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Electronic supporting information

for the paper

Application of the Intramolecular Diels–Alder Vinylarene (IMDAV) Reaction for the Synthesis of Benzo-, Carbocyclo-, Thienothiopheneisoindolecarboxylic Acids and Its Limitations.

Elizaveta D. Yakovleva[a], Evgeniya R. Shelukho[a], Maryana A. Nadirova[a], Pavel P. Erokhin[a], Daria N. Simakova[a], Victor N. Khrustalev[a,b], Mikhail S. Grigoriev[c], Anton P. Novikov[c], Anna A. Romanycheva[d], Anton A. Shetnev[e], Olga P. Bychkova[f], Alexey S. Trenin[f], Fedor I. Zubkov[a], Vladimir P. Zaytsev[a]

[a]*Peoples' Friendship University of Russia (RUDN University), 6 Miklukho-Maklaya St., Moscow 117198, Russian Federation*

[b]*Zelinsky Institute of Organic Chemistry of RAS, 47 Leninsky Prospect, 119991 Moscow, Russian Federation*

[c]*Frumkin Institute of Physical Chemistry and Electrochemistry, Russian Academy of Sciences, Leninsky pr. 31, bldg. 4, 119071, Moscow, Russian Federation*

[d]*Pharmaceutical Technology Transfer Center, Yaroslavl State Pedagogical University Named After K. D. Ushinsky, 108/1 Republican St., 150000, Yaroslavl, Russian Federation*

[e]*Moscow Institute of Physics and Technology, 1 "A" Kerchenskaya st., 117303 Moscow, Russian Federation*

[f]*Gause Institute of New Antibiotics, 11 B. Pirogovskaya Street, 119021 Moscow, Russian Federation*

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1. General information

All reagents and solvents were purchased from commercial suppliers (Acros Organics, Aldrich, Alfa Aesar, AstaTech and Reachim) and used without further purification. No reactions require absolute solvents (CH_2Cl_2, DCE, MeOH, EtOH, PhH, PhMe, *o*-xylene, EtOAc, 1,4-dioxane, DMF) and in an inert atmosphere (excluding the synthesis of products **27**). Thin layer chromatography, when necessary, was carried out on aluminum backed silica plates Sorbfil. The plates were visualized under UV light (254 nm) or in I_2 vapor. Organic layers were dried over anhydrous $MgSO_4$ or Na_2SO_4 and concentrated *in vacuo*. In rare cases, when the precipitate of acids **8**, **10, 12**, **16**, **17**, **20** was not formed after 12 h standing at room temperature, the solvent was removed *in vacuo* and the residual was solidified by addition of hexane/diethyl ether. Melting points for all crystalline compounds were measured on a capillary point apparatus Stuart SMP 10 equipped with a digital thermometer and were uncorrected. IR spectra were obtained in KBr pellets using an Infralum FT-801 IR-Fourier spectrometer. GC-MS mass spectra were taken on a Thermo Focus DSQ II GC-MS spectrometer (electron ionization, 70 eV, ion source temperature 200 °C, gas chromatographic inlet with a Varian Factor-Four VF-5ms column). LC-MS mass spectra were taken on Agilent 1100 series LC/MSD spectrometer with an API-ES/APCI ionization mode. NMR spectra were run in deuterated (>99%) solvents on Jeol JNM-ECA 600 (600.2 MHz for ^1H, 150.9 MHz for ^{13}C and 564.7 for ^{19}F) or Bruker Avance NEO 700 (700.2 MHz for ^1H, 176.1 MHz for ^{13}C and 658.8 MHz for ^{19}F) spectrometer for 2−8% solutions in $CDCl_3$ or DMSO-d_6 at 23−25 °C. Residual signals of deuterated solvents were used as internal standards ($CDCl_3$: 7.25 ppm for ^1H nuclei, 77.2 ppm for ^{13}C nuclei; DMSO-d_6: 2.50 ppm for ^1H nuclei, 39.5 ppm for ^{13}C nuclei). Microanalyses were performed for C, H, N, and S with the elemental analysis system Eurovector EA 3000 (CHNS) and were within ±0.4 % of theoretical values.

2. X-ray diffraction analysis

Compounds **8u** and **16d** have similar geometries and crystallize in the monoclinic space group $P2_1/c$ (**8u** with two crystallographically independent molecules in the unit cell, **16d** with only one independent molecule). Compound **10d** crystallizes in space group *P*-1 with two independent molecules with the same geometry (Alignment RMSD {N32,C31,O31,...} to {N2,C1,O1,...} without inversion) is 0.425 Å). The two crystallographically independent molecules **8u** have similar geometries (RMSD when superimposed without inversion 1.443 Å). All structures also contain solvent molecules (DMSO). In **8u**, the hydrogen atom at C10 is replaced by a CF_3 group, in contrast to **16d** and **10d**. The phenyl fragment is fluorinated in the *para* position to the 2-pyrrolidone nitrogen atom in **8u**, and brominated in **16d** and unsubstituted in **10d**. Compounds **8u** and **16d** contain a condensed tetracyclic system containing two five-membered rings (dihydrothiophene (in **16d**) or tetrahydrothiophene (in **8u**) and 2-pyrrolidone) and two six-membered rings (benzene and cyclohexene (in **8u**) or cyclohexane (in **16d**)) and differ only in the position of the double bond in the central five and six-membered rings. Compound **10d** also contains a tetracyclic system, but the thiophene fragment is not hydrogenated, and the benzyl fragment is replaced by cyclooctane. The benzene (in **8g** and **16d**) and thiophene moieties have a planar conformation in the three compounds, while the pyrrolidone ring adopts a *half-chair* or *envelope* conformation. The six-membered cyclohexene ring has a symmetrical boat conformation at **8u**, while the cyclohexane ring at **16d** and **10d** has a *half-chair* or *envelope* conformation. The cyclooctane fragment in **10d** has a distorted conformation (four atoms (C11C11AC5AC6 form one plane, four C7C6C11C10 atoms form another plane at 66(1)° to the first and the last two atoms C8 and C9 are in *trans* position relative to the last plane). The phenyl substituent is almost coplanar with the basal plane of the pyrrolidone ring in **8u** and **16d** (the torsion angles C1-N2-C11-C16 (in **8u**) and C1A-N2A-C13A-C14A (in **16d**) are 26.2(3), 25.1(3) and 22.2(3)°, respectively, for two crystallographically independent molecules). The phenyl substituent is more twisted relative to the pyrrolidone fragment at **10d** in one of the molecules (C1-N2-C21-C22 torsion angle is -34.7(4)°) and less in the other (C31-N32-C51-C52 torsion angle is 10.5(3)°), similar to **8u** and **16d**.

The molecules of **8u, 16d** and **10d** possess four asymmetric centers at the C3A, C9B, C10 and C10A carbon atoms and can have potentially numerous diastereomers. The crystals of these structures are racemic and consist of enantiomeric pairs with the relative configuration of the centers of 3A***RS***,9B***RS***,10***RS***,10A***RS***.

Compound **17** crystallizes in the monoclinic *C*2/c space group with two crystallographically independent molecules in the unit cell and includes a fused tetracyclic system containing the two five-membered rings (dihydrothiophene and 2-pyrrolidone) and two

six-membered rings (benzene and cyclohexene). The two crystallographically independent molecules of **17** have very similar geometries. The both five-membered rings adopt the usual *envelope* conformation, and the six-membered cyclohexene ring has an unsymmetrical *boat* conformation. The dihedral angles between the basal plane of the cyclohexene ring and the basal planes of the fused dihydrothiophene and pyrrolidone rings are 24.7(4) and 23.6(4)° / 24.3(3) and 23.9(2)°, respectively, for the two crystallographically independent molecules. The phenyl substituent is practically coplanar to the basal plane of the pyrrolidone ring (the interplane angle is equal to 13.0(4) and 12.0(2)°, respectively, for the two crystallographically independent molecules).

The molecules of **17** possess four asymmetric centers at the C3A, C9B, C10 and C10A carbon atoms and can have potentially numerous diastereomers. The crystal of **17** is racemic and consists of enantiomeric pairs with the relative configuration of the centers of 3A***RS***,9B***RS***,10***RS***,10A***RS***.

In the crystal of **17**, molecules form H-bonded associates in the 1:1 ratio with dimethylsulfoxide solvate molecules. The strongly disordered dimethylsulfoxide solvate molecules occupy the voids within the crystal packing of the molecules of **17** (Figure S4). The associates are arranged at van-der-Waals distances (Figure S4).

Compound **12a** crystallizes in the monoclinic *C*2/c space group with three crystallographically independent molecules in the unit cell. The three crystallographically independent molecules of **12a** have similar geometries differing only by the rotation angle of the phenyl substituent relative to the basal plane of the pyrrolidone ring (the interplane angle is equal to 15.83(11), 31.22(12) and 6.98(14)°, respectively, for the three crystallographically independent molecules).

Compound **12a** includes a fused tetracyclic system containing the three five-membered rings (cyclopentane, dihydrothiophene and 2-pyrrolidone) and one six-membered ring (cyclohexene). Compound **12i** includes a fused tetracyclic system containing the two five-membered rings (dihydrothiophene and 2-pyrrolidone) and two six-membered rings (cycloheptane and cyclohexene). Compound **12k** includes a fused pentacyclic system containing the two five-membered rings (dihydrothiophene and 2-pyrrolidone) and three six-membered rings (benzene and two cyclohexene). In all three compounds **12a**, **12i** and **12k**, the five-membered rings adopt the usual *envelope* conformation, and the six-membered cyclohexene rings have a *sofa* conformation. The cycloheptane ring in **12i** has a *chair* conformation. The dihedral angles between the basal plane of the central cyclohexene ring and the basal planes of the fused dihydrothiophene and pyrrolidone rings are 23.10(19) and 80.80(15)° / 19.24(16) and 83.14(15)° / 20.9(2) and 80.63(15)° (for the three crystallographically independent molecules of

12a), 23.06(5) and 86.81(5)° (**12i**), and 27.43(6) and 83.23(5)° (**12k**), respectively. The phenyl substituent in **12i** and **12k** is twisted relative to the basal plane of the pyrrolidone ring by 28.67(5) and 12.62(10)°, respectively.

The molecules of **12a**, **12i** and **12k** possess four asymmetric centers at the C3A, C6A, C7 and C7A (**30a**), C5A, C8A, C9 and C9A (**12i**) and C6A, C9A, C10 and C10A (**12k**) carbon atoms and can have potentially numerous diastereomers. The crystals of **12a**, **12i** and **12k** are racemic and consist of enantiomeric pairs with the relative configuration of the centers of 3A(5A, 6A)***RS***,6A(8A,9A)***RS***,7(9,10)***SR***,7A(9A,10A)***SR***.

In the crystal of **12a**, molecules form the centrosymmetric hexameric associates by the strong O─H···O hydrogen bonds (Table 1) and the non-valent attractive S10···S44 [*x*, 1-*y*, 0.5+*z*] interactions (3.4014(19) Å) (Figure S9). The hexameric associates are arranged at van-der-Waals distances (Figure S10).

In the crystal of **12i**, molecules form the centrosymmetric dimers by the strong O─H···O hydrogen bonds (Table S1, Figure S11). The dimers are arranged at van-der-Waals distances (Figure S11). The benzene solvate molecules fill the voids within the crystal packing of the dimers of **12i** (Figure S11).

In the crystal of **12k**, molecules form H-bonded associates in the 1:1 ratio with dimethylsulfoxide solvate molecules by the strong O─H···O hydrogen bonds (Table S1) (Figure S12). The associates are arranged at van-der-Waals distances (Figure S12).

Table S1. Hydrogen bonds for **12a**, **12i** and **12k** [Å and °].

D─H···A	d(D─H)	d(H···A)	d(D···A)	∠(D─H···A)
Compound **12a**				
O3─H3···O4	0.87(5)	1.86(5)	2.715(4)	168(5)
O6─H6···O1	0.94(5)	1.70(5)	2.617(4)	164(4)
O9─H9···O7^{a}	0.99(5)	1.69(5)	2.662(4)	164(4)
Compound **12i**				
O20─H20O···O19^{b}	0.91(2)	1.71(2)	2.6126(12)	176(2)
Compound **12k**				
O3─H3O···O4	0.89(2)	1.77(2)	2.655(7)	171(2)
O3─H3O···O4'	0.89(2)	1.70(2)	2.575(6)	166(2)

Symmetry transformations used to generate equivalent atoms: [a] -*x*+3/2, -*y*+3/2, -*z*+2; [b] -*x*, -*y*, -*z*+1

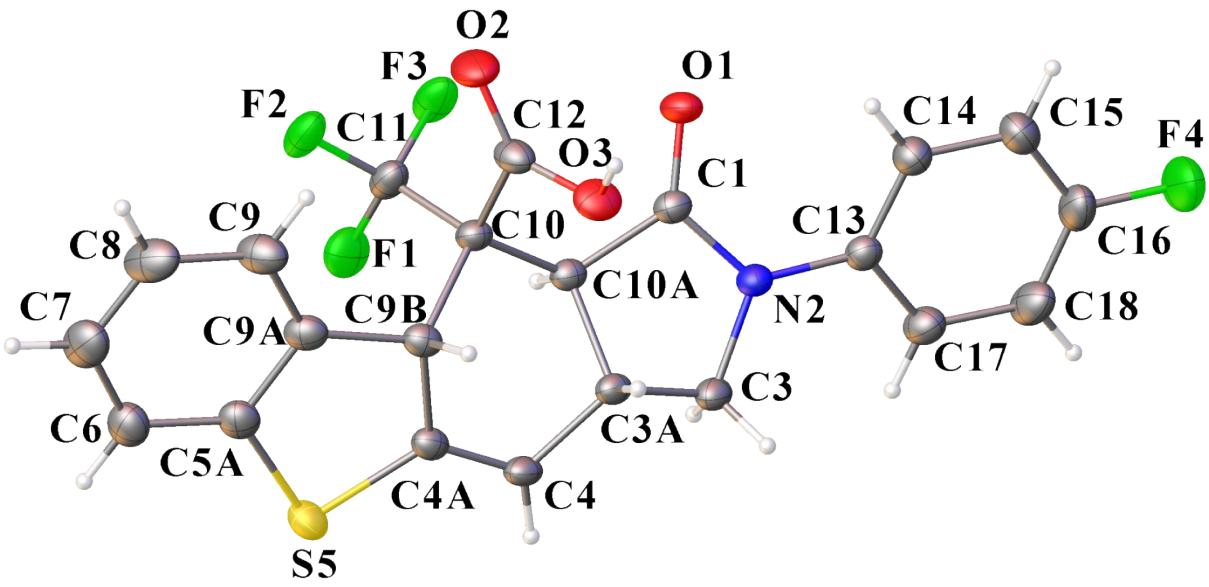


Figure S1. Molecular structure of **8u**. One of the two crystallographically independent molecules is shown only.

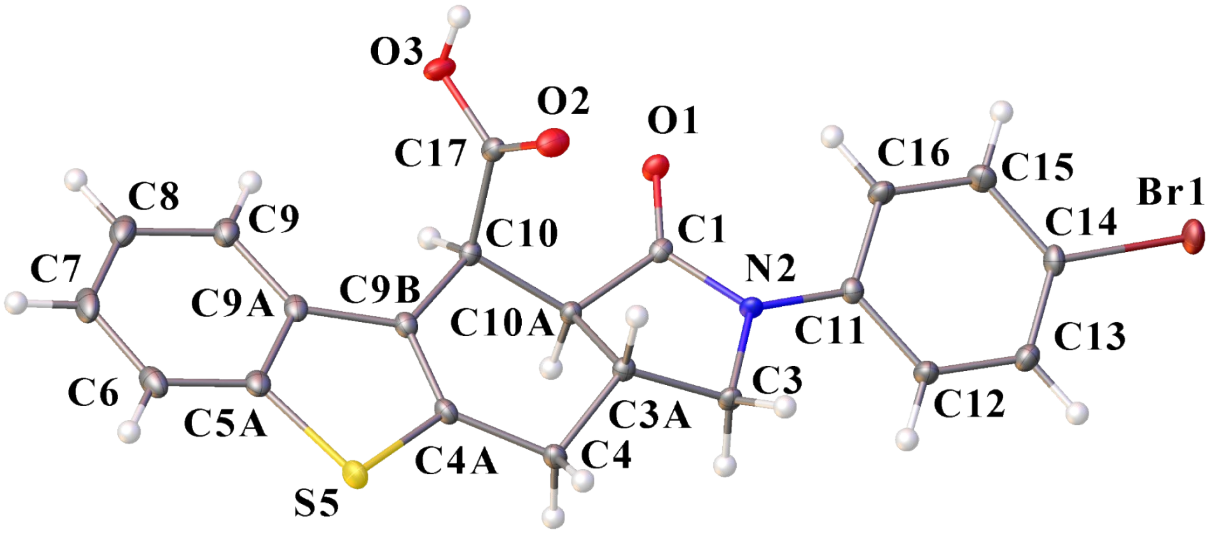


Figure S2. Molecular structure of **16d**.

