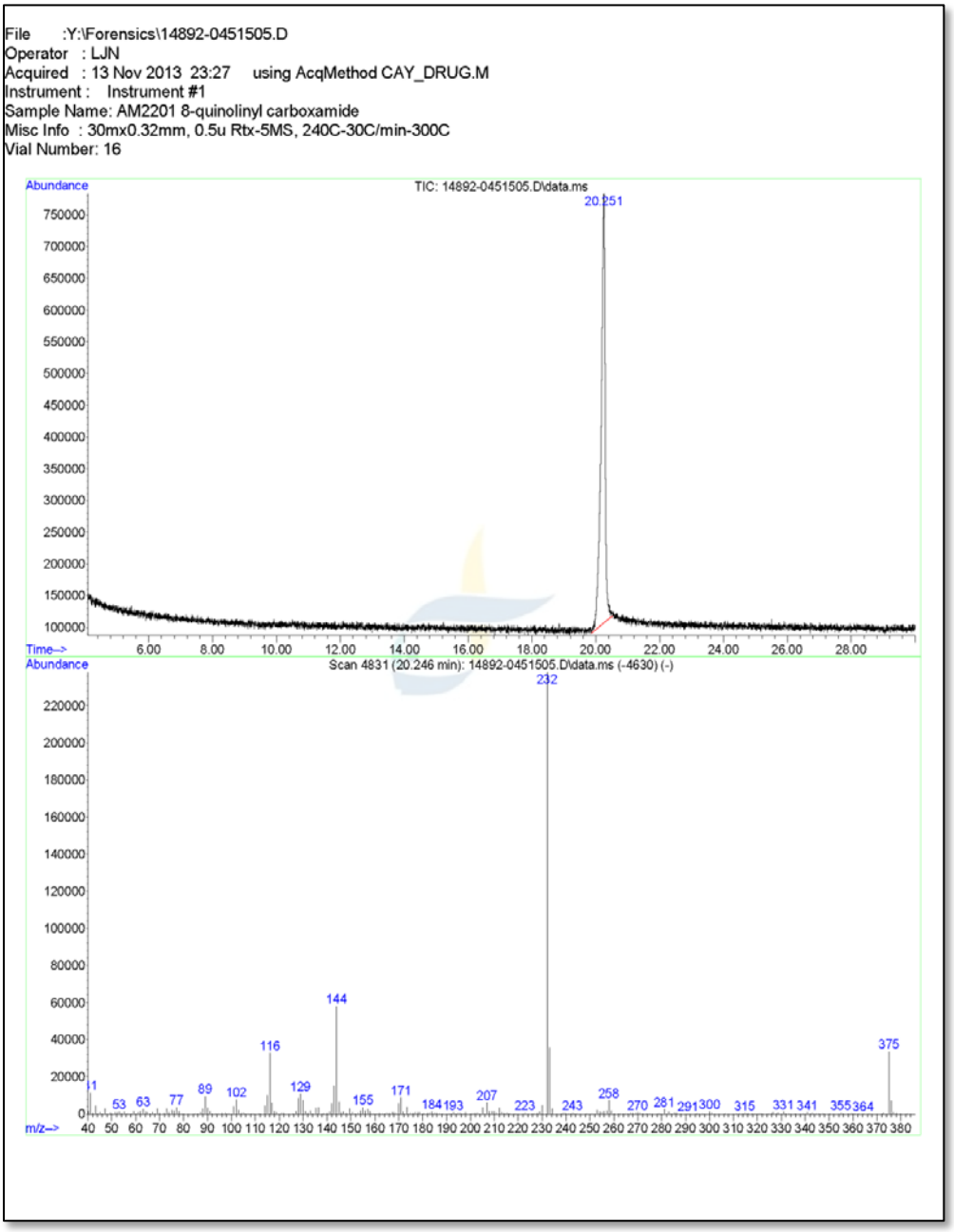


Figure 5. Fourier Transform Infrared Spectroscopy of NM2201

PerkinElmer Spectrum 100/400
Sample analyzed as neat oil
Range: 4000-600 cm^{-1}, 16 scans, 1 cm^{-1} resolution