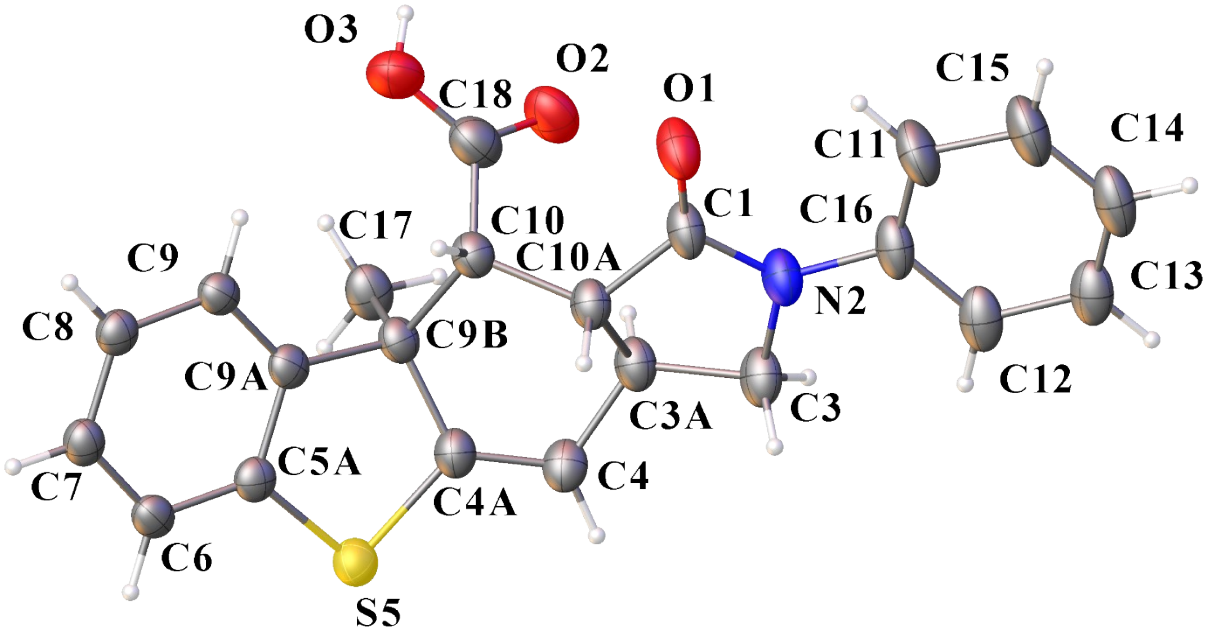


Figure S3. Molecular structure of **17** (30%-ellipsoids). One of the two crystallographically independent molecules is shown only.

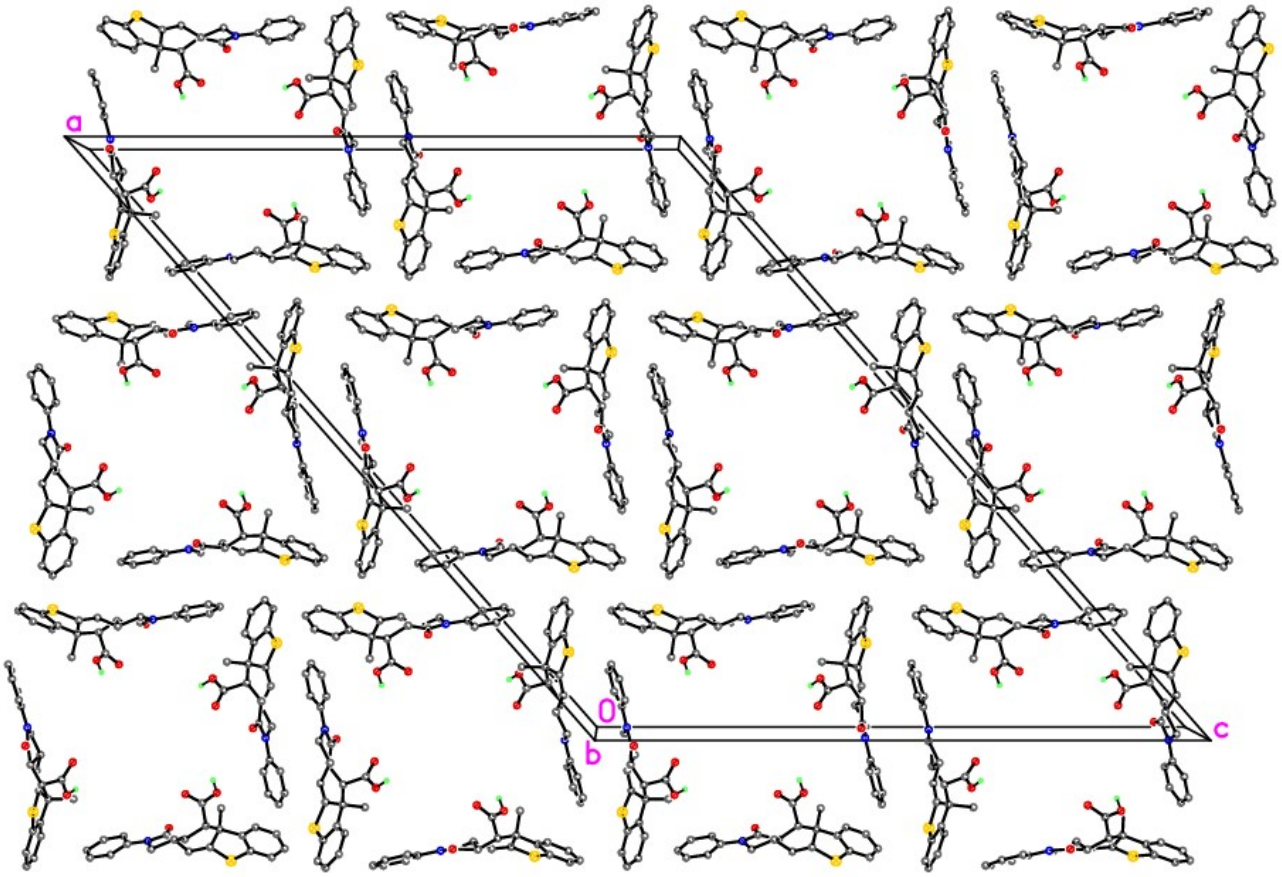


Figure S4. Crystal structure of **17** (the strongly disordered dimethylsulfoxide solvate molecules are absent).

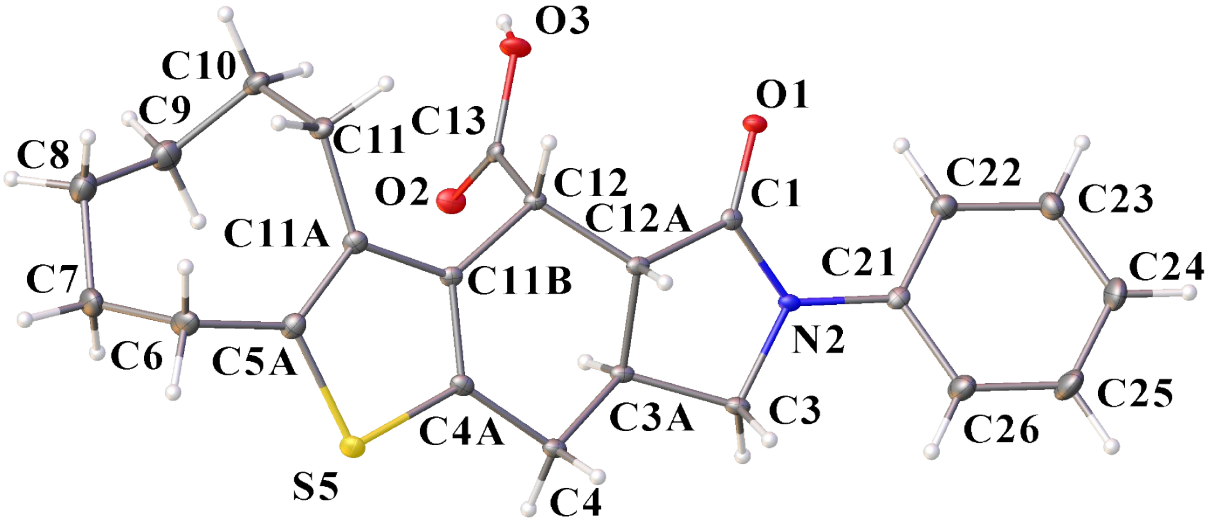


Figure S5. Molecular structure of **10d**. One of the two crystallographically independent molecules is shown only.

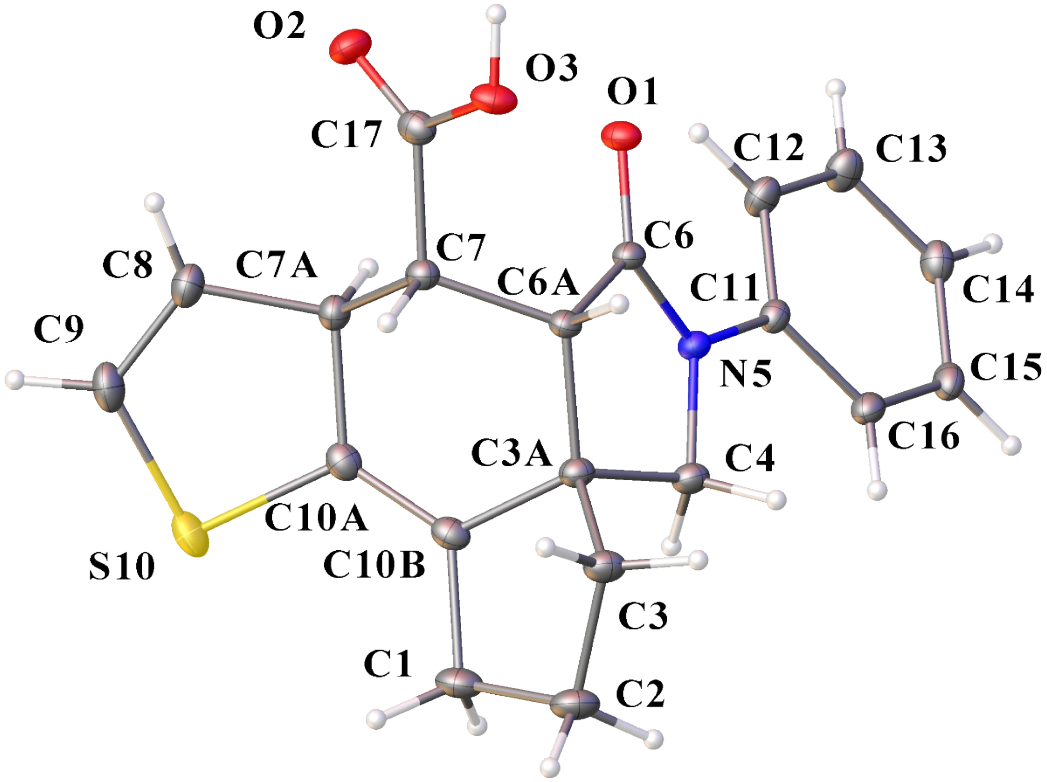


Figure S6. Molecular structure of **12a** (30%-ellipsoids). One of the three crystallographically independent molecules is shown only.

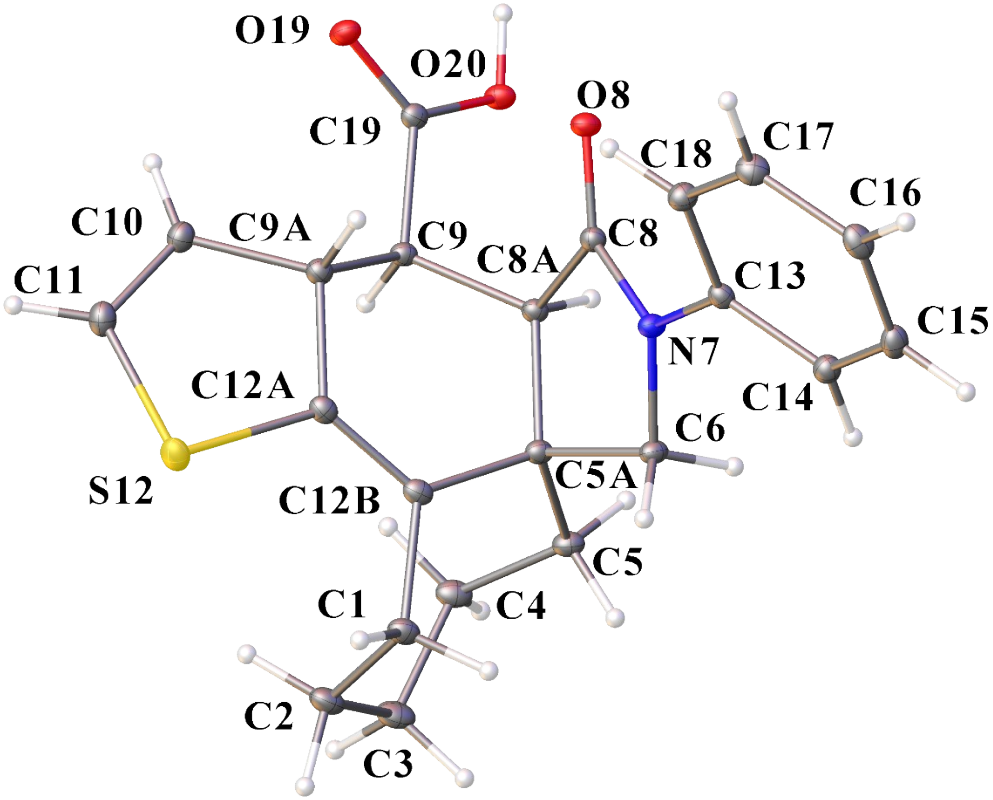


Figure S7. Molecular structure of **12i** (40%-ellipsoids).

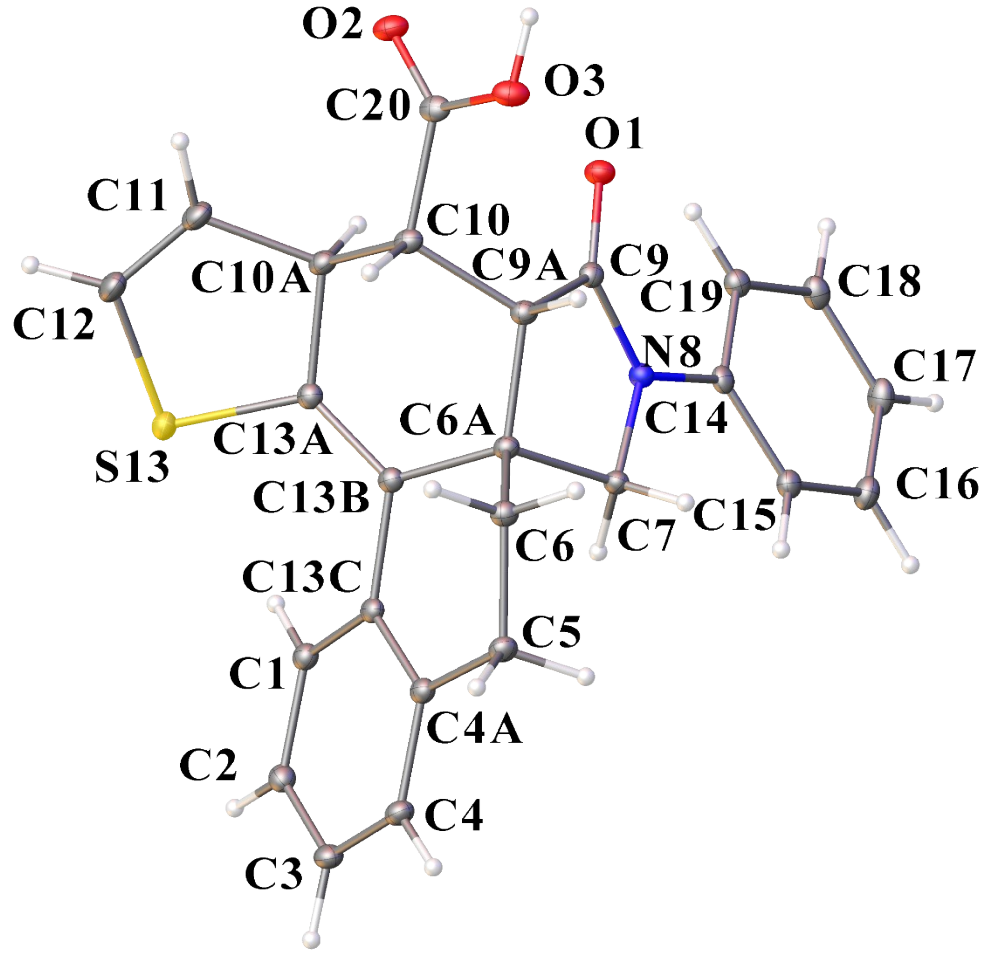


Figure S8. Molecular structure of **12k** (40%-ellipsoids).

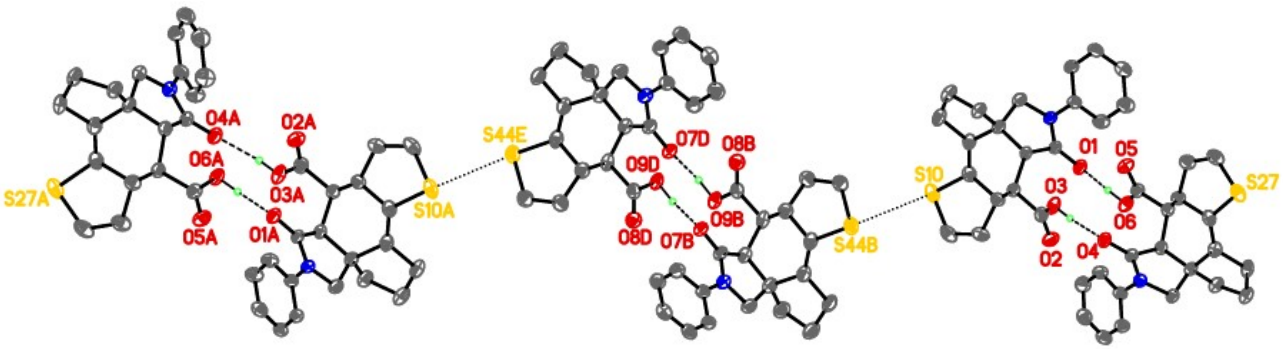


Figure S9. The centrosymmetric hexameric associate of **12a**.

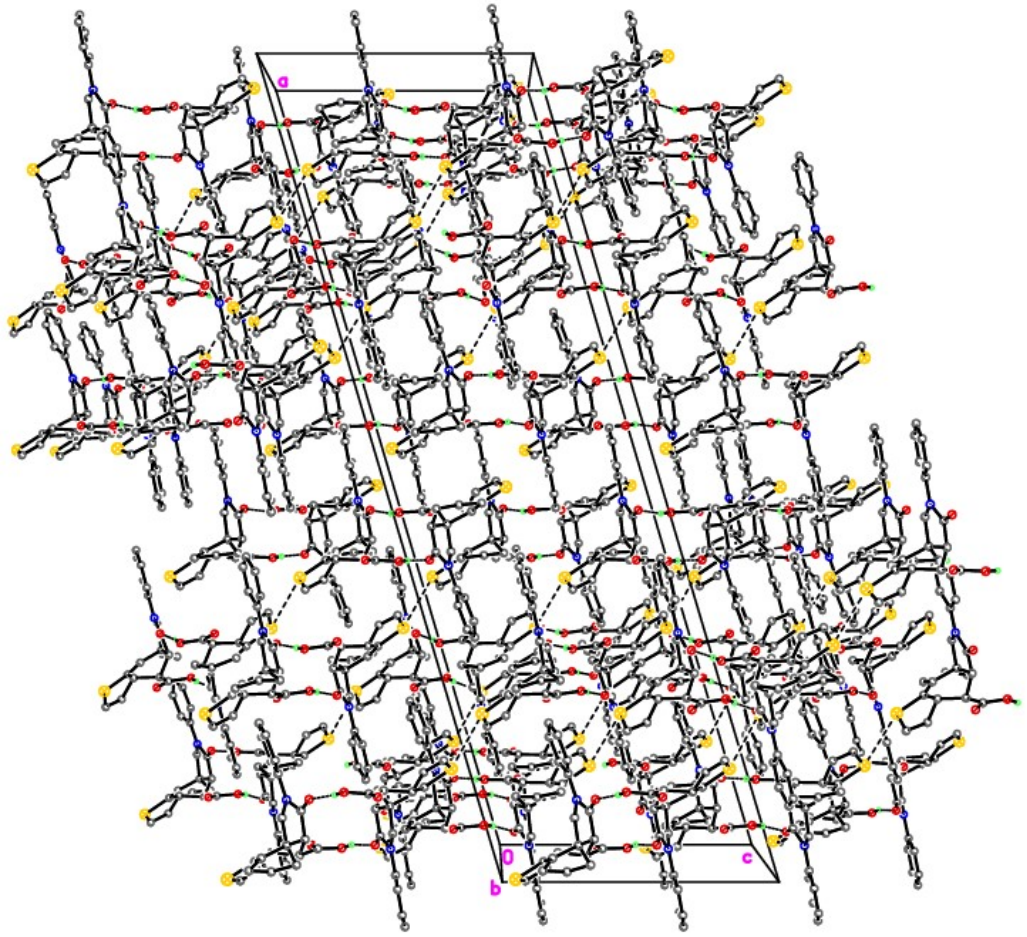


Figure S10. Crystal structure of **12a** along the crystallographic ***b*** axis.

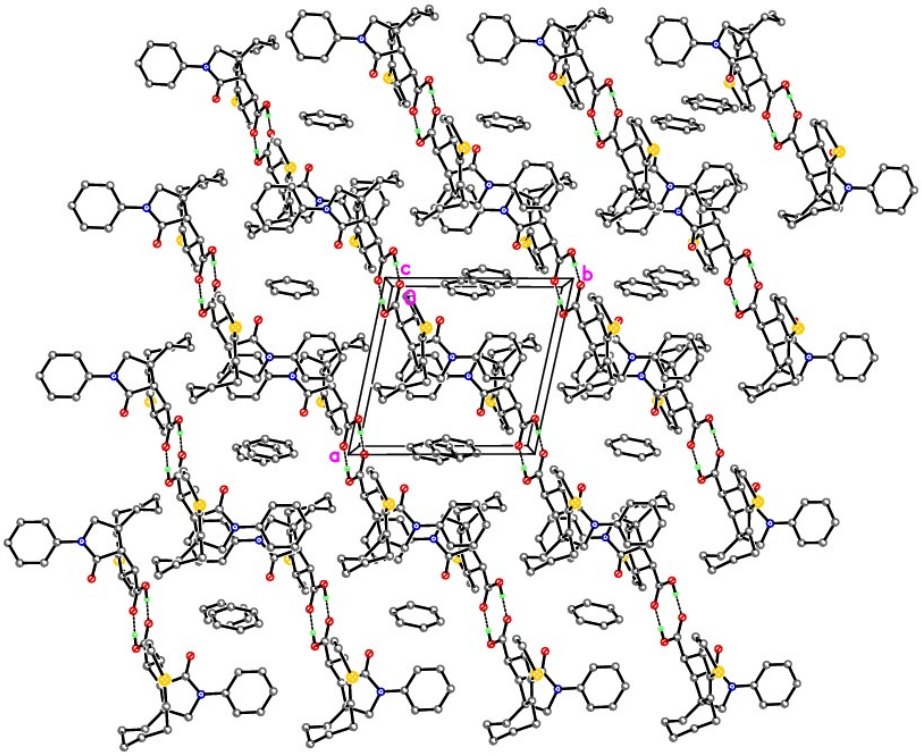


Figure S11. Crystal structure of **12i** along the crystallographic ***c*** axis.

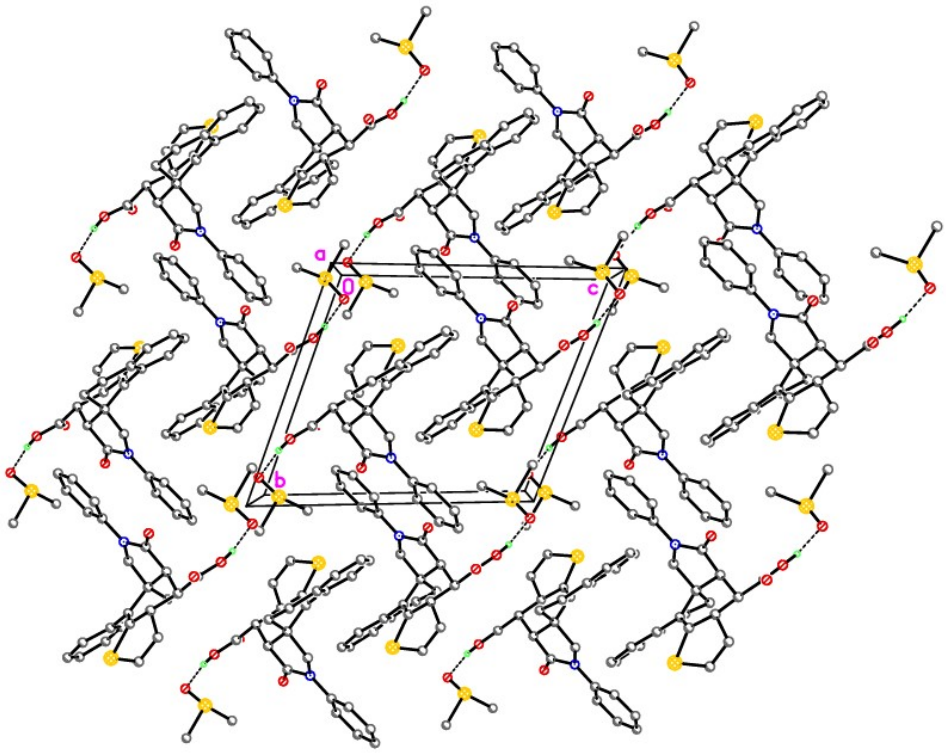


Figure S12. Crystal structure of **12k** along the crystallographic ***a*** axis.

Experimental part

The single-crystal X-ray diffraction data for **17**, **12i** and **12k** were collected on a four-circle XtaLAB Rigaku Synergy-S diffractometer equipped with a HyPix-6000HE area-detector (T = 100 K, λ(Cu$K\alpha$)-radiation, graphite monochromator, shutterless ω-scan mode). The data were integrated and corrected for absorption by the *CrysAlisPro* program [1]. The single-crystal X-ray diffraction data for **12a** were collected at the 'Belok/XSA' beamline (λ = 0.80246 Å, T = 100 K) of the National Research Center 'Kurchatov Institute' (Moscow, Russian Federation) using a single-axis MARdtb goniometer equipped with a Rayonix SX-165 position-sensitive CCD detector. In total, 480-720 frames for two different orientations of the crystal were collected in direct geometry (θ = 0°) with an oscillation range of 1.0° in the φ scanning mode. The data were indexed and integrated using the utility *iMOSFLM* from the CCP4 software suite [2] and then scaled and corrected for absorption using the Scala program [3]. For details, see Table S2. The crystal structure of **8u**, **16d** and **10d** was determined by X-ray structural analysis using an automatic four-circle area-detector diffractometer Bruker KAPPA APEX II with MoKα radiation at IPCE RAS. The cell parameters were refined over the entire data set, together with data reduction using SAINT-Plus software [4]. Absorption corrections were introduced using the SADABS program [5].

The structures were solved by intrinsic phasing modification of direct methods using the SHELXT-2018/2 program [6] and refined by a full-matrix least squares technique on F^2 with anisotropic displacement parameters for non-hydrogen atoms (SHELXL-2018/3 [7]). In the case of **17**, all attempts to model and refine positions of the solvate dimethylsulfoxide molecules were unsuccessful. Therefore, their contribution to the total scattering pattern was removed by use of the utility *SQUEEZE* in PLATON06 [8]. The hydrogen atoms of the OH-groups in **17** were objectively localized in the difference-Fourier maps and refined within riding model with fixed isotropic displacement parameters [U_{iso}(H) = 1.5U_{eq}(O)]. The hydrogen atoms of the OH-groups in **12a**, **12i** and **12k** were objectively localized in the difference-Fourier maps and refined isotropically with fixed displacement parameters [U_{iso}(H) = 1.5U_{eq}(O)]. The other hydrogen atoms in all compounds were placed in calculated positions and refined within riding model with fixed isotropic displacement parameters [U_{iso}(H) = 1.5U_{eq}(C) for the CH_3-groups and 1.2U_{eq}(C) for the other groups]. In the structures **8u**, **16c** and **10d** the C-H bonded hydrogen atoms were placed in geometrically calculated positions and refined in an idealized geometry with isotropic temperature factors equal to 1.5U_{eq}(C) for the CH_3-groups and 1.2U_{eq}(C) for the other groups. The hydrogen atoms of the OH-groups in **8u**, **16c** and **10d** were objectively located from the difference Fourier synthesis and refined with isotropic temperature factors equal to 1.5U_{eq}(O). Crystal data, data collection, and structure refinement details are summarized in Table S3.

Crystallographic data for all investigated compounds have been deposited with the Cambridge Crystallographic Data Center, CCDC 2303415 (**17**), CCDC 2303416 (**12a**), CCDC 2303417 (**12i**), CCDC 2303418 (**12k**), CCDC 2309507 (**8u**), CCDC 2309508 (**10d**) and CCDC 2309509 (**16d**). Copies of this information may be obtained free of charge from the Director, CCDC, 12 Union Road, Cambridge CB2 1EZ, UK (Fax: +44 1223 336033; e-mail:

deposit@ccdc.cam.ac.uk or www.ccdc.cam.ac.uk).

Table S2. Crystal data and structure refinement for **17**, **12a**, **12i** and **12k**.

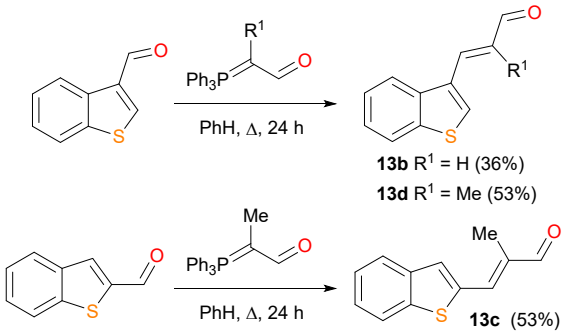
Identification code	**17** • $(CH_3)_2SO$	**12a**	**12i** • C_6H_6	**12k** • $(CH_3)_2SO$
Empirical formula	$C_{23}H_{20}NO_3SCl_3$	$C_{20}H_{19}NO_3S$	$C_{28}H_{29}NO_3S$	$C_{27}H_{27}NO_4S_2$
Formula weight	455.57	353.42	459.58	493.62
Crystal size, mm	0.10×0.11×0.14	0.02×0.20×0.20	0.12×0.15×0.15	0.08×0.09×0.13
Wavelength, Å	1.54184	0.80246	1.54184	1.54184
Crystal system	Monoclinic	Monoclinic	Triclinic	Triclinic
Space group	*C*2/c	*C*2/c	*P*-1	*P*-1
a, Å	48.894(5)	46.828(9)	9.84055(7)	9.65056(14)
b, Å	6.5606(6)	15.239(3)	10.20769(7)	11.27375(16)
c, Å	37.444(4)	14.999(3)	12.02385(8)	12.80694(18)
α, deg.	90	90	95.4243(6)	101.9836(12)
β, deg.	131.285(18)	106.54(3)	96.5429(6)	108.1812(13)
γ, deg.	90	90	101.3110(6)	109.8073(13)
V, Å^3	9026(3)	10261(4)	1168.116(14)	1166.44(4)
Z	16	24	2	2
Density (calc.), Mg/m^3	1.341	1.373	1.307	1.405
μ, mm^{-1}	2.394	0.283	1.471	2.362
F(000)	3840	4464	488	520
Theta range, deg.	3.14 – 78.07	2.05 – 30.95	3.73 – 77.87	3.88 – 77.94
Index ranges	$-62 \le h \le 60$, $-8 \le k \le 8$, $-46 \le l \le 47$	$-59 \le h \le 59$, $-18 \le k \le 19$, $-19 \le l \le 19$	$-12 \le h \le 12$, $-10 \le k \le 12$, $-15 \le l \le 15$	$-12 \le h \le 12$, $-13 \le k \le 14$, $-16 \le l \le 15$
Reflections collected	71072	41360	35467	35519
Independent reflections, R_{int}	9510, 0.096	11127, 0.069	4944, 0.047	4945, 0.050
Reflections observed	4237	8375	4751	4703
R_1 / wR_2 ($I > 2\sigma(I)$)	0.079 / 0.186	0.090 / 0.199	0.036 / 0.097	0.035 / 0.092
R_1 / wR_2 (all data)	0.157 / 0.231	0.114 / 0.214	0.037 / 0.098	0.036 / 0.093
Goodness-of-fit on F^2	1.078	1.016	1.077	1.078
Extinction coefficient	—	0.00155(15)	—	—
T_{min} / T_{max}	0.517 / 0.870	0.936 / 0.987	0.677 / 1.000	0.657 / 0.826
$\Delta\rho_{max}$ / $\Delta\rho_{min}$, e·Å^{-3}	0.374 / -0.292	1.333 / -0.792	0.324 / -0.376	0.449 / -0.328

Table S3. Crystal data and structure refinement for **8u**, **16d** and **10d**.

Identification code	**8u**	**16d**	**10d**
CCDC number	2309507	2309509	2309508

Empirical formula	$C_{24}H_{15}D_6NO_4F_4S_2$	$C_{23}H_{16}D_6BrNO_4S_2$	$C_{48}H_{50}D_6N_2O_7S_3$
Formula weight	533.57	526.48	875.16
Temperature/K	296(2)	100(2)	100(2)
Crystal system	monoclinic	monoclinic	triclinic
Space group	$P2_1/c$	$P2_1/c$	*P*-1
a/Å	12.2769(3)	13.5933(6)	11.1667(8)
b/Å	11.7542(3)	12.7117(5)	13.3681(10)
c/Å	32.9548(9)	12.7881(5)	15.9013(13)
α/°	90	90	74.286(2)
β/°	94.633(2)	97.701(2)	80.082(2)
γ/°	90	90	71.936(2)
Volume/Å^3	4740.0(2)	2189.78(16)	2162.2(3)
Z	8	4	2
ρ_{calc}g/cm^3	1.495	1.597	1.344
μ/mm^{-1}	0.288	2.099	0.227
F(000)	2176.0	1064.0	924.0
Crystal size/mm^3	0.5 × 0.4 × 0.32	0.4 × 0.18 × 0.16	0.2 × 0.14 × 0.04
Radiation	MoKα (λ = 0.71073)	MoKα (λ = 0.71073)	MoKα (λ = 0.71073)
2Θ range for data collection/°	7.444 to 55	6.846 to 59.998	7.464 to 53.948
Index ranges	-15 ≤ h ≤ 15, -15 ≤ k ≤ 15, -42 ≤ l ≤ 41	-19 ≤ h ≤ 19, -17 ≤ k ≤ 17, -17 ≤ l ≤ 17	-14 ≤ h ≤ 14, -17 ≤ k ≤ 17, -20 ≤ l ≤ 20
Reflections collected	55760	80424	58286
Independent reflections	10839 [R_{int} = 0.0507, R_{sigma} = 0.0436]	6368 [R_{int} = 0.0715, R_{sigma} = 0.0354]	9374 [R_{int} = 0.1141, R_{sigma} = 0.0952]
Data/restraints/parameters	10839/0/646	6368/0/284	9374/0/547
Goodness-of-fit on F^2	1.016	1.012	1.002
Final R indexes [I>=2σ (I)]	R_1 = 0.0487, wR_2 = 0.1076	R_1 = 0.0302, wR_2 = 0.0608	R_1 = 0.0574, wR_2 = 0.0989
Final R indexes [all data]	R_1 = 0.0949, wR_2 = 0.1282	R_1 = 0.0474, wR_2 = 0.0662	R_1 = 0.1139, wR_2 = 0.1156
Largest diff. peak/hole / e Å^{-3}	0.27/-0.29	0.46/-0.34	0.45/-0.35

3. Synthetic procedures



Scheme S1. Synthesis of starting 3-(2-benzothienyl)- and 3-(3-benzothienyl)acroleins **13**.