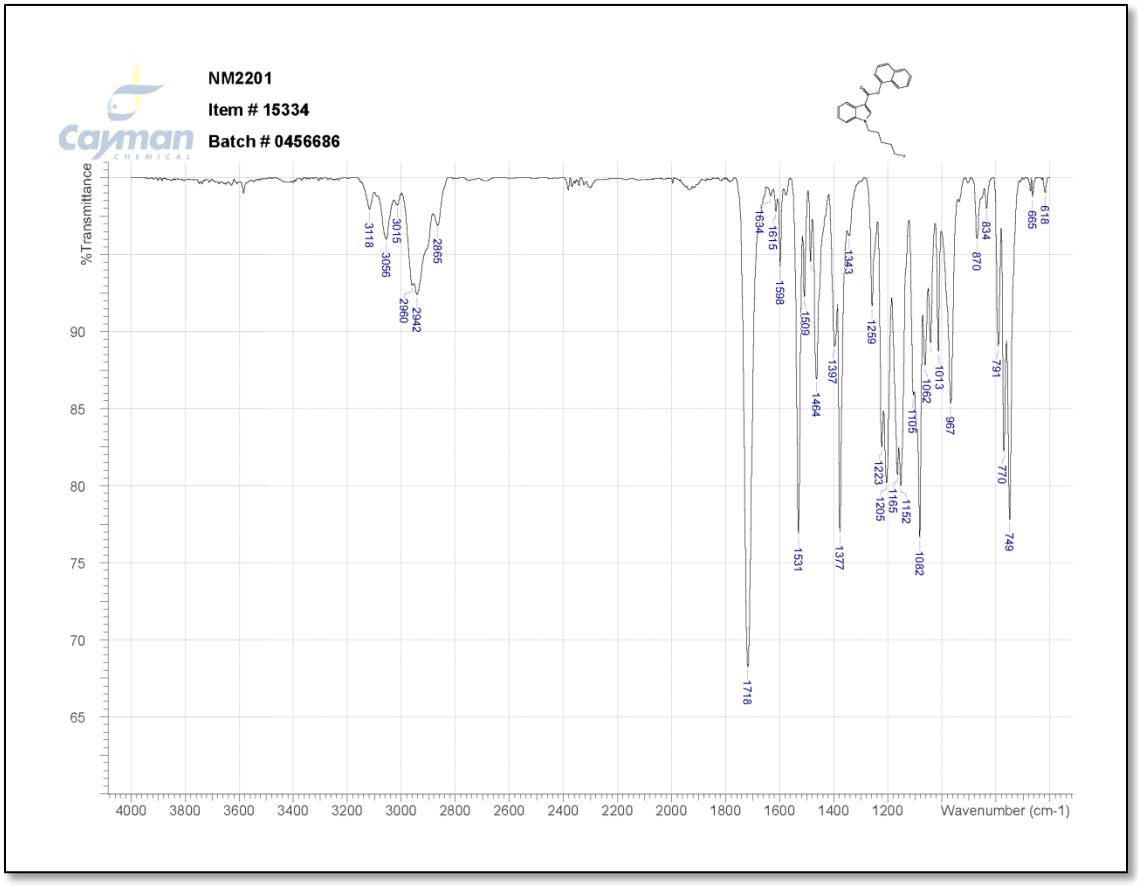


Figure 6. Fourier Transform Infrared Spectroscopy of AM2201 8-quinolinyl carboxamide

PerkinElmer Spectrum 100/400
Sample prepared as KBr pellet
Range: 4000-600 cm^{-1}, 16 scans, 1 cm^{-1} resolution

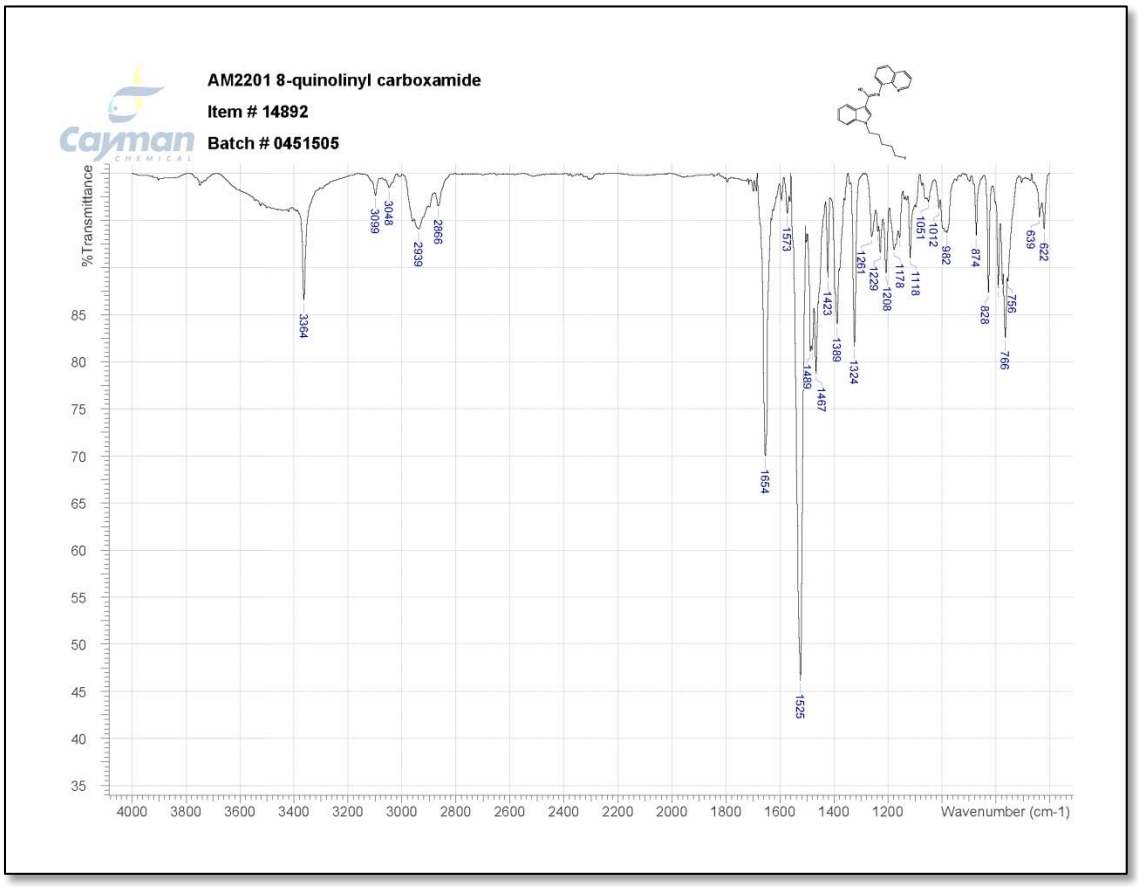


Figure 7. ^{1}H Nuclear Magnetic Resonance Spectroscopy of NM2201

Varian ^{UNITY}INOVA 400 MHz Spectrometer with Oxford magnet
Nalorac Z-Spec 4NG400-5HT 4-nucleus probe
Spectrum set to solvent peak at 7.26ppm ($CDCl_3$)

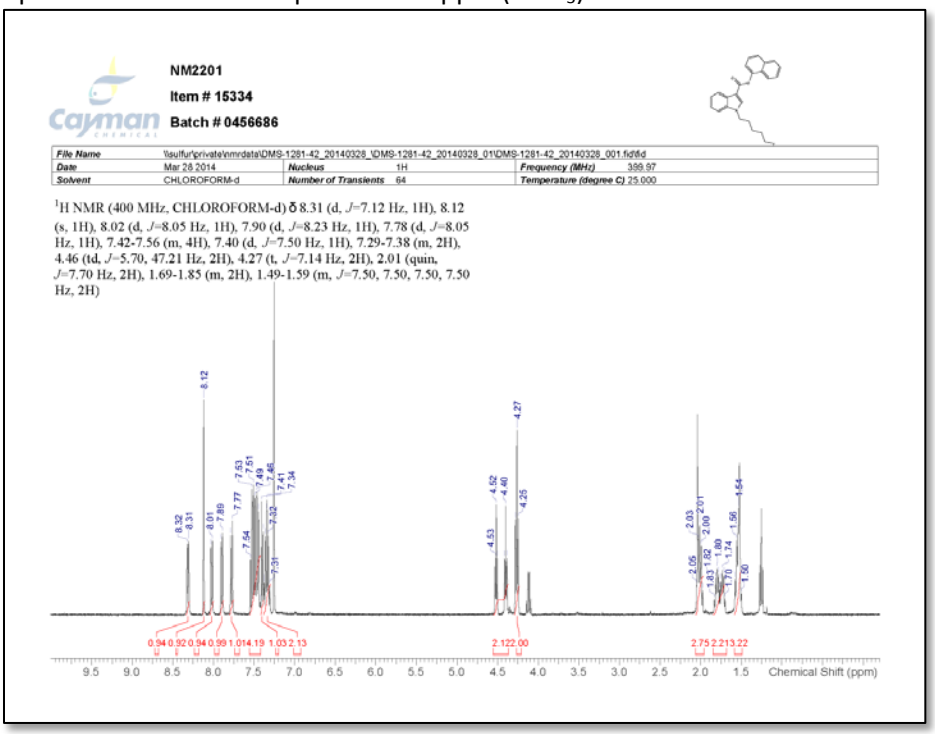


Figure 8. ^{1}H Nuclear Magnetic Resonance Spectroscopy of NM-2201, Enhanced for Detail

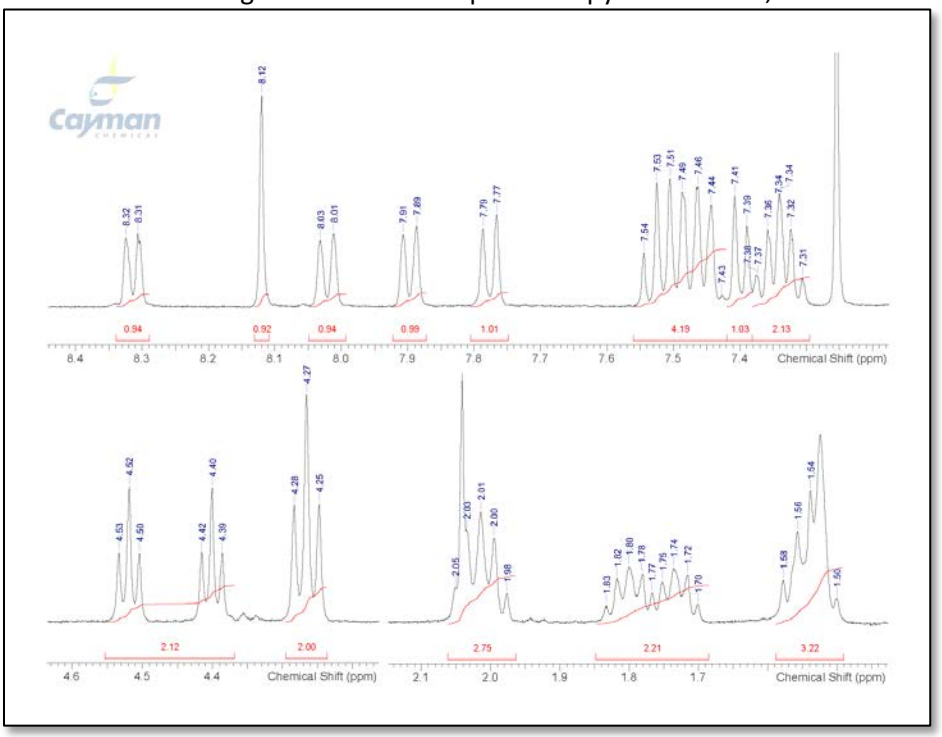


Figure 9. ^{1}H Nuclear Magnetic Resonance Spectroscopy of AM2201 8-quinolinyl carboxamide

Varian ^{UNITY}INOVA 400 MHz Spectrometer with Oxford magnet
Nalorac Z-Spec 4NG400-5HT 4-nucleus probe
Spectrum set to solvent peak at 7.26ppm ($CDCl_3$)