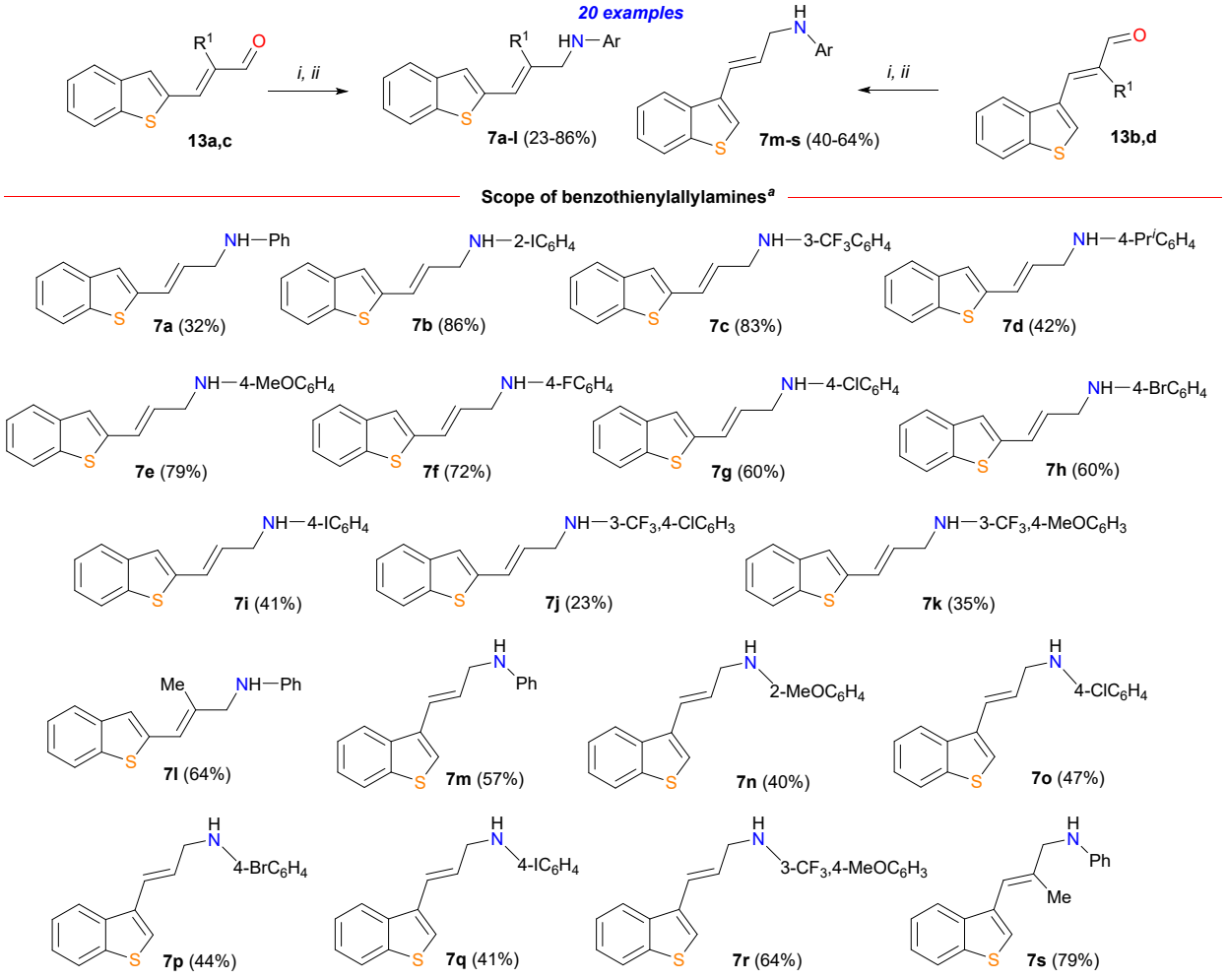
General Procedure for the Synthesis of Products 13b-d and Characterization Data. A mixture of the corresponding benzothiophenecarbaldehyde (2.2 mmol) and (triphenylphosphoranylidine)acetaldehyde (1.00 g, 3.3 mmol) or 2-(triphenylphosphoranylidene)propionaldehyde (1.05 g, 3.3 mmol) in dry benzene was refluxed until the process was complete (TLC and GC/MS monitoring, ~24 h). The reaction mixture was cooled to 25°C, concentrated, and then purified by column chromatography (SiO_2; 20 × 1.8 cm).

(*E*)-3-(Benzo[*b*]thiophen-2-yl)acrylaldehyde (13a). The physicochemical characteristics of compound **13a** have been published previously [9].

(*E*)-3-(Benzo[*b*]thiophen-3-yl)acrylaldehyde (13b). Eluent: EtOAc/heptane (1:100). Yield: 0.15 g (36%); yellow oil. R_f 0.28 (EtOAc : hexane, 1:10). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.75 (d, *J* = 7.6 Hz, 1H, CHO), 8.02 (d, *J* = 8.1 Hz, 1H, H Ar), 7.92 (d, *J* = 8.1 Hz, 1H, H Ar), 7.88 (s, 1H, H-2 Thien), 7.73 (d, *J* = 16.0 Hz, 1H, H-3), 7.51 (dd, *J* = 7.9, 1.0 Hz, 1H, H Ar), 7.45 (dd, *J* = 7.9, 1.0 Hz, 1H, H Ar), 6.83 (dd, *J* = 16.0, 7.6 Hz, 1H, H-2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C): 193.8, 143.9, 140.6, 136.7, 131.4, 130.2, 128.8, 125.4, 125.3, 123.2, 121.9. IR (KBr, cm^{-1}): ν_{max} = 1659 (C=O), 1615 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 188 (75) $[M]^+$, 187 (86), 160 (34), 134 (40), 128 (15), 115 (100), 89 (24), 82 (12), 74 (18), 69 (26), 63 (25), 50 (24), 45 (57), 39 (26).

(*E*)-3-(Benzo[*b*]thiophen-2-yl)-2-methylacrylaldehyde (13c). Eluent: EtOAc/heptane (1:100). Yield: 0.24 g (53%); yellow powder. R_f 0.50 (EtOAc : hexane, 1:10). M.p. 130 °C; ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.60 (s, 1H, CHO), 7.89–7.86 (m, 2H, H Ar), 7.62 (s, 1H, H-3 Thien), 7.49 (s, 1H, H-3), 7.44–7.42 (m, 2H, H Ar), 2.20 (s, 3H, CH_3). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 194.4, 142.3, 142.1, 138.7, 138.6, 137.2, 129.7, 126.1, 125.1, 124.6, 122.3, 10.8. IR (KBr, cm^{-1}): ν_{max} = 1682 (C=O), 1617 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 202 (50) $[M]^+$, 201 (97), 187 (21), 173 (100), 158 (11), 147 (62), 141 (31), 134 (52), 129 (23), 115 (15), 89 (13), 69 (11), 45 (16).

(*E*)-3-(Benzo[*b*]thiophen-3-yl)-2-methylacrylaldehyde (13d). Mixture EtOAc : heptane (1:50) as eluent. Yield: 0.24 g (53%); yellow powder. R_f 0.40 (EtOAc : hexane, 1:50). M.p. 86 °C; ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.71 (s, 1H, CHO), 7.95–7.93 (m, 2H, H Ar), 7.82 (s, 1H, H-2 Thien), 7.58 (s, 1H, H-3), 7.51 (dd, J = 7.9, 1.0 Hz, 1H, H Ar), 7.47 (dd, J = 7.9, 1.0 Hz, 1H, H Ar), 2.17 (s, 3H, CH_3). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 194.9, 139.8, 139.4, 138.9, 138.3, 130.8, 129.1, 125.3, 124.9, 122.9, 121.5, 11.7. IR (KBr, cm^{-1}): ν_{max} = 1664 (C=O), 1619 (C=C). MS (ESI): m/z = 203 $[M+H]^+$.



Scheme S2. Substrates and products scope of benzothienylallylamines **7**. Reaction conditions: ***i*** $ArNH_2$ (1.0 equiv.), MS 4Å (1 g), abs. DCM (10 mL), r.t, 24 h; ***ii*** $NaBH_4$ (2.0 equiv.), MeOH (10 mL), r.t, 24 h. [a] Isolated yields after column chromatography.

General Procedure for the Synthesis of Products 7a-s and Characterization Data. To a solution of the corresponding aniline (0.7 mmol) in CH_2Cl_2 (10 mL) in the presence of a molecular sieves (MS 4Å), corresponding benzothienylacrolein **13** (0.7 mmol) was added at room temperature. The mixture was stirred for 2 h, the molecular sieves were filtered off, washed with CH_2Cl_2 (2×5 mL), and then was concentrated. $NaBH_4$ (29.3 mg, 0.77 mmol) was added to the residue diluted in MeOH (10 mL). The mixture was stirred vigorously at room temperature for 24 h (TLC or GC-MS control), then poured into H_2O (10 ml) and extracted with CH_2Cl_2 (3×10 ml),

the combined organic layers were dried over anhydrous $MgSO_4$, concentrated, and purified by column chromatography (SiO_2, 23 × 1.6 cm) or by crystallization in pentane.

(*E*)-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)aniline (7a). Eluent: EtOAc/heptane (1:20). Yield: 59.4 mg (32%); yellow powder. R_f 0.45 (EtOAc/hexane, 1:16). M.p. 100 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.75 (d, *J* = 7.1 Hz, 1H, H Ar), 7.67 (dd, *J* = 7.1, 2.0 Hz, 1H, H Ar), 7.31–7.27 (m, 2H, H Ar), 7.21 (dd, *J* = 8.1, 7.1 Hz, 2H, H Ar), 7.10 (s, 1H, H-3 Thienyl), 6.84 (d, *J* = 15.6 Hz, 1H, H-3), 6.75 (t, *J* = 7.1 Hz, 1H, H Ar), 6.67 (d, *J* = 8.6, 1.0 Hz, 2H, H Ar), 6.25 (dt, *J* = 15.6, 5.5 Hz, 1H, H-2), 3.96 (dd, *J* = 1.5, *J* = 5.5 Hz, 2H, H-1), 3.89 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.0, 142.2, 140.2, 138.9, 129.7 (2C), 129.4, 125.2 (2C), 124.7, 124.5, 123.5, 122.7, 122.3, 117.9, 113.1, 46.0. IR (KBr, cm^{-1}): ν_{max} = 3410 (NH), 1600, 1503 (C=C). MS (ESI): *m/z* = 266 $[M+H]^+$.

***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-2-iodoaniline (7b).** Eluent: EtOAc/heptane (1:20). Yield: 235.4 mg (86%); yellow oil. R_f 0.65 (EtOAc/hexane, 1:10). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.73 (d, *J* = 7.1 Hz, 1H, H Ar), 7.68–7.64 (m, 2H, H Ar), 7.30–7.27 (m, 2H, H Ar), 7.20 (t, *J* = 7.6 Hz, 1H, H Ar), 7.11 (s, 1H, H-3 Thien), 6.81 (d, *J* = 15.6 Hz, 1H, H-3), 6.61 (d, *J* = 8.1 Hz, 1H, H Ar), 6.46 (t, *J* = 7.6 Hz, 1H, H Ar), 6.23 (dt, *J* = 15.6, 5.1 Hz, 1H, H-2), 4.38 (br.s, 1H, NH), 4.01 (d, *J* = 5.1 Hz, 2H, H-1). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 146.9, 142.0, 140.1, 139.2, 138.9, 129.6, 128.8, 125.4, 124.8, 124.5, 123.6, 122.9, 122.3, 119.1, 111.1, 85.5 46.1. IR (KBr, cm^{-1}): ν_{max} = 3387 (NH), 1589, 1503 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 391 (21) $[M]^+$, 264 (16), 173 (100), 171 (11), 147 (15), 129 (10).

***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-3-(trifluoromethyl)aniline (7c).** Eluent: EtOAc/heptane (1:20). Yield: 193.5 mg (83%); yellow powder. R_f 0.53 (EtOAc/hexane, 1:6). M.p. 82–83 °C. ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.76–7.75 (m, 1H, H Ar), 7.68 (dd, *J* = 7.2, 2.1 Hz, 1H, H Ar), 7.33–7.28 (m, 4H, H Ar), 7.13 (s, 1H, H-3 Thien), 6.98 (d, *J* = 7.6 Hz, 1H, H Ar), 6.86 (d, *J* = 15.7 Hz, 1H, H-3), 6.80 (d, *J* = 8.1, 2.1 Hz, 1H, H Ar), 6.23 (dt, *J* = 15.7, 5.5 Hz, 1H, H-2), 4.16 (s, 1H, NH), 4.00 (d, *J* = 5.5, 1.7 Hz, 2H, H-1). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 147.9, 141.8, 140.0, 138.8, 131.6 (q, $J_{C,F}$ = 31.1 Hz), 129.7, 128.5, 125.6, 124.8, 124.5, 124.3 (q, $J_{C,F}$ = 272.8 Hz), 123.5, 122.9, 122.2, 115.8, 114.1 (q, $J_{C,F}$ = 4.1 Hz), 109.2 (q, $J_{C,F}$ = 4.1 Hz), 45.6. ^{19}F NMR (658.8 MHz, $CDCl_3$, 25 °C) δ -62.8. IR (KBr, cm^{-1}): ν_{max} = 3396 (NH), 1612, 1491 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 333 (33) $[M]^+$, 174 (100), 161 (8), 147 (47), 128 (11), 115 (8), 45 (6).

***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-isopropylaniline (7d)**. Eluent: EtOAc/heptane (1:20). Yield: 90.3 mg (42%); yellow powder. R_f 0.53 (EtOAc/hexane, 1:6). M.p. 78 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.74 (d, *J* = 8.1 Hz, 1H, H Ar), 7.65 (dd, *J* = 7.1, 2.0 Hz, 1H, H Ar), 7.30–

7.26 (m, 2H, H Ar), 7.10 (s, 1H, H-3 Thien), 7.07 (d, *J* = 8.6 Hz, 2H, H Ar), 6.84 (d, *J* = 15.6 Hz, 1H, H-3), 6.63 (d, *J* = 8.6 Hz, 2H, H Ar), 6.25 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.94 (dd, *J* = 5.6, 1.5 Hz, 2H, H-1), 3.78 (br.s, 1H, NH), 2.84 (hept, *J* = 7.1 Hz, 1H, CH), 1.21 (d, *J* = 7.1 Hz, 6H, 2 CH_3). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 145.9, 142.2, 140.1, 138.8, 138.3, 130.0, 127.2 (2C), 125.0, 124.6, 124.4, 123.4, 122.5, 122.2, 113.1 (2C), 46.3, 33.2, 24.3 (2C). IR (KBr, cm^{-1}): ν_{max} = 3389 (NH), 1613, 1517 (C=C). MS (ESI): *m/z* = 308 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-methoxyaniline (7e).** Eluent: EtOAc/heptane (1:20). Yield: 163.1 mg (79%); yellow powder. R_f 0.34 (EtOAc/hexane, 1:10). M.p. 115 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.74 (d, *J* = 7.1 Hz, 1H, H Ar), 7.65 (d, *J* = 7.6 Hz, 1H, H Ar), 7.31–7.26 (m, 2H, H Ar), 7.10 (s, 1H, H-3 Thien), 6.83 (d, *J* = 15.6 Hz, 1H, H-3), 6.80 (d, *J* = 8.1 Hz, 2H, H Ar), 6.64 (d, *J* = 8.1 Hz, 2H, H Ar), 6.25 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.91 (d, *J* = 5.6 Hz, 2H, H-1), 3.75 (s, 3H, OCH_3), 3.61 (s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 152.5, 142.3, 142.2, 140.2, 138.9, 130.1, 125.2, 124.7 (2C), 124.5, 123.5, 122.6, 122.3, 115.1 (2C), 114.5, 55.9, 47.0. IR (KBr, cm^{-1}): ν_{max} = 3398 (NH), br. 1512 (C=C). MS (ESI): *m/z* = 296 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-fluoroaniline (7f).** Eluent: EtOAc/heptane (1:20). Yield: 142.6 mg (72%); yellow powder. R_f 0.33 (EtOAc/hexane, 1:10). M.p. 108 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.76 (dd, *J* = 7.1, 1.5 Hz, 1H, H Ar), 7.66 (dd, *J* = 7.6, 1.5 Hz, 1H, H Ar), 7.33–7.29 (m, 2H, H Ar), 7.13 (s, 1H, H-3 Thien), 6.93 (t, *J* = 8.6 Hz, 2H, H Ar), 6.84 (d, *J* = 15.6 Hz, 1H, H-3), 6.62 (dd, *J* = 8.6, 4.0 Hz, 2H, H Ar), 6.25 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.93 (dd, *J* = 5.6, 1.5 Hz, 2H, H-1), 3.77 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 156.0 (d, $J_{C,F}$ = 235.6 Hz), 144.3 (d, $J_{C,F}$ = 2.9 Hz), 142.1, 140.1, 138.9, 129.5, 125.4, 124.8, 124.6, 123.5, 122.8, 122.3, 115.8 (d, $J_{C,F}$ = 21.7 Hz, 2C), 113.9 (d, $J_{C,F}$ = 7.2 Hz, 2C), 46.6. ^{19}F NMR (564.7 MHz, $CDCl_3$, 25 °C) δ -127.5. IR (KBr, cm^{-1}): ν_{max} = 3405 (NH), br. 1509 (C=C). MS (ESI): *m/z* = 284 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-chloroaniline (7g).** Eluent: EtOAc/heptane (1:20). Yield: 125.6 mg (60%); yellow powder. R_f 0.38 (EtOAc/hexane, 1:4). M.p. 111°C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.74 (dd, *J* = 7.1, 1.5 Hz, 1H, H Ar), 7.66 (dd, *J* = 7.1, 2.0 Hz, 1H, H Ar), 7.31–7.28 (m, 2H, H Ar), 7.14–7.12 (m, 2H, H Ar), 7.10 (s, 1H, H-3 Thien), 6.82 (d, *J* = 15.6 Hz, 1H, H-3), 6.58 (d, *J* = 8.6 Hz, 2H, H Ar), 6.20 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.93 (dd, *J* = 5.6, 1.5Hz, 2H, H-1), 3.91 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 146.4, 141.9, 140.1, 138.9, 129.2 (2C), 129.0, 125.5, 124.8, 124.6, 123.5, 122.9, 122.4, 122.3, 114.1 (2C), 46.0. IR (KBr, cm^{-1}): ν_{max} = 3409 (NH), 1597, 1496 (C=C). MS (ESI): *m/z* = 300 $[M+H, Cl^{35}]^+$, 302 $[M+H, Cl^{37}]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-bromoaniline (7h).** Eluent: EtOAc/heptane (1:20). Yield: 144.5 mg (60%); yellow oil. R_f 0.35 (EtOAc/hexane, 1:10). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.73 (dd, *J* = 7.6, 1.5 Hz, 1H, H Ar), 7.65 (dd, *J* = 7.1, 1.5 Hz, 1H, H Ar), 7.30–7.25 (m, 4H, H Ar), 7.09 (s, 1H, H-3 Thien), 6.80 (d, *J* = 15.6 Hz, 1H, H-3), 6.53 (d, *J* = 9.1 Hz, 2H, H Ar), 6.19 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 4.00 (br.s, 1H, NH), 3.92 (dd, *J* = 5.6, 2.0 Hz, 2H, H-1). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 146.8, 141.9, 140.0, 138.8, 132.0 (2C), 128.9, 125.4, 124.7, 124.5, 123.5, 122.8, 122.2, 114.6 (2C), 109.4, 46.8. IR (KBr, cm^{-1}): ν_{max} = 3409 (NH), 1593, 1492 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 345 for Br^{81} (25) $[M]^+$, 343 for Br^{79} (24), 173 (100), 147 (9), 129 (22), 45 (13).