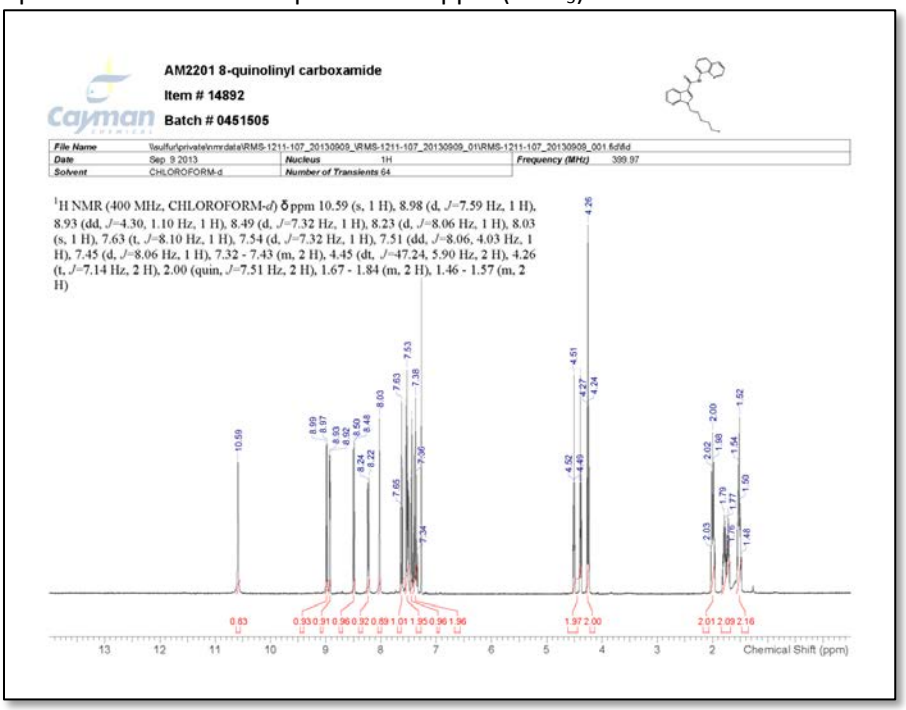
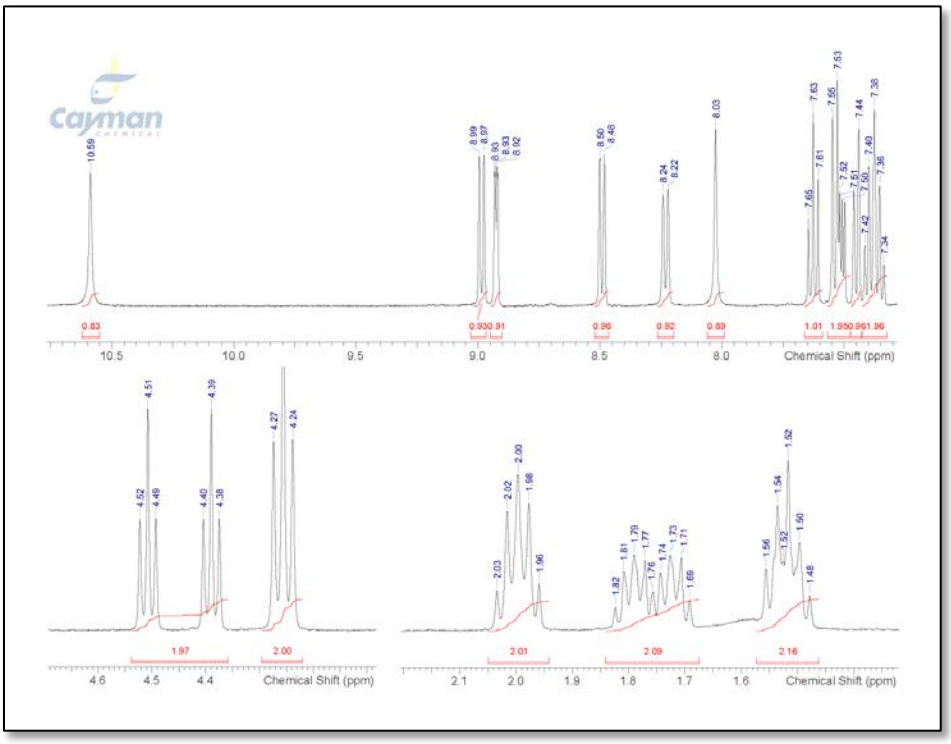
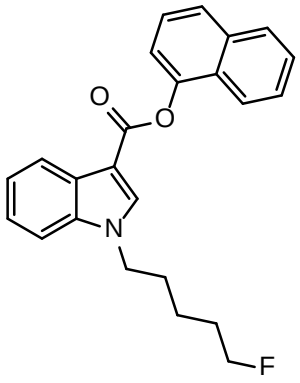


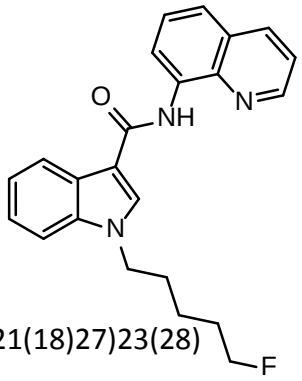
Figure 10. ^{1}H Nuclear Magnetic Resonance Spectroscopy of AM2201 8-quinolinyl carboxamide, Enhanced for Detail



Part 2. USACIL Data



Compound Information
Name: NM2201
Synonyms: naphthalen-1-yl 1-(5-fluoropentyl)-1H-indole-3-carboxylate
CAS#: N/A
MF: $C_{24}H_{22}FNO_2$
MW: 375.4 g/mol
SMILES: FCCCCCN1C=C(C(OC2=C(C=CC=C3)C3=CC=C2)=O)C4=CC=CC=C41
InChl Key: PRGFSQYZCKCBQO-UHFFFAOYSA-N
InChl: InChI=1S/C24H22FNO2/c25-15-6-1-7-16-26-17-21(20-12-4-5-13-22(20)26)24(27)28-23-14-8-10-18-9-2-3-11-19(18)23/h2-5,8-14,17H,1,6-7,15-16H2



Name: AM2201 8-quinolinyl carboxamide
Synonyms: 1-(5-fluoropentyl)-N-(quinolin-8-yl)-1H-indole-3-carboxamide
CAS#: N/A
MF: $C_{23}H_{22}FN_3O$
MW: 375.4 g/mol
SMILES: O=C(Nc2cccc1cccnc12)c4cn(CCCCCF)c3ccccc34
InChl Key: FIWJUBZDMCCWRU-UHFFFAOYSA-N
InChl: InChI=1S/C23H22FN3O/c24-13-4-1-5-15-27-16-19(18-10-2-3-12-21(18)27)23(28)26-20-11-6-8-17-9-7-14-25-22(17)20/h2-3,6-12,14,16H,1,4-5,13,15H2,(H,26,28)

Background:

A seizure of suspected NM2201 was received by the Defense Forensic Science Center. For newly encountered substances with potential isomer variants, an analytical scheme is often chosen which will identify a compound without isomer differentiation. During the course of analysis, the question was raised whether AM2201 8-quinolinyl carboxamide could be differentiated from NM2201. Both compounds have the same nominal mass (375 g/mol) and give similar EI mass spectra. Importantly, the compounds are not isomers and therefore the answer needed to be addressed before identifying and reporting "NM2201 or one of its optical, positional, or geometric isomers".

Using exact mass analysis, it was theorized that they could be differentiated.

Compound	Molecular Formula	Monoisotopic Mass
NM2201	$C_{24}H_{22}FNO_2$	375.1635 g/mol
AM2201 8-quinolinyl carboxamide	$C_{23}H_{22}FN_3O$	375.1747 g/mol

However, exact mass analysis is not available at most forensic laboratories. After analyzing both compounds using standard methods of analysis, it was determined that the two compounds are readily distinguishable.