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-iodoaniline (7i).** Crystallization in pentane. Yield: 112.2 mg (41%); yellow powder. R_f 0.47 (EtOAc/hexane, 1:10). M.p. 142 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.76 (dd, *J* = 7.6, 1.5 Hz, 1H, H Ar), 7.68 (dd, *J* = 7.1, 2.0 Hz, 1H, H Ar), 7.45 (d, *J* = 9.1 Hz, 2H, H Ar), 7.33–7.29 (m, 2H, H Ar), 7.12 (s, 1H, H-3 Thien), 6.83 (d, *J* = 15.6 Hz, 1H, H-3), 6.46 (d, *J* = 9.1 Hz, 2H, H Ar), 6.21 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.96 (br.s, 1H, NH), 3.93 (d, *J* = 5.6 Hz, 2H, H-1). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 147.5, 141.9, 140.1, 138.9, 138.0 (2C), 128.9, 125.5, 124.8, 124.6, 123.6 (2C), 122.9, 122.3, 115.3, 78.4, 45.7. IR (KBr, cm^{-1}): ν_{max} = 3387 (NH), 1588, 1490 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 391 (45) $[M]^+$, 219 (7), 173 (100), 129 (21), 45 (12) .

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-chloro-3-(trifluoromethyl)aniline (7j).** Eluent: EtOAc/heptane (1:20). Yield: 59.2 mg (23%); yellow powder. R_f 0.35 (EtOAc/hexane, 1:16). M.p. 113 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.74 (d, *J* = 8.6 Hz, 1H, H Ar), 7.67 (dd, *J* = 8.1, 2.0 Hz, 1H, H Ar), 7.33–7.26 (m, 3H, H Ar), 7.12 (s, 1H, H-3 Thien), 6.92 (d, *J* = 3.0 Hz, 1H, H Ar), 6.81 (d, *J* = 15.6 Hz, 1H, H-3), 6.68 (dd, *J* = 8.6, 2.5 Hz, 1H, H Ar), 6.18 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 4.10 (br.s, 1H, NH), 3.96-3.94 (m, 2H, H-1). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 146.4, 141.6, 140.1, 138.9, 132.2, 128.9 (q, 1C, $J_{C,F}$ = 30.3 Hz), 128.0, 125.9, 124.9, 124.8 (q, 1C, $J_{C,F}$ = 273.1 Hz), 124.6, 123.6, 123.2, 122.3, 119.5, 116.4, 111.8 (q, 1C, $J_{C,F}$ = 5.8 Hz), 45.7. ^{19}F NMR (658.8 MHz, $CDCl_3$, 25 °C) δ -62.8. IR (KBr, cm^{-1}): ν_{max} = 3416 (NH), 1611, 1506 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 369 for Cl^{37} (7) $[M]^+$, 367 for Cl^{35} (25), 173 (100), 147 (12), 129 (28), 115 (10), 45 (31).

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-methoxy-3-(trifluoromethyl)aniline (7k).** Eluent: EtOAc/heptane (1:20). Yield: 88.9 mg (35%); yellow powder. R_f 0.26 (EtOAc/hexane, 1:10). M.p. 91 °C; ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.74 (dd, *J* = 7.6, 1.5 Hz, 1H, H Ar), 7.67 (dd, *J* = 6.6, 1.5 Hz, 1H, H Ar), 7.31–7.27 (m, 2H, H Ar), 7.11 (s, 1H, H-3 Thien), 6.90–6.88 (m, 2H, H Ar), 6.83 (d, *J* = 15.6 Hz, 1H, H-3), 6.77 (dd, *J* = 8.6, 2.5 Hz, 1H, H Ar), 6.21 (dt, *J* = 15.6, 5.6

Hz, 1H, H-2), 3.92 (dd, *J* = 1.5, 5.6 Hz, 2H, H-1), 3.82 (s, 3H, CH_3), 3.79 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 149.9, 142.0, 141.6, 140.1, 138.9, 129.1, 125.5, 124.8, 124.6, 123.8 (q, 1C, $J_{C,F}$ = 273.1 Hz), 123.6, 122.9, 122.3, 119.7 (q, 1C, $J_{C,F}$ = 30.3 Hz), 117.0, 114.4, 112.1 (q, 1C, $J_{C,F}$ = 5.8 Hz), 56.9, 46.5. IR (KBr, cm^{-1}): ν_{max} = 3443 (NH), br. 1513 (C=C). MS (ESI): *m/z* = 364 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)-2-methylallyl)aniline (7l).** Eluent: EtOAc/heptane (1:100). Yield: 125.0 mg (64%); yellow powder. R_f 0.66 (EtOAc/hexane, 1:10). M.p. 109 °C; ^1H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.80 (d, *J* = 8.1 Hz, 1H, H Ar), 7.73 (d, *J* = 7.6 Hz, 1H, H Ar), 7.36–7.29 (m, 2H, H Ar), 7.22 (dd, *J* = 8.6, 7.6 Hz, 2H, H Ar), 7.17 (s, 1H, H-3 Thien), 6.77-6.74 (m, 2H, H-3, H-Ar), 6.68 (dd, *J* = 8.6, 1.0 Hz, 2H, H Ar), 4.01 (br.s, 1H, NH), 3.89 (br.s, 2H, H-1), 2.15 (s, 3H, CH_3). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.2, 141.0, 139.8, 139.6, 137.3, 129.4 (2C), 124.4, 124.1, 123.4, 123.3, 122.1, 119.1, 117.7, 113.0 (2C), 52.5, 17.1. IR (KBr, cm^{-1}): ν_{max} = 3437 (NH), 1608, 1509 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 279 (100) $[M]^+$, 276 (28), 264 (19), 187 (100), 172 (55), 171 (50), 147 (26), 143 (12), 139 (10), 77 (18).

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)aniline (7m).** Eluent: EtOAc/heptane (1:20). Yield: 105.7 mg (57%); yellow oil. R_f 0.60 (EtOAc/hexane, 1:10). ^1H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.88 (d, *J* = 8.1 Hz, 1H, H Ar), 7.87 (d, *J* = 7.1 Hz, 1H, H Ar), 7.43–7.36 (m, 3 H, H Ar), 7.23 (dd, *J* = 7.6, 8.6 Hz, 2H, H Ar), 6.92 (d, *J* = 15.6 Hz, 1H, H-3), 6.78–6.72 (m, 3 H, H Ar), 6.43 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 4.03 (dd, *J* = 5.6, 1.5 Hz, 2H, H-1), 3.92 (br.s, 1H, NH). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 148.0, 140.5, 137.6, 133.6, 129.3 (2C), 128.9, 124.5, 124.3, 123.9, 122.9, 122.0, 121.9, 117.8, 113.1 (2C), 46.5. IR (KBr, cm^{-1}): ν_{max} = 3409 (NH), 1601, 1503 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 265 (38) $[M]^+$, 173 (100), 171 (32), 147 (11), 129 (33), 115 (12), 77 (22), 51 (10), 45 (29).

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-2-methoxyaniline (7n).** Eluent: EtOAc/heptane (1:20). Yield: 82.6 mg (40%); yellow powder. R_f 0.44 (EtOAc/hexane, 1:10). M.p. 78 °C; ^1H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.90 (d, *J* = 7.9 Hz, 1H, H Ar), 7.87 (d, *J* = 7.9 Hz, 1H, H Ar), 7.43–7.37 (m, 3H, H Ar), 6.94–6.91 (m, 2H, H-3, H Ar), 6.84 (d, *J* = 7.6 Hz, 1H, H Ar), 6.76–6.73 (m, 2H, H Ar), 6.45 (dt, *J* = 15.6, 5.7 Hz, 1H, H-2), 4.52 (br.s, 1H, NH), 4.05 (dd, *J* = 5.7, 1.2 Hz, 2H, H-1), 3.90 (s, 3 H, OCH_3). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 147.0, 140.5, 138.0, 137.7, 133.7, 129.1, 124.5, 124.3, 123.7, 122.9, 122.0, 121.9, 121.4, 116.8, 110.3, 109.5, 55.5, 46.2. IR (KBr, cm^{-1}): ν_{max} = 3418 (NH), 1599, 1518 (C=C). MS (ESI): *m/z* = 296 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-chloroaniline (7o).** Eluent: EtOAc/heptane (1:20). Yield: 98.7 mg (47%); yellow powder. R_f 0.31 (EtOAc/hexane, 1:2). M.p. 113 °C; ^1H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.87–7.86 (m, 2H, H Ar), 7.42–7.36 (m, 3H, H-2 Thienyl, H Ar),

7.16 (d, *J* = 8.8 Hz, 2H, H Ar), 6.90 (d, *J* = 15.7 Hz, 1H, H-3), 6.63 (d, *J* = 8.8 Hz, 2H, H Ar), 6.38 (dt, *J* = 15.7, 5.5 Hz, 1H, H-2), 3.99 (d, *J* = 5.5 Hz, 2H, H-1), 3.95 (br.s, 1H, NH). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) 146.5, 140.5, 137.6, 133.4, 129.1 (2C), 128.2, 124.5, 124.3, 124.1, 122.9, 122.3, 122.1, 121.9, 114.1 (2C), 46.5. IR (KBr, cm^{-1}): ν_{max} = 3413 (NH), 1599, 1499 (C=C). MS (ESI): *m/z* = 300 $[M+H, Cl^{35}]^+$, 302 $[M+H, Cl^{37}]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-bromoaniline (7p).** Eluent: EtOAc/heptane (1:20). Yield: 105.6 mg (44%); yellow oil. R_f 0.42 (EtOAc/hexane, 1:2). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.87–7.86 (m, 2H, H Ar), 7.46 (d, *J* = 8.6 Hz, 2H, H Ar), 7.42–7.37 (m, 3H, H-2 Thienyl, H Ar), 6.89 (d, *J* = 16.0 Hz, 1H, H-3), 6.50 (d, *J* = 8.6 Hz, 2H, H Ar), 6.37 (dt, *J* = 16.0, 5.5 Hz, 1H, H-2), 3.98 (d, *J* = 5.5 Hz, 2H, H-1), 3.97 (s, 1H, NH). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) 147.6, 140.5, 137.9 (2C), 137.6, 133.4, 128.1, 124.5, 124.3, 124.1, 122.9, 122.1, 121.9, 115.3 (2C), 78.3, 46.2. IR (KBr, cm^{-1}): ν_{max} = 3413 (NH), 1590, 1493 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 345 for Br^{81} (23) $[M]^+$, 343 for Br^{79} (25), 173 (100), 129 (19), 45 (13).

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-idoaniline (7q).** Eluent: EtOAc/heptane (1:20). Yield: 112.2 mg (41%); yellow oil. R_f 0.47 (EtOAc/hexane, 1:2). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.88–7.86 (m, 2H, H Ar), 7.43–7.37 (m, 3H, H-2 Thienyl, H Ar), 7.30 (d, *J* = 8.8 Hz, 2H, H Ar), 6.89 (d, *J* = 16.0 Hz, 1H, H-3), 6.59 (d, *J* = 8.8 Hz, 2H, H Ar), 6.37 (dt, *J* = 16.0, 5.7 Hz, 1H, H-2), 3.98 (d, *J* = 5.7 Hz, 2H, H-1), 3.97 (s, 1H, NH). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 147.0, 140.5, 137.6, 133.4, 132.0 (2C), 128.2, 124.6, 124.3, 124.1, 123.0, 122.1, 121.9, 114.6 (2C), 109.3, 46.4. IR (KBr, cm^{-1}): ν_{max} = 3424 (NH), 1594, 1496 (C=C). MS (ESI): *m/z* = 392 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-methoxy-3-(trifluoromethyl)aniline (7r).** Eluent: EtOAc/heptane (1:20). Yield: 162.6 mg (64%); yellow oil. R_f 0.32 (EtOAc/hexane, 1:5). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.86–7.86 (m, 2H, H Ar), 7.41–7.34 (m, 3H, H Ar), 6.92–6.87 (m, 3H, H-3, H Ar), 6.81 (dd, *J* = 8.6, 2.5 Hz, 1H, H Ar), 6.36 (dt, *J* = 15.6, 5.6 Hz, 1H, H-2), 3.97 (dd, *J* = 5.6, 1.5 Hz, 2H, H-1), 3.85 (s, 3H, OCH_3), 3.81 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 149.9, 141.7, 140.5, 137.7, 133.5, 128.5, 124.6, 124.4, 124.3, 123.8 (q, $J_{C,F}$ = 273.1 Hz), 123.0, 122.1, 121.9, 119.6 (q, $J_{C,F}$ = 30.3 Hz), 117.2, 114.4, 112.1 (q, $J_{C,F}$ = 5.8 Hz), 56.9, 47.2. ^{19}F NMR (564.7 MHz, $CDCl_3$, 25 °C) δ -62.1. IR (KBr, cm^{-1}): ν_{max} = 3391 (NH), 1509 (C=C). MS (ESI): *m/z* = 364 $[M+H]^+$.

***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)-2-methylallyl)aniline (7s).** Eluent: EtOAc/heptane (1:100). Yield: 154.3 mg (79%); yellow oil. R_f 0.33 (EtOAc/hexane, 1:10). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.87–7.86 (m, 1H, H Ar), 7.65–7.64 (m, 1H, H Ar), 7.38–7.35 (m, 2H, H Ar), 7.27 (br.s, 1H, H-2 Thien), 7.23 (t, *J* = 8.6 Hz, 2H, H Ar), 6.77–6.73 (m, 3H, H Ar), 6.69 (s, 1H, H-3), 4.13 (br.s, 1H, NH), 3.95 (s, 2H, H-1), 1.97 (s, 3H, CH_3). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ

148.2, 139.5, 139.1, 137.9, 132.9, 129.3 (2C), 124.4, 124.0, 122.9, 122.6, 122.2, 117.8, 117.6, 113.0 (2C), 52.0, 17.0. IR (KBr, cm^{-1}): ν_{max} = 3417 (NH), 1602, 1505 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 279 (100) $[M]^+$, 264 (11), 187 (100), 172 (50), 171 (48), 147 (18), 77 (13).

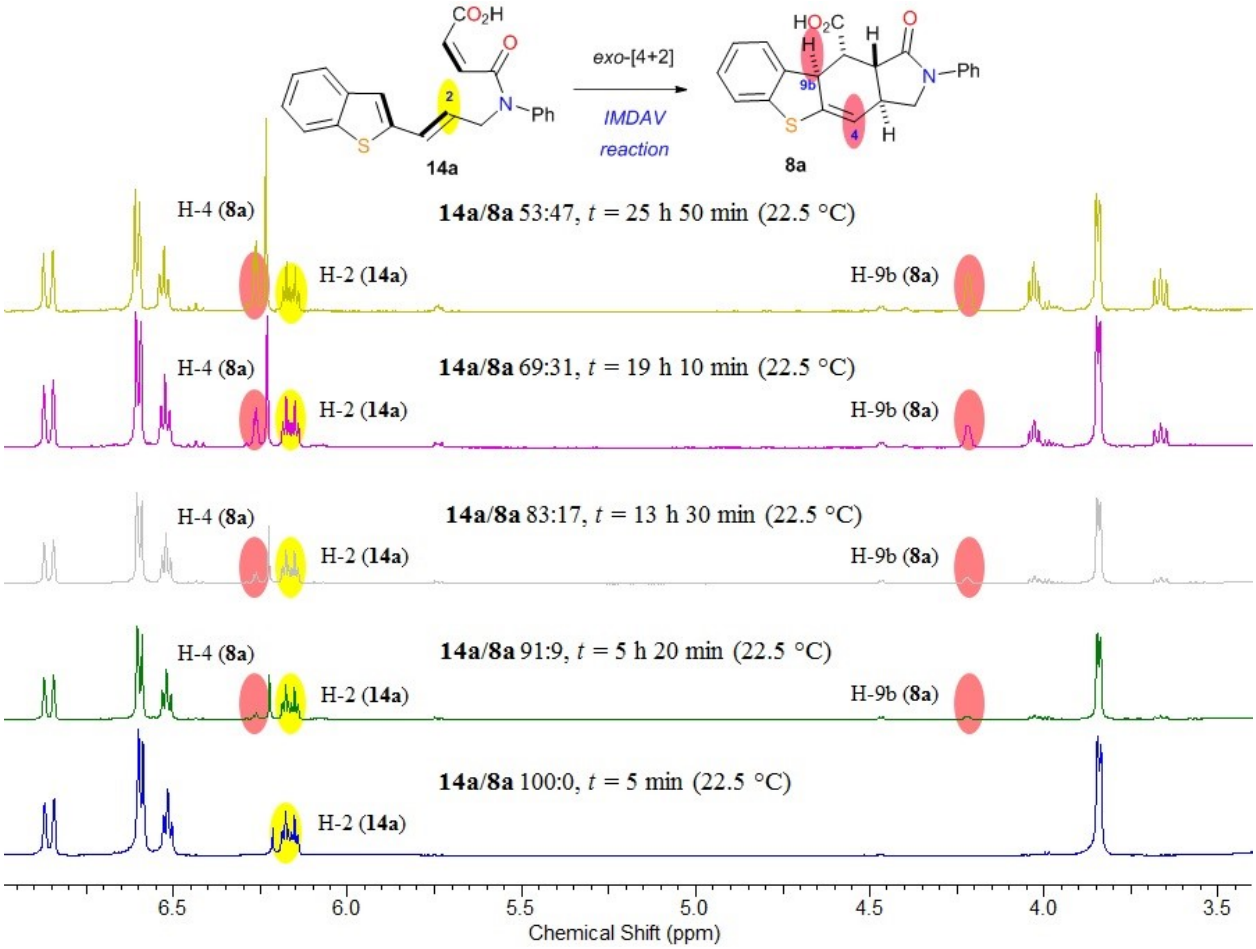


Fig. S13. Real-time NMR-experiment to monitor the formation of amide **14a** (in yellow) and the product of the IMDAV reaction **8a** (in pink)**.**

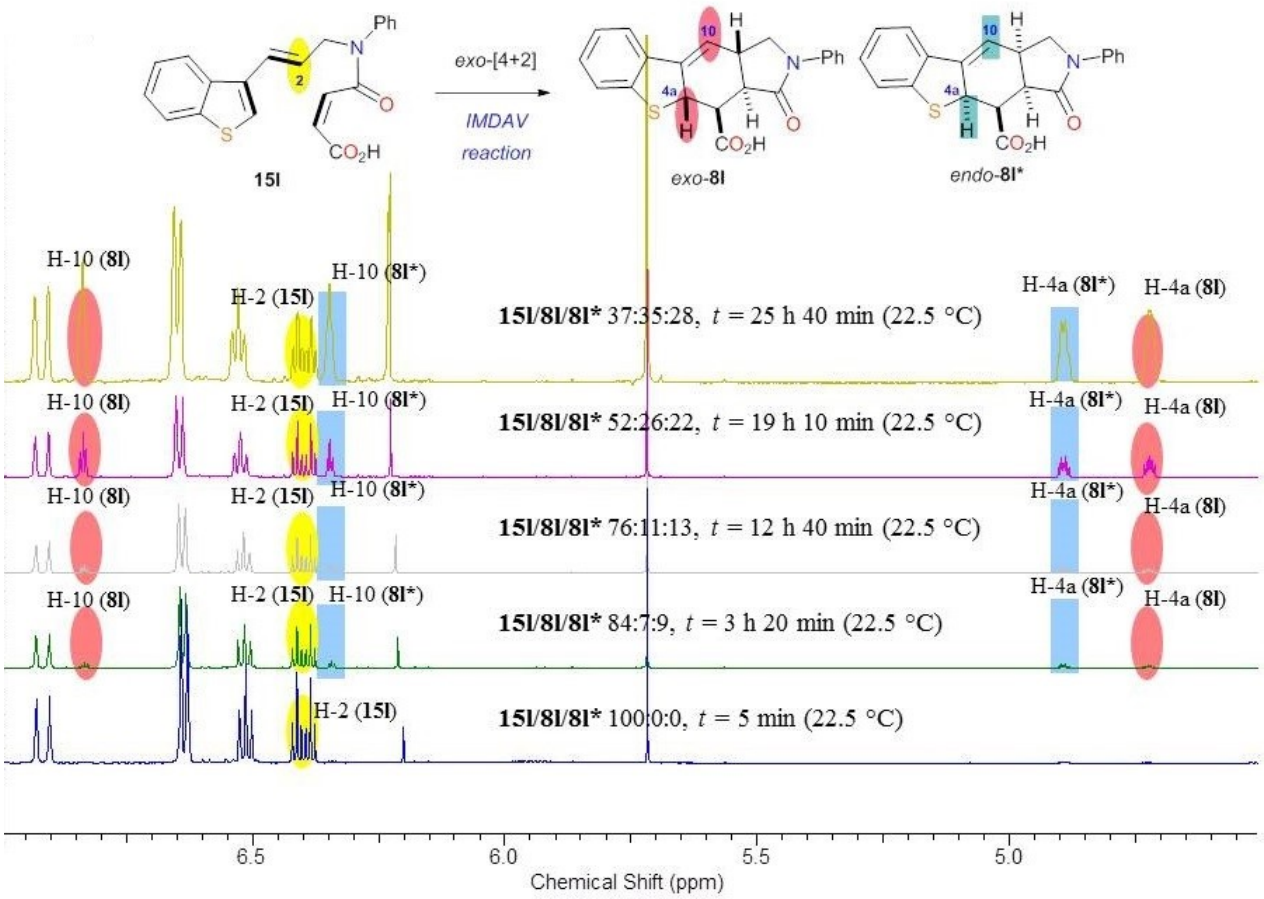


Fig. S14. Real-time NMR-experiment to monitor the formation of amide **15l** (in yellow) and the products of the IMDAV reaction **8l and 8l*** (in pink and light-blue)**.**

General Procedure for the Synthesis of Products 8a-r and Characterization Data. Maleic anhydride (0.05 g, 0.5 mmol) was added to the corresponding allylamine **7** (0.5 mmol) diluted in PhH (5 mL). The resulting mixture was heated at reflux for 3-4 hours and then cooled to room temperature. The resulting precipitate was filtered off, washed with PhH (5 ml), Et_2O (2×5 ml), and air dried to give the title acids **8a-j,l-q** as colorful solid powders.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-1-Oxo-2-phenyl-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8a). Reflux for 4 hours. Yield: 165.6 mg (91%); colourless powder. M.p. 234–236 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.91 (s, 1H, CO_2H), 7.59 (d, J = 8.6 Hz, 2H, H Ar), 7.52 (d, J = 7.6 Hz, 1H, H Ar), 7.38–7.32 (m, 3H, H Ar), 7.23 (t, J = 7.6 Hz, 1H, H Ar), 7.19 (dt, J = 7.6, 1.5 Hz, 1H, H Ar), 7.08 (t, J = 7.6 Hz, 1H, H Ar), 6.27 (t, J = 3.3 Hz, 1H, H-4), 4.23-4.20 (m, 1H, H-9b), 4.03 (dd, J = 9.1, 8.1 Hz, 1H, H-3A), 3.67 (dd, J = 10.6, 9.1 Hz, 1H, H-3B), 3.18–3.13 (m, 2H, H-3a, H-10), 2.52 (dd, J = 12.6, 7.6 Hz, 1H, H-10a). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 175.8, 171.9, 140.3, 140.1, 138.9, 138.6, 129.2 (2C), 128.6, 125.7, 124.6, 124.2, 122.3, 121.0, 119.4 (2C), 51.0, 50.2, 48.6, 42.6, 36.0. IR (KBr, cm^{-1}): ν_{max} = br. 1703 (N-C=O, CO_2). MS (ESI): m/z = 364 $[M+H]^+$.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-1-Oxo-2-(3-(trifluoromethyl)phenyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8b). Reflux for 3 hours. Yield: 165.9 mg (77%); colourless powder. M.p. 225-227 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 13.02 (s, 1H, CO_2H), 8.14 (s, 1H, H Ar), 7.80 (d, J = 8.1 Hz, 1H, H Ar), 7.63 (t, J = 8.1 Hz, 1H, H Ar), 7.56 (d, J = 7.6 Hz, 1H, H Ar), 7.48 (d, J = 7.6 Hz, 1H, H-6 Ar), 7.37 (d, J = 7.6 Hz, 1H, H Ar), 7.26 (t, J = 7.6 Hz, 1H, H Ar), 7.22 (dt, J = 7.6, 1.0 Hz, 1H, H Ar), 6.31 (t, J = 3.3 Hz, 1H, H-4), 4.27-4.25 (m, 1H, H-9b), 4.17 (dd, J = 8.9, 7.6 Hz, 1H, H-3A), 3.77 (dd, J = 11.1, 8.9 Hz, 1H, H-3B), 3.23–3.17 (m, 2H, H-3a, H-10), 2.63 (dd, J = 13.1, 8.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 172.7, 140.9, 140.1, 139.2, 138.6, 130.5, 130.0 (d, $J_{C,F}$ = 31.6 Hz), 128.7, 125.8, 124.7, 124.6 (q, $J_{C,F}$ = 272.2Hz), 122.7, 122.4, 120.8, 120.4 (d, $J_{C,F}$ = 3.8 Hz), 115.7 (d, $J_{C,F}$ = 3.8 Hz), 51.0, 50.2, 48.5, 42.6, 35.9. ^{19}F NMR (658.8 MHz, DMSO-d_6, 25 °C) δ -61.2. IR (KBr, cm^{-1}): ν_{max} = 1742 (CO_2H), 1682 (N-C=O). MS (ESI): *m/z* = 432 $[M+H]^+$. Anal. Calcd for $C_{22}H_{16}F_3NO_3S$: C, 61.25; H, 3.74; N, 3.25; S, 7.43. Found: C, 61.27; H, 3.69; N, 3.80; S, 7.54.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Isopropylphenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8c). Reflux for 3 hours. Yield: 153.9 mg (76%); colourless powder. M.p. 229-231 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.93 (s, 1H, CO_2H), 7.56-7.53 (m, 3H, H Ar), 7.37 (d, J = 7.6 Hz, 1H, H Ar), 7.28–7.22 (m, 4H, H Ar), 6.31 (br.s, 1H, H-4), 4.25 (br. s, 1H, H-9b), 4.05 (br. t, J = 7.9 Hz, 1H, H-3A), 3.69 (dd, J = 10.1, 9.8 Hz, 1H, H-3B), 3.21–3.17 (m, 2H, H-3a, H-10), 2.87 (hept, J = 6.7 Hz, 1H, CH), 2.54 (dd, J = 12.4, 8.1 Hz, 1H, H-10a), 1.20 (d, J = 6.7 Hz, 6H, CH_3). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.9, 171.7, 144.3, 140.2, 138.9, 138.6, 138.1, 128.6, 126.9 (2C), 125.7, 124.6, 122.4, 121.0, 119.6 (2C), 51.1, 50.3, 48.6, 42.6, 36.2, 33.4, 24.5 (2C). IR (KBr, cm^{-1}): ν_{max} = 1727 (CO_2), 1666 (N-C=O). MS (ESI): *m/z* = 406 $[M+H]^+$. Anal. Calcd for $C_{24}H_{23}NO_3S$: C, 71.08; H, 5.72; N, 3.45; S, 7.91. Found: C, 70.99; H, 5.86; N, 3.21; S, 8.13.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8d). Reflux for 3.5 hours. Yield: 149.3 mg (76%); colourless powder. M.p. 240-242 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.91 (s, 1H, CO_2H), 7.55 (d, J = 7.6 Hz, 1H, H Ar), 7.52 (d, J = 9.1 Hz, 2H, H Ar), 7.36 (d, J = 7.6 Hz, 1H, H Ar), 7.26 (t, J = 7.6 Hz, 1H, H Ar), 7.22 (t, J = 7.6 Hz, 1H, H Ar), 6.95 (d, J = 9.1 Hz, 2H, H Ar), 6.30 (t, J = 3.5 Hz, 1H, H-4), 4.25-4.23 (m, 1H, H-9b), 4.01 (t, J = 8.7 Hz, 1H, H-3A), 3.74 (s, 3H, OMe), 3.68 (dd, J = 10.6, 9.1 Hz, 1H, H-3B), 3.20–3.17 (m, 1H, H-3a), 3.16 (dd, J = 8.1, 6.1 Hz, 1H, H-10), 2.53 (dd, J = 13.1, 8.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.9, 171.4, 156.1, 140.2, 138.9, 138.7, 133.6, 128.7, 125.7, 124.7, 122.4, 121.3 (2C), 121.1, 114.4 (2C), 55.8, 51.1, 50.6, 48.5, 42.7, 36.3. IR (KBr, cm^{-1}): ν_{max} = 1714 (CO_2), 1640 (N-

C=O). MS (ESI): *m/z* = 394 $[M+H]^+$. Anal. Calcd for $C_{22}H_{19}NO_4S$: C, 67.16; H, 4.87; N, 3.56; S, 8.15. Found: C, 66.89; H, 5.12; N, 3.23; S, 8.45.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8e). Reflux for 4 hours. Yield: 141.0 mg (74%); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.94 (s, 1H, CO_2H), 7.65– 7.62 (m, 2H, H Ar), 7.55 (d, *J* = 7.6 Hz, 1H, H Ar), 7.36 (d, *J* = 7.6 Hz, 1H, H Ar), 7.27–7.21 (m, 4H, H Ar), 6.30 (t, *J* = 3.3 Hz, 1H, H-4), 4.26-4.24 (m, 1H, H-9b), 4.06 (dd, *J* = 8.6, 7.6 Hz, 1H, H-3A), 3.71 (dd, *J* = 11.1, 8.6 Hz, 1H, H-3B), 3.21–3.16 (m, 2H, H-3a, H-10), 2.57 (dd, *J* = 12.6, 8.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 171.9, 158.8 (d, $J_{C,F}$ = 241.3 Hz), 140.1, 139.0, 138.6, 136.7 (d, $J_{C,F}$ = 2.9 Hz), 128.7, 125.8, 124.7, 122.4, 121.4 (d, $J_{C,F}$ = 8.7 Hz, 2C), 121.0, 115.8 (d, $J_{C,F}$ = 21.7 Hz, 2C), 51.1, 50.5, 48.4, 42.6, 36.1. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -118.8. IR (KBr, cm^{-1}): ν_{max} = br. 1704 (N-C=O, CO_2). MS (ESI): *m/z* = 382 $[M+H]^+$. Anal. Calcd for $C_{21}H_{16}FNO_3S$: C, 66.13; H, 4.23; N, 3.67; S, 8.41. Found: C, 65.96; H, 4.22; N, 3.47; S, 8.40.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Chlorophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8f). Reflux for 3 hours. Yield: 146.9 mg (74%); colourless powder. M.p. 240-242 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.96 (s, 1H, CO_2H), 7.67 (d, *J* = 9.1 Hz, 2H, H Ar), 7.56 (d, *J* = 7.6 Hz, 1H, H Ar), 7.44 (d, *J* = 9.1 Hz, 2H, H Ar), 7.36 (d, *J* = 7.6 Hz, 1H, H Ar), 7.26 (t, *J* = 7.6 Hz, 1H, H Ar), 7.22 (dt, *J* = 7.6, 1.5 Hz, 1H, H Ar), 6.30 (t, *J* = 3.3 Hz, 1H, H-4), 4.26-4.23 (m, 1H, H-9b), 4.08 (dd, *J* = 8.9, 7.6 Hz, 1H, H-3A), 3.70 (dd, *J* = 11.1, 8.9 Hz, 1H, H-3B), 3.21–3.15 (m, 2H, H-3a, H-10), 2.58 (dd, *J* = 12.6, 8.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 172.2, 140.1, 139.2, 139.1, 138.6, 129.2, 129.1 (2C), 128.7, 127.9, 125.8, 124.7, 122.4, 121.0 (2C), 51.0, 50.3, 48.5, 42.6, 35.9. IR (KBr, cm^{-1}): ν_{max} = br. 1698 (N-C=O, CO_2). MS (ESI): *m/z* = 398 $[M+H, Cl^{35}]^+$, 400 $[M+H, Cl^{37}]^+$. Anal. Calcd for $C_{21}H_{16}ClNO_3S$: C, 63.39; H, 4.05; N, 3.52; S, 8.06. Found: C, 63.41; H, 3.49; N, 3.57; S, 7.88.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8g). Reflux for 3.5 hours. Yield: 159.1 mg (72%); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.97 (s, 1H, CO_2H), 7.61–7.55 (m, 5 H, H Ar), 7.37 (d, *J* = 7.6 Hz, 1H, H Ar), 7.27–7.21 (m, 2H, H Ar), 6.31 (t, *J* = 3.5 Hz, 1H, H-4), 4.26-4.23 (m, 1H, H-9b), 4.07 (t, *J* = 8.5 Hz, 1H, H-3A), 3.70 (dd, *J* = 10.6, 8.5Hz, 1H, H-3B), 3.20–3.16 (m, 2H, H-3a, H-10), 2.58 (dd, *J* = 12.6, 7.6 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 172.2, 140.1, 139.6, 139.1, 138.6, 132.0 (2C), 128.7, 125.8, 124.7, 122.4, 121.4 (2C), 121.0, 116.0, 51.0, 50.2, 48.5, 42.6, 35.9. IR (KBr, cm^{-1}):