Gas chromatography / Mass spectrometry:

Sample Preparation: Approximately 4 mg/ml in MeOH

Instrument: Agilent 6890N/5975B

GC Parameters

Column: HP-35MS
Carrier Gas: Helium
Oven Program: Initial Temp: 240 °C, ramp 30 °C /min, Final Temp 300 °C (hold for 11 min)
Injector Volume: 1 µl
Split Ratio: 100:1

MS Parameters

Injector 250°C
MSD Transfer Line: 290°C
MS Source: 230°C
MS Quad: 150°C
Mass Scan Range: 34-550 m/z
Threshold: 150
Tune File: atune.u

Figure 11. GC/MS of NM2201

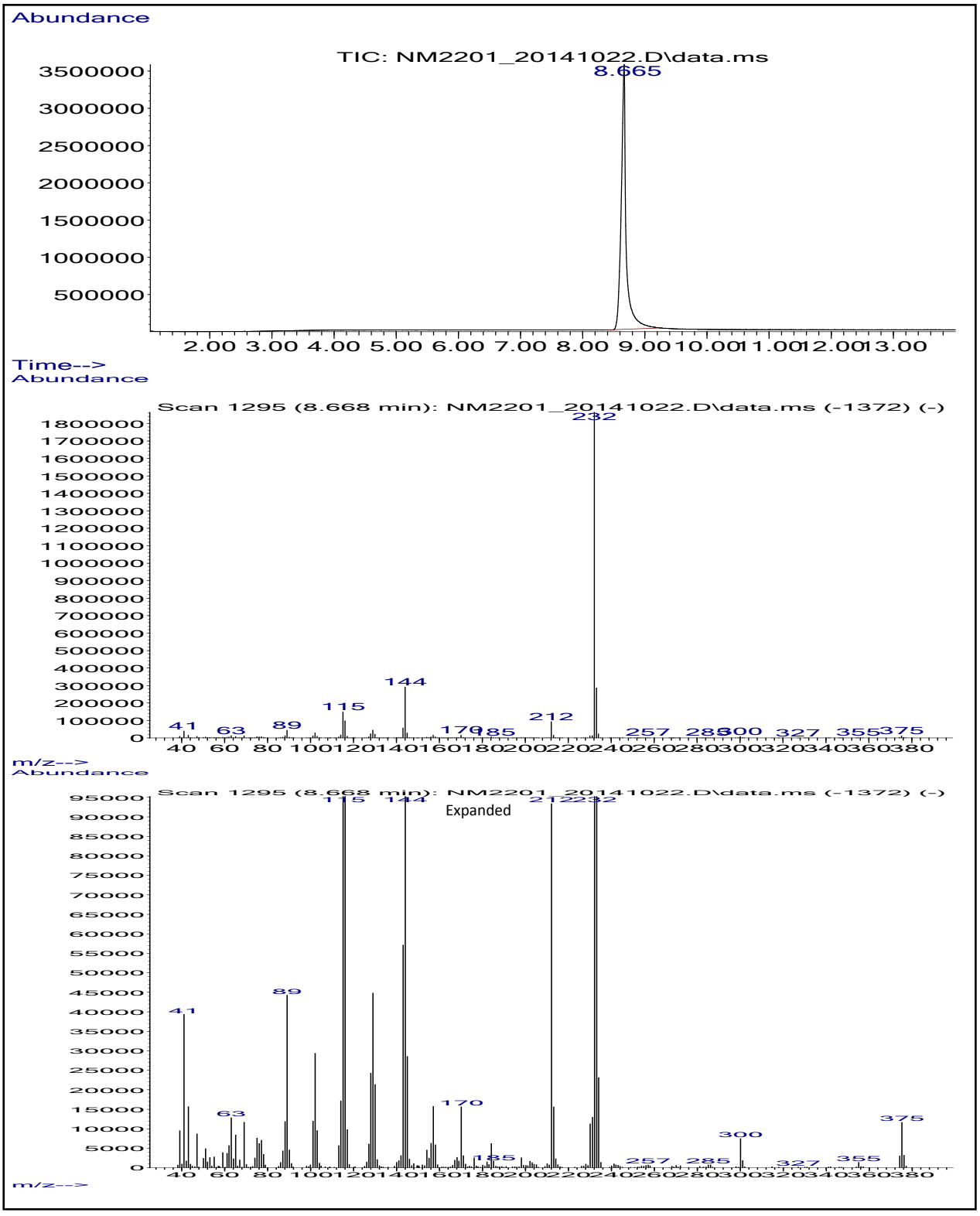
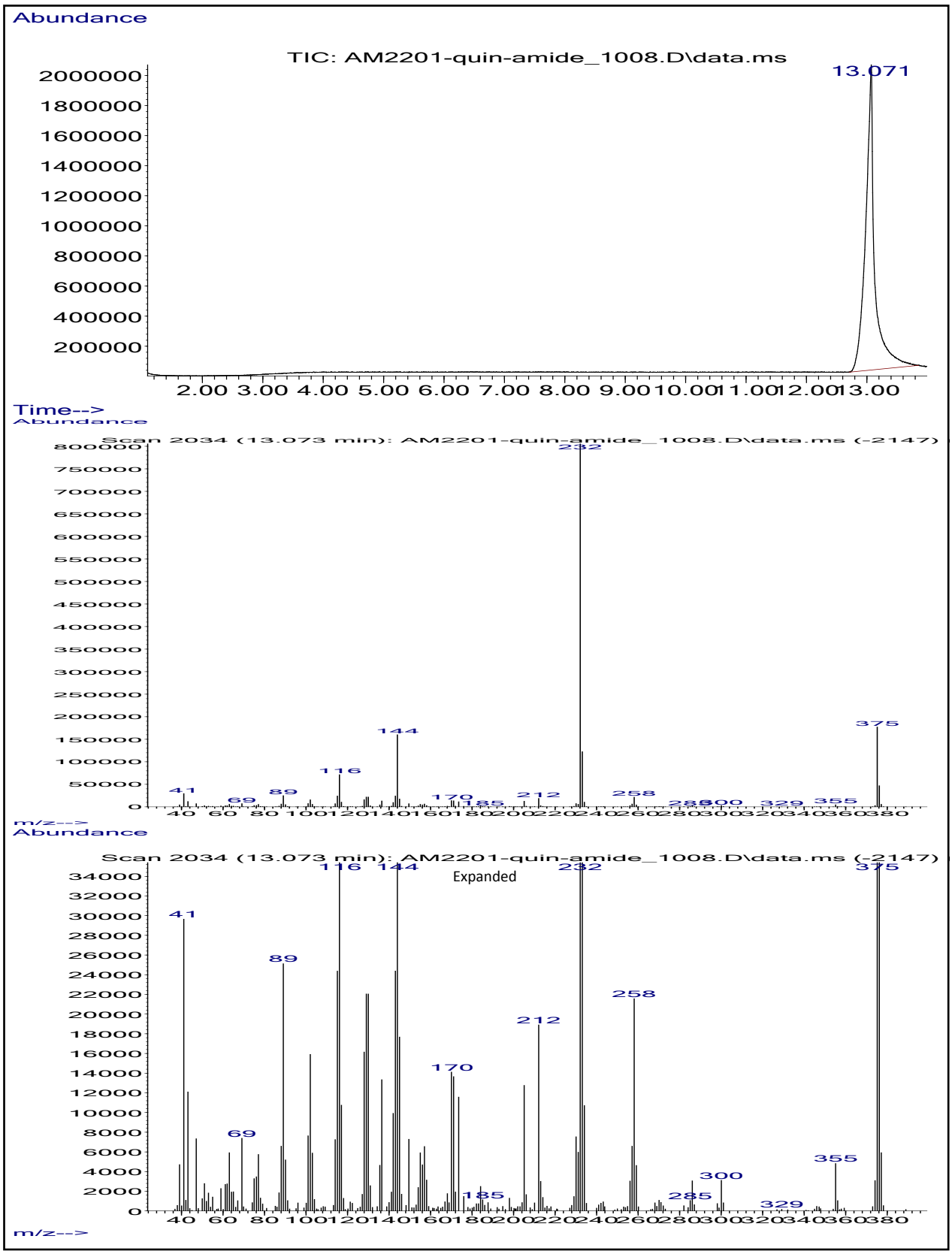