ν_{max} = 1719 (CO_2), 1673 (N-C=O). MS (ESI): *m/z* = 442 [M+H, Br^{79}]$^+$, 444 [M+H, Br^{81}]$^+$. Anal. Calcd for $C_{21}H_{16}BrNO_3S$: C, 57.02; H, 3.65; N, 3.17; S, 7.25. Found: C, 57.17; H, 3.48; N, 3.01; S, 7.11.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Iodophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8h). Reflux for 3 hours. Yield: 173.6 mg (71%); colourless powder. M.p. 248–250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.97 (s, 1H, CO_2H), 7.71 (d, *J* = 9.1 Hz, 2H, H Ar), 7.55 (d, *J* = 7.6 Hz, 1H, H Ar), 7.47 (d, *J* = 9.1 Hz, 2H, H Ar), 7.36 (d, *J* = 7.6 Hz, 1H, H Ar), 7.23 (t, *J* = 7.6 Hz, 1H, H Ar), 7.21 (t, *J* = 7.6 Hz, 1H, H Ar), 6.29 (t, *J* = 3.5 Hz, 1H, H-4), 4.25-4.23 (m, 1H, H-9b), 4.05 (t, *J* = 8.5 Hz, 1H, H-3A), 3.67 (dd, *J* = 11.1, 8.5 Hz, 1H, H-3B), 3.19–3.14 (m, 2H, H-3a, H-10), 2.56 (dd, *J* = 12.6, 7.6 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 172.2, 140.1 (2C), 139.1, 138.6, 137.8 (2C), 128.7, 125.8, 124.7, 122.4, 121.6 (2C), 121.0, 88.1, 51.0, 50.1, 48.6, 42.6, 35.9. IR (KBr, cm^{-1}): ν_{max} = br. 1706 (CO_2, N-C=O). MS (ESI): *m/z* = 490 [M+H]$^+$. Anal. Calcd for $C_{21}H_{16}INO_3S$: C, 51.55; H, 3.30; N, 2.86; S, 6.55. Found: C, 51.71; H, 3.09; N, 3.00; S, 6.67.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Chloro-3-(trifluoromethyl)phenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8i). Reflux for 4 hours. Yield: 90.7 mg (39%); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 13.01 (s, 1H, CO_2H), 8.24 (d, *J* = 2.5 Hz, 1H, H Ar), 7.82 (dd, *J* = 8.6, 2.5 Hz, 1H, H Ar), 7.75 (d, *J* = 9.1 Hz, 1H, H Ar), 7.56 (d, *J* = 7.1 Hz, 1H, H Ar), 7.36 (d, *J* = 7.1 Hz, 1H, H Ar), 7.26 (t, *J* = 7.1 Hz, 1H, H Ar), 7.22 (t, *J* = 7.1 Hz, 1H, H Ar), 6.31 (t, *J* = 3.3 Hz, 1H, H-4), 4.27-4.25 (m, 1H, H-9b), 4.18 (t, *J* = 8.7 Hz, 1H, H-3A), 3.76 (dd, *J* = 11.1, 8.7 Hz, 1H, H-3B), 3.22–3.17 (m, 2H, H-3a, H-10), 2.63 (dd, *J* = 7.6, *J* = 12.6 Hz, 1H, H-10a). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 175.6, 172.8, 140.0, 139.5, 139.2, 138.5, 132.6, 128.6, 127.1 (q, $J_{C,F}$ = 31.1 Hz), 125.7, 124.9, 124.6, 124.0, 123.2 (q, $J_{C,F}$ = 272.8 Hz), 122.4, 120.7, 118.1 (q, $J_{C,F}$ = 5.4 Hz), 50.9, 50.1, 48.4, 42.5, 35.6. IR (KBr, cm^{-1}): ν_{max} = 1723 (CO_2), 1677 (N-C=O). MS (ESI): *m/z* = 466 [M+H, Cl^{35}]$^+$, 468 [M+H, Cl^{37}]$^+$. Anal. Calcd for $C_{22}H_{15}ClF_3NO_3S$: C, 56.72; H, 3.25; N, 3.01; S, 6.88. Found: C, 56.71; H, 3.42; N, 2.86; S, 7.01.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Methoxy-3-(trifluoromethyl)phenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8j). Reflux for 4 hours. Yield: 202.8 mg (88%); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.96 (s, 1H, CO_2H), 7.99 (d, *J* = 2.5 Hz, 1H, H Ar), 7.73 (dd, *J* = 9.1, 2.5Hz, 1H, H Ar), 7.55 (d, *J* = 7.6 Hz, 1H, H Ar), 7.36 (dd, *J* = 9.1, 1.5 Hz, 1H, H-9), 7.30 (d, *J* = 9.1 Hz, 1H, H Ar), 7.26 (t, *J* = 7.6 Hz, 1H, H Ar), 7.21 (t, *J* = 7.6 Hz, 1H, H Ar), 6.30 (t, *J* = 3.3 Hz, 1H, H-4), 4.26-4.24 (m, 1H, H-9b), 4.08 (dd, *J* = 8.6, 7.6 Hz, 1H, H-3A), 3.88 (s, 3H, OCH_3), 3.72 (dd, *J* = 8.6,

10.6 Hz, 1H, H-3B), 3.21–3.16 (m, 2H, H-3a, H-10), 2.56 (dd, *J* = 7.6, 12.6 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 175.8, 172.0, 153.6, 140.1, 139.0, 138.6, 133.1, 128.7, 125.8, 125.0, 124.7, 124.1 (q, $J_{C,F}$ = 273.1 Hz), 122.4, 120.9, 118.4 (q, $J_{C,F}$ = 5.8 Hz), 117.1 (q, $J_{C,F}$ = 30.3 Hz), 113.9, 56.8, 51.1, 50.4, 48.4, 42.6, 36.2. IR (KBr, cm^{-1}): ν_{max} = 1724 (CO_2), 1657 (N-C=O). MS (ESI): *m/z* = 462 $[M+H]^+$. Anal. Calcd for $C_{23}H_{18}F_3NO_4S$: C, 59.86; H, 3.93; N, 3.04; S, 6.95. Found: C, 56.70; H, 3.99; N, 3.12; S, 7.02.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-3-Oxo-2-phenyl-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8l). Reflux for 4 hours. Yield: 132.5 mg (73%); colourless powder. M.p. 206-207 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.84 (s, 1H, CO_2H), 7.64-7.61 (m, 3H, H Ar), 7.39 (dd, *J* = 8.6, 7.1 Hz, 2H, H Ar), 7.29 (d, *J* = 7.6 Hz, 1H, H Ar), 7.24 (dt, *J* = 8.1, 1.0 Hz, 1H, H-4 Ar), 7.14–7.11 (m, 2H, H Ar), 6.89 (t, *J* = 3.5 Hz, 1H, H-10), 4.77–4.71 (m, 1H, H-4a), 4.14 (dd, *J* = 8.6, 7.6 Hz, 1H, H-1A), 3.80 (dd, *J* = 11.1, 8.1 Hz, 1H, H-1B), 3.15–3.10 (m, 2H, H-4, H-10a), 2.66 (dd, *J* = 13.1, 8.1 Hz, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 174.7, 171.6, 142.8, 142.4, 140.3, 135.1, 129.9, 129.2 (2C), 125.3, 124.3, 123.1, 122.9, 122.2, 119.6 (2C), 50.7, 50.1, 48.1, 43.4, 35.1. IR (KBr, cm^{-1}): ν_{max} = br. 1693 (N-C=O, CO_2). MS (ESI): *m/z* = 364 $[M+H]^+$. Anal. Calcd for $C_{21}H_{17}NO_3S$: C, 69.40; H, 4.71; N, 3.85; S, 8.82. Found: C, 69.71; H, 4.59; N, 3.50; S, 8.49.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(2-Methoxyphenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8m). Reflux for 4 hours. Yield: 98.3 mg (50%); colourless powder. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.79 (s, 1H, CO_2H), 7.59 (d, *J* = 7.6 Hz, 1H, H Ar), 7.30–7.22 (m, 4 H, H Ar), 7.11 (t, *J* = 8.6 Hz, 2H, H Ar), 6.97 (t, *J* = 7.6 Hz, 1H, H Ar), 6.85 (t, *J* = 3.0 Hz, 1H, H-10), 4.76-4.74 (m, 1H, H-4a), 3.89 (dd, *J* = 8.6, 7.6 Hz, 1H, H-1A), 3.80 (s, 3H, OCH_3), 3.69 (dd, *J* = 10.6, 9.1 Hz, 1H, H-1B), 3.20–3.15 (m, 1H, H-10a), 3.12 (dd, *J* = 8.1, 6.1 Hz, 1H, H-4), 2.53 (dd, *J* = 12.6, 8.6 Hz, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 174.6, 171.8, 154.9, 142.8, 142.5, 135.1, 129.8, 128.9, 128.7, 128.0, 125.3, 123.2, 122.9, 122.1, 120.9, 113.0, 56.2, 51.9, 50.9, 47.0, 43.5, 36.5. IR (KBr): ν_{max} = br. 1701 (N-C=O, CO_2) cm^{-1}. MS (ESI): *m/z* = 394 $[M+H]^+$.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Chlorophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8n). Reflux for 4 hours. Yield: 113.4 mg (57%); colourless powder. M.p. 230-232 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.86 (s, 1H, CO_2H), 7.68 (d, *J* = 8.7 Hz, 2H, H Ar), 7.64 (d, *J* = 7.6 Hz, 1H, H Ar), 7.45 (d, *J* = 8.7 Hz, 2H, H Ar), 7.31 (d, *J* = 7.6 Hz, 1H, H Ar), 7.24 (t, *J* = 7.6 Hz, 1H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 6.88 (br.s, 1H, H-10), 4.76 (br.s, 1H, H-4a), 4.14 (t, *J* = 8.8 Hz, 1H, H-1A), 3.79 (t, *J* = 8.8 Hz, 1H, H-1B), 3.17–3.10 (m, 2H, H-4, H-10a), 2.70 (dd, *J* = 12.6, 8.1 Hz, 1H, H-3a). ^{13}C NMR

(176.1 MHz, DMSO-d_6, 25 °C) δ 174.6, 171.8, 142.8, 142.3, 139.1, 135.0, 129.9, 129.0 (2C), 127.9, 125.2, 122.9 (2C), 121.9, 121.0 (2C), 50.6, 50.0, 47.9, 43.3, 34.9. IR (KBr, cm^{-1}): ν_{max} = 1726 (CO_2), 1654 (N-C=O). MS (ESI): *m/z* = 398 [M+H, Cl^{35}]$^+$, 400 [M+H, Cl^{37}]$^+$. Anal. Calcd for $C_{21}H_{16}ClNO_3S$: C, 63.39; H, 4.05; N, 3.52; S, 8.06. Found: C, 63.17; H, 3.84; N, 3.64; S, 8.23.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Bromophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8o). Reflux for 4 hours. Yield: 112.7 mg (51%); colourless powder. M.p. 214-215 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.61 (s, 1H, CO_2H), 7.72 (d, *J* = 8.8 Hz, 2H, H Ar), 7.61 (d, *J* = 7.6 Hz, 1H, H Ar), 7.49 (d, *J* = 8.8 Hz, 2H, H Ar), 7.29 (d, *J* = 7.6 Hz, 1H, H Ar), 7.24 (t, *J* = 7.6 Hz, 1H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 6.84 (t, *J* = 3.3 Hz, 1H, H-10), 4.78–4.77 (m, 1H, H-4a), 4.13 (t, *J* = 8.6 Hz, 1H, H-1A), 3.77 (dd, *J* = 11.0, 8.6 Hz, 1H, H-1b), 3.19–3.11 (m, 2H, H-4, H-10a), 2.68 (dd, *J* = 12.9, 7.9 Hz, 1H, H-3a). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 174.3, 171.6, 143.0, 142.3, 140.2, 137.8 (2C), 135.1, 129.8, 125.2, 122.8 (2C), 122.0, 121.9 (2C), 87.8, 50.9, 50.1, 48.1, 43.3, 34.9. IR (KBr, cm^{-1}): ν_{max} = br. 1704 (N-C=O, CO_2). MS (ESI): *m/z* = 442 [M+H, Br^{79}]$^+$, 444 [M+H, Br^{81}]$^+$. Anal. Calcd for $C_{21}H_{16}BrNO_3S$: C, 57.02; H, 3.65; N, 3.17; S, 7.25. Found: C, 56.87; H, 3.82; N, 3.33; S, 7.02.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Iodophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8p). Reflux for 4 hours. Yield: 117.4 mg (48%); colourless powder. M.p. 218–220 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.86 (s, 1H, CO_2H), 7.64–7.61 (m, 3H, H Ar), 7.58 (d, *J* = 9.1 Hz, 2H, H Ar), 7.31 (d, *J* = 7.6 Hz, 1H, H Ar), 7.24 (t, *J* = 7.6 Hz, 1H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 6.88 (t, *J* = 3.3 Hz, 1H, H-10), 4.77–4.75 (m, 1H, H-4a), 4.14 (t, *J* = 8.4 Hz, 1H, H-1A), 3.78 (dd, *J* = 8.4, 10.5 Hz, 1H, H-1B), 3.16–3.10 (m, 2H, H-4, H-10a), 2.71 (dd, *J* = 7.9, 12.9 Hz, 1H, H-3a). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 174.5, 171.8, 142.8, 142.3, 139.5, 135.0, 131.9 (2C), 129.9, 125.2, 122.9 (2C), 122.2, 121.4 (2C), 116.0, 50.6, 50.0, 47.9, 43.3, 34.9. IR (KBr, cm^{-1}): ν_{max} = br. 1713 (N-C=O, CO_2). MS (ESI): *m/z* = 490 [M+H]$^+$. Anal. Calcd for $C_{21}H_{16}INO_3S$: C, 51.55; H, 3.30; N, 2.86; S, 6.55. Found: C, 51.72; H, 3.49; N, 3.12; S, 6.72.

(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Methoxy-3-(trifluoromethyl)phenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8q). Reflux for 3.5 hours. Yield: 154.4 mg (67 %); colourless powder. M.p. 216-217 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.85 (s, 1H, CO_2H), 7.99 (d, *J* = 2.5 Hz, 1H, H Ar), 7.73 (dd, *J* = 8.6, 2.5 Hz, 1H, H Ar), 7.62 (d, *J* = 7.6 Hz, 1H, H-6), 7.31–7.29 (m, 2H, H Ar), 7.23 (t, *J* = 7.6 Hz, 1H, H Ar), 7.12 (t, *J* = 7.6 Hz, 1H, H Ar), 6.86 (t, *J* = 3.0 Hz, 1H, H-10), 4.76-4.74 (m, 1H, H-4a), 4.14 (dd, *J* = 8.6, 7.6 Hz, 1H, H-1A), 3.88 (s, 3H, OCH_3), 3.81 (dd, *J* = 10.6, 8.6 Hz, 1H, H-1B), 3.15–3.10 (m, 2H, H-

4, H-10a), 2.67 (dd, J = 13.1, 8.1Hz, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 174.6, 171.7, 153.7, 142.9, 142.4, 135.0, 133.1, 129.9, 125.3, 125.2, 124.1 (q, $J_{C,F}$ = 273.1 Hz), 122.9, 122.8, 122.2, 118.5 (q, $J_{C,F}$ = 5.8 Hz), 117.3 (d, $J_{C,F}$ = 30.3 Hz), 113.8, 56.9, 50.7, 50.3, 47.8, 43.4, 35.2. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -60.8. IR (KBr, cm^{-1}): ν_{max} = 1740 (CO_2), 1671 (N-C=O). MS (ESI): m/z = 462 $[M+H]^+$. Anal. Calcd for $C_{23}H_{18}F_3NO_4S$: C, 59.86; H, 3.93; N, 3.04; S, 6.95. Found: C, 59.60; H, 3.76; N, 3.27; S, 6.74.

General Procedure for the Synthesis of Products 8s-x and Characterization Data. To a solution of the corresponding amine **7b,e-h,m** (0.5 mmol) in dry benzene (5 mL) was added trifluoromethylmaleic anhydride (0.5 mmol). The reaction mixture was stirred for 24 hours. The colourless precipitates from the reaction were filtered off, washed with PhH (5 ml), Et_2O (2×5 ml), and air dried to give the title acids **8s-x** as solid powders.

(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(2-Iodophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8s). Yield: 89.3 mg (32 %); colourless powder. M.p. 231–233 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 14.19 (s, 1H, CO_2H), 7.95 (d, J = 7.6 Hz, 1H, H Ar), 7.48 (t, J = 7.6 Hz, 1H, H Ar), 7.40 (d, J = 7.6 Hz, 2H, H Ar), 7.30 (t, J = 7.6 Hz, 1H, H Ar), 7.20–7.14 (m, 3H, H Ar), 6.41 (t, J = 3.5, 1H, H-4), 4.94 (s, 1H, H-9b), 3.89–3.80 (m, 2H, H-3), 3.29–3.24 (m, 1H, H-3a), 2.67 (d, J = 11.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.5, 169.0, 141.9, 139.8 (2C), 138.3, 134.9, 130.5, 130.0, 129.3, 128.9, 127.0, 126.0 (q, $J_{C,F}$ = 283.2 Hz), 124.8, 122.8, 118.9, 99.5, 55.3, 54.7 (q, $J_{C,F}$ = 23.1 Hz), 51.5, 51.3, 39.6. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -63.8, -65.7. IR (KBr, cm^{-1}): ν_{max} = 1760 (CO_2), 1676 (N-C=O). MS (ESI): m/z = 558 $[M+H]^+$. Anal. Calcd for $C_{22}H_{15}F_3INO_3S$: C, 47.41; H, 2.71; N, 2.51; S, 5.75. Found: C, 47.60; H, 2.76; N, 2.26; S, 5.92.