Figure 12. GC/MS of AM2201 8-quinolinyl carboxamide



Liquid Chromatography / Mass Spectrometry

Sample Preparation: Approximately 4 mg/ml in MeOH, 1 µL injection

Instrument: Thermo TSQ Quantum Access MAX in ESI Mode (HESI II Ion Source) equipped with Accela Autosampler and Quaternary Pump.

Column: Thermo Hypersil GOLD (50 mm x 2.1 mm, 1.9µ) **@**35 °C,

LC Gradient: 15 mM Ammonium Acetate Buffer (A) and Acetonitrile (B)

Time	%A	%B	Flow
0	50	50	300 µL/min
8	25	75	300 µL/min
9	50	50	300 µL/min
10	50	50	300 µL/min

MS Parameters: **Full Scan (ESI):**100-650 m/z

Instrument Settings:

Spray Voltage:	3500 V
Vaporizer Temp:	150 °C
Sheath Gas Pressure:	10 psi
Ion Sweep Gas Pressure:	10 psi
Aux Gas Pressure:	10 arbitrary units
Capillary Temperature:	270 °C
Tube Lens Offset:	101 V
Skimmer Offset:	0 V
Capillary Offset:	35 V

Figure 13. LC/ESI-MS of NM2201

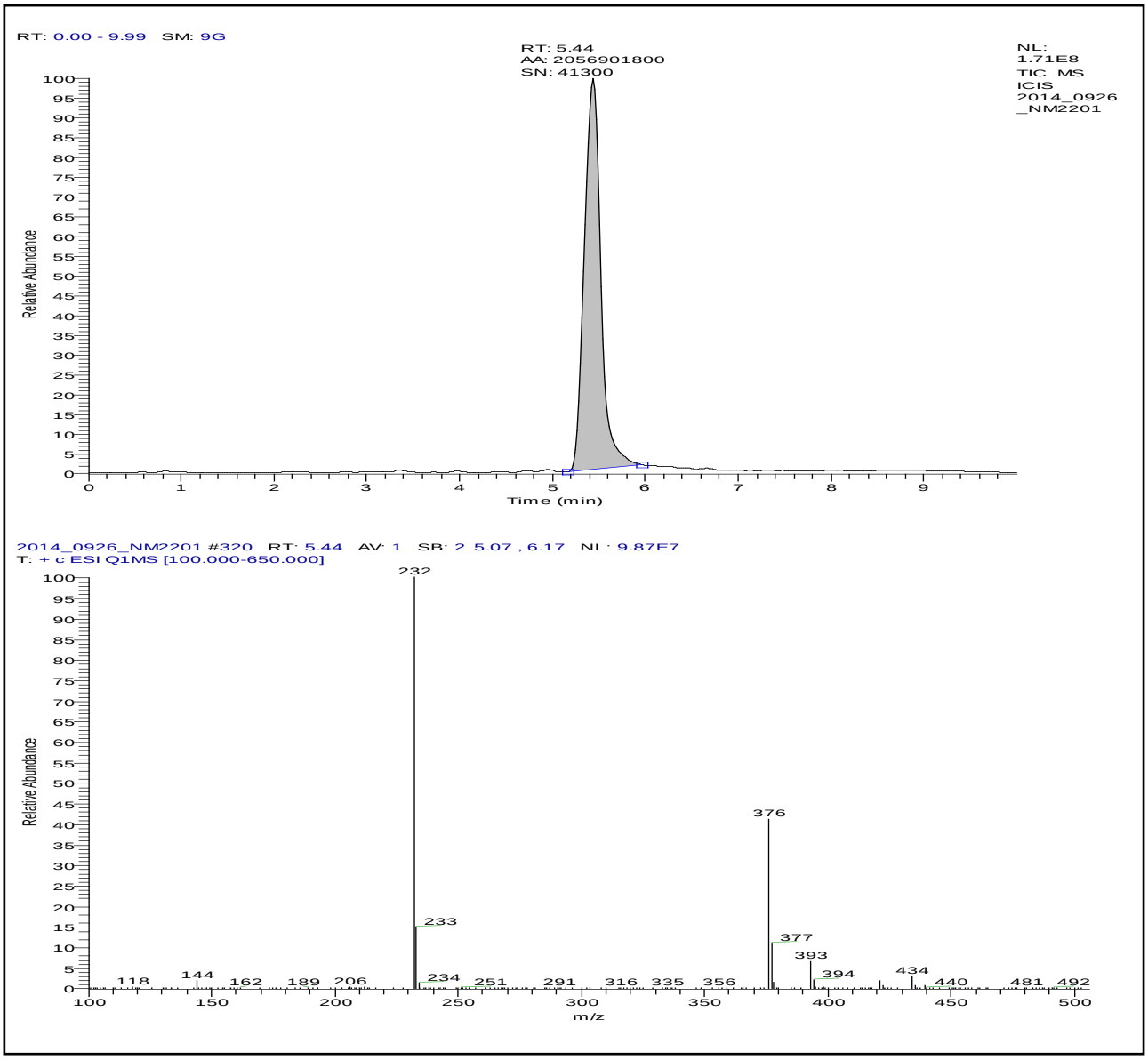
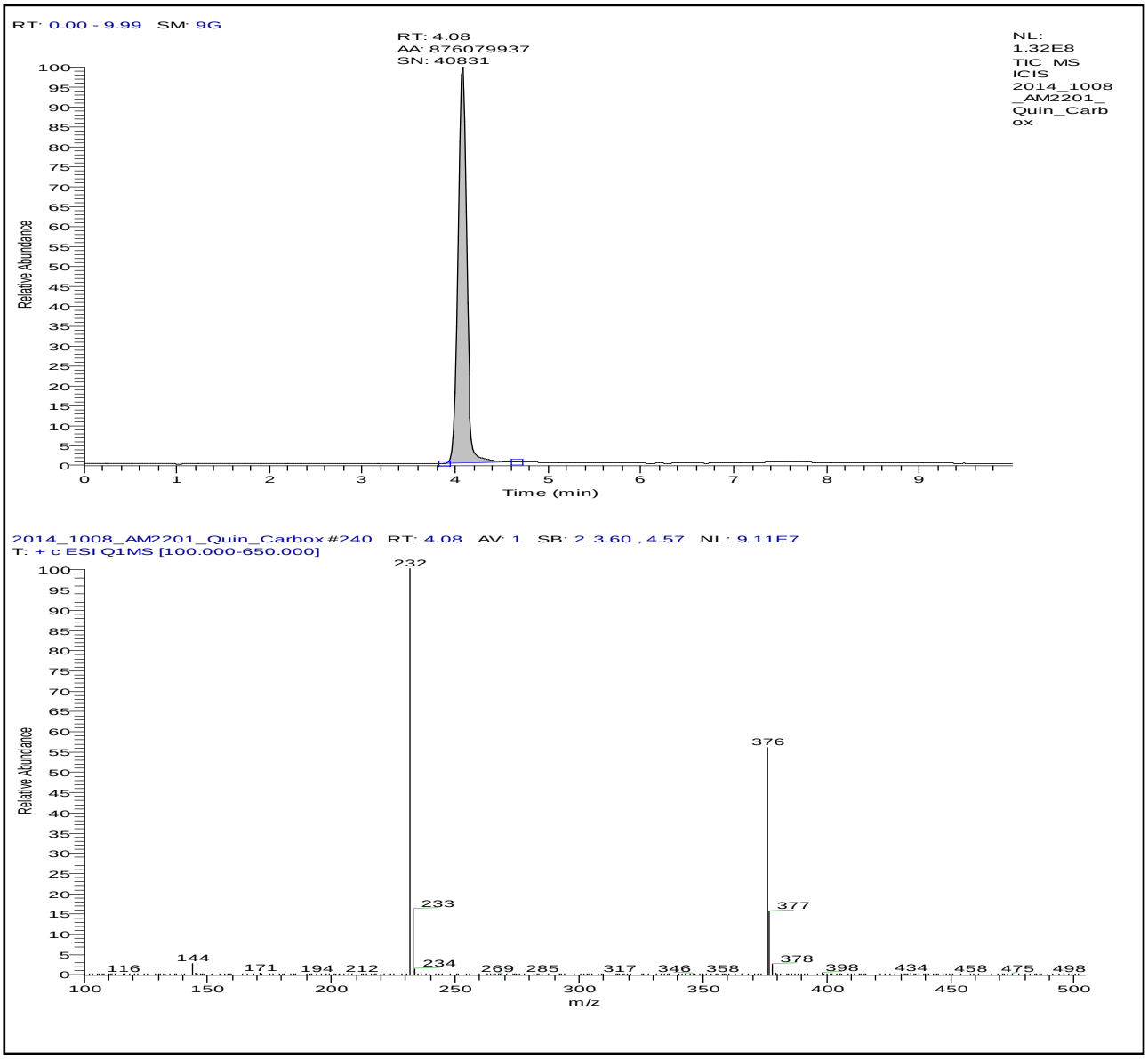


Figure 14. LC/ESI-MS of AM2201 8-quinolinyl carboxamide



Fourier Transform Infrared Spectroscopy

Sample Preparation: NM2201 Sample Preparation: Direct deposit of methanol solution
AM2201 8-quinolinylcarboxamide Sample Preparation: Neat

Instrument: Nicolet 6700 FT-IR with Smart iTR diamond ATR accessory
Software: Omnic 8.1.11

No. of scans: 32
Correction: H_2O and CO_2
Beamsplitter: KBr
Range: 4000-690 cm^{-1}
Gain: Autogain
Zero filling: None
Phase Correction: Power spectrum

Resolution: 4
Detector: DTGS TEC
Source: IR
Optimal Velicity: 0.6329
Aperature: 74
Apodization: Happ-Genzel

Figure 15. Fourier Transform Infrared Spectroscopy of NM2201

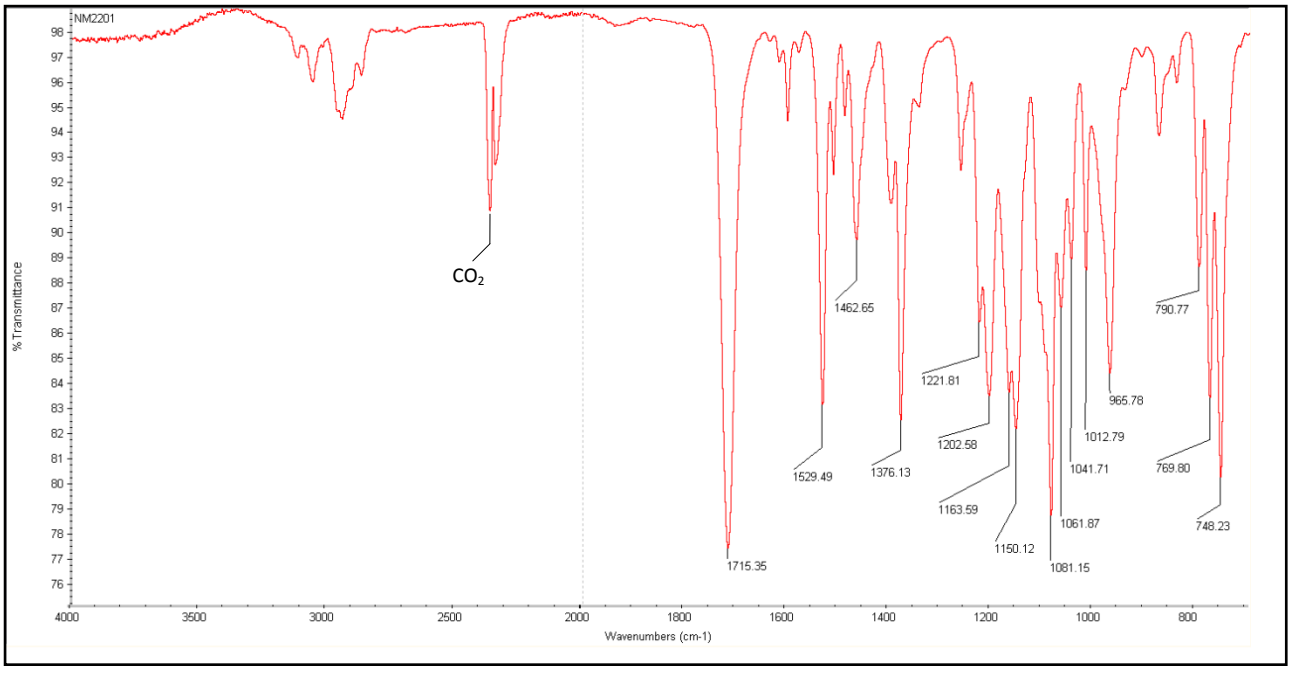
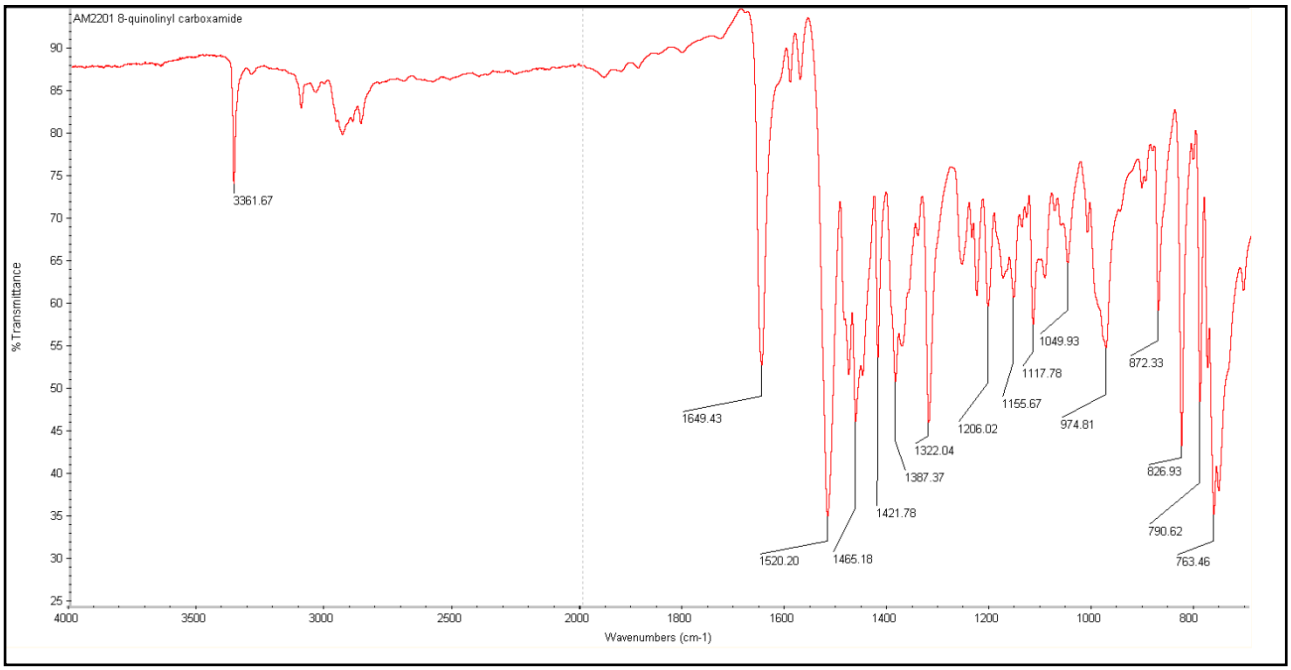


Figure 16. Fourier Transform Infrared Spectroscopy of AM2201 8-quinolinyl carboxamide



Part 3.

External Links:

Forendex link to NM-2201

Forendex link to AM2201 8-quinolinyl carboxamide