(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8t). Yield: 184.4 mg (80 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C] δ 14.19 (s, 1H, CO_2H), 7.51 (d, J = 9.1 Hz, 2H, H Ar), 7.39 (d, J = 8.1 Hz, 1H, H Ar), 7.29 (t, J = 7.6 Hz, 1H, H Ar), 7.20–7.15 (m, 2H, H Ar), 6.95 (d, J = 9.1 Hz, 2H, H Ar), 6.40 (t, J = 3.5 Hz, 1H, H-4), 4.90 (s, 1H, H-9b), 4.03 (dd, J = 8.6, 7.6 Hz, 1H, H-3A), 3.94 (dd, J = 10.6, 8.6 Hz, 1H, H-3B), 3.75 (s, 3H, OMe), 3.09–3.03 (m, 1H, H-3a), 2.75 (d, J = 13.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ *there are no signal* CF_3 169.9, 168.9, 156.4, 139.8, 138.1, 134.9, 133.4, 129.3, 126.9, 124.8, 122.8, 121.6 (2C), 118.0, 114.4 (2C), 55.8, 55.4, 55.0 (q, $J_{C,F}$ = 23.1 Hz), 51.9, 49.7, 38.8. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -63.9, -65.6. IR (KBr, cm^{-1}): ν_{max} = 1758 (CO_2), 1665 (N-C=O). MS (ESI): m/z = 462 $[M+H]^+$. Anal. Calcd for $C_{23}H_{18}F_3NO_4S$: C, 59.86; H, 3.93; N, 3.04; S, 6.95. Found: C, 59.92; H, 3.99; N, 2.83; S, 7.17.

(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8u). Yield: 143.7 mg (64 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 14.21 (s, 1H, CO_2H), 7.64 (dd, J = 9.1, 5.0 Hz, 2H, H Ar), 7.40–7.16 (m, 6H, H Ar), 6.41 (t, J = 3.3 Hz, 1H, H-4), 4.91 (s, 1H, H-9b), 4.09 (dd, J = 8.6, 7.6 Hz, 1H, H-3A), 3.94 (dd, J = 10.6, 8.6 Hz, 1H, H-3B), 3.10–3.04 (m, 1H, H-3a), 2.80 (d, J = 12.6 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.9, 169.3, 159.0 (d, $J_{C,F}$ = 239.9 Hz), 139.8, 138.2, 136.6, 134.9, 129.3, 126.9, 126.0 (q, $J_{C,F}$ = 280.3 Hz), 124.8, 122.8, 121.8 (d, $J_{C,F}$ = 7.2 Hz, 2C), 118.9, 115.9 (d, $J_{C,F}$ = 23.1 Hz, 2C), 55.4, 55.0 (q, $J_{C,F}$ = 23.1 Hz), 51.9, 49.6, 38.6. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -118.3, -65.6. IR (KBr, cm^{-1}): ν_{max} = 1665 (N-C=O), 1753 (CO_2). MS (ESI): *m/z* = 450 $[M+H]^+$. Anal. Calcd for $C_{22}H_{15}F_4NO_3S$: C, 58.79; H, 3.36; N, 3.12; S, 7.13. Found: C, 58.79; H, 3.30; N, 3.11; S, 7.18.

(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Chlorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8v). Yield: 179.0 mg (77 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 14.23 (s, 1H, CO_2H), 7.66 (d, J = 9.1 Hz, 2H, H Ar), 7.46 (d, J = 9.1 Hz, 2H, H Ar), 7.40 (d, J = 8.1 Hz, 1H, H Ar), 7.66 (t, J = 8.1 Hz, 1H, H Ar), 7.20–7.16 (m, 2H, H Ar), 6.41 (t, J = 3.5 Hz, 1H, H-4), 4.91 (s, 1H, H-9b), 4.11 (dd, J = 8.9, 7.6 Hz, 1H, H-3A), 3.93 (dd, J = 11.1, 8.9 Hz, 1H, H-3B), 3.10–3.04 (m, 1H, H-3a), 2.84 (d, J = 13.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.9, 169.6, 139.8, 139.1, 138.2, 134.9, 129.3, 129.1 (2C), 128.3, 127.0, 126.0 (q, $J_{C,F}$ = 283.2 Hz), 124.8, 122.8, 121.3 (2C), 118.9, 55.4, 55.0 (q, $J_{C,F}$ = 23.1 Hz), 52.0, 49.3, 38.4. ^{19}F NMR (658.8 MHz, DMSO-d_6, 25 °C) δ -65.7, -67.2. IR (KBr, cm^{-1}): ν_{max} = 1754 (CO_2), 1679 (N-C=O). MS (ESI): *m/z* = 466 $[M+H, Cl^{35}]^+$, 468 $[M+H, Cl^{37}]^+$. Anal. Calcd for $C_{22}H_{15}ClF_3NO_3S$: C, 56.72; H, 3.25; N, 3.01; S, 6.88. Found: C, 56.79; H, 3.31; N, 2.97; S, 6.90.

(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8w). Yield: 213.8 mg (84 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 14.24 (s, 1H, CO_2H), 7.60 (d, J = 9.1 Hz, 2H, H Ar), 7.57 (d, J = 9.1 Hz, 2H, H Ar), 7.39 (d, J = 7.6 Hz, 1H, H Ar), 7.29 (t, J = 7.6 Hz, 1H, H Ar), 7.20–7.15 (m, 2H, H Ar), 6.40 (t, J = 3.5 Hz, 1H, H-4), 4.90 (br.s, 1H, H-9b), 4.10 (dd, J = 8.1, 7.6 Hz, 1H, H-3A), 3.92 (dd, J = 10.6, 9.1 Hz, 1H, H-3B), 3.09–3.03 (m, 1H, H-3a), 2.83 (d, J = 13.1 Hz, 1H, H-10a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.9, 169.6, 139.8, 139.4, 138.2, 134.9, 132.0 (2C), 129.3, 126.9, 126.0 (q, $J_{C,F}$ = 283.2 Hz), 124.8, 122.8, 121.6 (2C), 118.9, 116.4, 55.4, 55.0 (q, $J_{C,F}$ = 23.1 Hz), 52.0, 49.2, 38.4. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -65.6. IR (KBr, cm^{-1}): ν_{max} = 1754 (CO_2), 1677 (N-C=O).

MS (ESI): *m/z* = 510 [M+H, Br^{79}]$^+$, 512 [M+H, Br^{81}]$^+$. Anal. Calcd for $C_{22}H_{15}BrF_3NO_3S$: C, 51.78; H, 2.96; N, 2.74; S, 6.28. Found: C, 51.84; H, 3.01; N, 2.70; S, 6.31.

(3a*RS*,4*SR*,4a*RS*,10a*SR*)-2-Phenyl-3-oxo-4-(trifluoromethyl)-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8x). Yield: 92.7 mg (43 %); colourless powder. M.p. 208-209 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 14.10 (s, 1H, CO_2H), 7.70 (d, *J* = 8.1 Hz, 1H, H Ar), 7.63 (d, *J* = 8.1 Hz, 2H, H Ar), 7.41–7.34 (m, 3H, H Ar), 7.25 (t, *J* = 7.6 Hz, 1H, H Ar), 7.17–7.12 (m, 2H, H Ar), 7.06 (t, *J* = 3.5, 1H, H-10), 5.17 (s, 1H, H-4a), 4.16 (dd, *J* = 8.1, 7.6 Hz, 1H, H-1A), 4.01 (dd, *J* = 10.1, 8.6 Hz, 1H, H-1B), 3.15–3.10 (m, 1H, H-10a), 2.86 (d, *J* = 13.1 Hz, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.2 (2C), 143.0 (2C), 140.1, 133.7, 129.9, 129.3 (2C), 125.9 (q, $J_{C,F}$ = 283.2 Hz), 125.1, 124.6, 122.7, 122.4, 121.4, 119.8 (2C), 55.1 (q, $J_{C,F}$ = 23.1 Hz), 52.9, 50.9, 49.2, 37.0. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -63.8, -65.3. IR (KBr, cm^{-1}): ν_{max} = 1758 (CO_2), 1681 (N-C=O). MS (ESI): *m/z* = 432 [M+H]$^+$.

General Procedure for the Synthesis of Products 16a-g and Characterization Data. To a suspension of benzothienoisoindolecarboxylic acid **8d,e,g,h,l,t,u,** (0.25 mmol) in 10 mL DCE was added an equimolar volume of HCl in dioxane (5.0 mol/l; 0.25 mmol, 0.0045 ml) and stirred for 2 h. The resulting precipitate was filtered off, washed with PhH (5 ml), Et_2O (2×5 ml), and air dried to give the title acids **16b-h** as colorful solid powders.

(3a*SR*,10*RS*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16b). Yield: 97.3 mg (99 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.76 (s, 1H, CO_2H), 8.03 (d, *J* = 8.1 Hz, 1H, H Ar), 7.91 (d, *J* = 8.1 Hz, 1H, H Ar), 7.59 (d, *J* = 9.1 Hz, 2H, H Ar), 7.41 (t, *J* = 7.6 Hz, 1H, H Ar), 7.34 (t, *J* = 7.6 Hz, 1H, H Ar), 6.97 (d, *J* = 9.1 Hz, 2H, H Ar), 4.27 (d, *J* = 4.8 Hz, 1H, H-10), 3.99 (dd, *J* = 8.1, 7.6 Hz, 1H, H-3A), 3.75 (m, 3H, CH_3), 3.71 (t, *J* = 9.6 Hz, 1H, H-3B), 3.42–3.38 (m, 1H, H-3a), 3.21 (dd, *J* = 16.1, 4.8 Hz, 1H, H-10a), 2.97 (dd, *J* = 13.1, 5.6 Hz, 1H, H-4A), 2.90 (dd, *J* = 15.6, 11.6 Hz, 1H, H-4B). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 172.7, 172.3, 156.1, 139.7, 138.8, 138.5, 133.6, 126.7, 124.8, 124.7, 122.9, 122.7, 121.2 (2C), 114.4 (2C), 55.7, 52.2, 47.8, 45.6, 32.8, 29.2. IR (KBr, cm^{-1}): ν_{max} = 1721 (CO_2), 1644 (N-C=O). MS (ESI): *m/z* = 394 [M+H]$^+$. Anal. Calcd for $C_{22}H_{19}NO_4S$: C, 67.16; H, 4.87; N, 3.56; S, 8.15. Found: C, 67.07; H, 4.93; N, 3.41; S, 8.10.

(3a*SR*,10*RS*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16c). Yield: 85.7 mg (90 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.82 (s, 1H, CO_2H), 8.04 (d, *J* = 8.1 Hz, 1H, H Ar), 7.91 (d, *J* = 8.1 Hz, 1H, H Ar), 7.71 (dd, *J* = 9.1, 4.5 Hz, 2H, H Ar), 7.41 (t, *J*

= 8.1 Hz, 1H, H Ar), 7.34 (t, *J* = 8.1 Hz, 1H, H Ar), 7.24 (t, *J* = 9.1, 2H, H Ar), 4.29 (d, *J* = 4.9, 1.5 Hz, 1H, H-10), 4.04 (dd, *J* = 8.6, 7.1 Hz, 1H, H-3A), 3.74 (dd, *J* = 10.6, 9.1 Hz, 1H, H-3B), 3.42–3.37 (m, 1H, H-3a), 3.23 (dd, *J* = 16.1, 4.9 Hz, 1H, H-10a), 2.98 (dd, *J* = 13.1, 5.0 Hz, 1H, H-4A), 2.91 (dd, *J* = 16.1, 12.1 Hz, 1H, H-4B). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 172.7 (2C), 158.8 (d, $J_{C,F}$ = 241.3 Hz), 139.7, 138.8, 138.5, 136.7 (d, $J_{C,F}$ = 2.9 Hz), 126.7, 124.8, 124.7, 122.9, 122.8, 121.3 (d, $J_{C,F}$ = 7.2 Hz, 2C), 115.9 (d, $J_{C,F}$ = 23.1 Hz, 2C), 52.2, 47.8, 39.6, 32.7, 29.2. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -118.7. IR (KBr, cm^{-1}): ν_{max} = br. 1703 (N-C=O, CO_2). MS (ESI): *m/z* = 382 $[M+H]^+$. Anal. Calcd for $C_{21}H_{16}FNO_3S$: C, 66.13; H, 4.23; N, 3.67; S, 8.41. Found: C, 66.11; H, 4.20; N, 3.66; S, 8.37.

(3a*SR*,10*RS*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16d). Yield: 77.4 mg (70 %); colourless powder. M.p. >250 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.84 (s, 1H, CO_2H), 8.05 (d, *J* = 7.9 Hz, 1H, H Ar), 7.92 (d, *J* = 7.9 Hz, 1H, H Ar), 7.69 (d, *J* = 8.8 Hz, 2H, H Ar), 7.59 (d, *J* = 8.8 Hz, 2H, H Ar), 7.41 (t, *J* = 7.6 Hz, 1H, H Ar), 7.34 (t, *J* = 7.6 Hz, 1H, H Ar), 4.30 (d, *J* = 4.9 Hz, 1H, H-10), 4.06 (t, *J* = 7.9 Hz, 1H, H-3A), 3.72 (t, *J* = 9.8 Hz, 1H, H-3B), 3.41–3.38 (m, 1H, H-3a), 3.24 (dd, *J* = 16.0, 4.9 Hz, 1H, H-10a), 3.01 (dd, *J* = 13.3, 5.3 Hz, 1H, H-4A), 2.92 (dd, *J* = 15.7, 11.7 Hz, 1H, H-4B). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.0, 172.6, 139.6, 139.5, 138.7, 138.4, 132.0 (2C), 126.6, 124.7 (2C), 122.9, 122.7, 121.3 (2C), 116.0, 51.8, 47.8, 39.6, 32.5, 29.1. IR (KBr, cm^{-1}): ν_{max} = br. 1704 (N-C=O, CO_2). MS (ESI): *m/z* = 442 $[M+H, Br^{79}]^+$, 444 $[M+H, Br^{81}]^+$. Anal. Calcd for $C_{21}H_{16}BrNO_3S$: C, 57.02; H, 3.65; N, 3.17; S, 7.25. Found: C, 56.87; H, 3.57; N, 3.04; S, 7.36.

(3a*SR*,10*RS*,10a*RS*)-2-(4-Iodophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16e). Yield: 105.1 mg (86 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.83 (s, 1H, CO_2H), 8.03 (d, *J* = 8.1 Hz, 1H, H Ar), 7.91 (d, *J* = 7.6 Hz, 1H, H Ar), 7.73 (d, *J* = 8.6 Hz, 2H, H Ar), 7.54 (d, *J* = 8.6 Hz, 2H, H Ar), 7.41 (t, *J* = 7.6 Hz, 1H, H Ar), 7.33 (t, *J* = 7.6, 1H, H Ar), 4.28 (d, *J* = 4.5 Hz, 1H, H-10), 4.04 (t, *J* = 8.1 Hz, 1H, H-3A), 3.71 (dd, *J* = 10.1, 9.1 Hz, 1H, H-3B), 3.40–3.37 (m, 1H, H-3a), 3.22 (dd, *J* = 16.1, 4.5 Hz, 1H, H-10a), 2.99 (dd, *J* = 13.1, 5.6 Hz, 1H, H-4A), 2.91 (dd, *J* = 15.6, 11.6 Hz, 1H, H-4B). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.0, 172.6, 140.0, 139.7, 138.8, 138.5, 137.9 (2C), 126.6, 124.8 (2C), 122.9, 122.8, 121.6 (2C), 88.1, 51.8, 47.9, 39.7, 32.5, 29.2. IR (KBr, cm^{-1}): ν_{max} = 1719 (CO_2), 1703 (N-C=O). MS (ESI): *m/z* = 490 $[M+H]^+$. Anal. Calcd for $C_{21}H_{16}INO_3S$: C, 51.55; H, 3.30; N, 2.86; S, 6.55. Found: C, 51.49; H, 3.11; N, 3.03; S, 6.67.

(3a*RS*,4*SR*,10a*SR*)-3-Oxo-2-phenyl-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-4-carboxylic acid (16f). Yield: 75.3 mg (83 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.99 (s, 1H, CO_2H), 7.94 (d, J = 8.1 Hz, 1H, H Ar), 7.75 (d, J = 7.6 Hz, 1H, H Ar), 7.70 (d, J = 8.1 Hz, 2H, H Ar), 7.43-7.36 (m, 4H, H Ar), 7.14 (t, J = 7.6 Hz, 1H, H Ar), 4.20 (d, J = 4.5 Hz, 1H, H-4), 4.09 (dd, J = 8.1, 7.6 Hz, 1H, H-1A), 3.78 (dd, J = 9.6, 9.1 Hz, 1H, H-1B), 3.23 (dd, J = 15.6, 4.5 Hz, 1H, H-3a), 3.20-3.14 (m, 1H, H-10a), 3.03 (dd, J = 13.1, 5.6 Hz, 1H, H-10A), 2.70 (dd, J = 14.1, 11.6 Hz, 1H, H-10B). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 172.7, 172.0, 140.3, 139.1, 138.6, 133.8, 132.1, 129.3 (2C), 125.4, 124.9, 124.3, 123.1, 121.9, 119.5 (2C), 52.1, 48.4, 41.2, 32.0, 27.5. IR (KBr, cm^{-1}): ν_{max} = 1730 (CO_2), 1657 (N-C=O). MS (ESI): m/z = 364 $[M+H]^+$. Anal. Calcd for $C_{21}H_{17}NO_3S$: C, 69.40; H, 4.71; N, 3.85; S, 8.82. Found: C, 69.49; H, 4.76; N, 3.83; S, 8.92.

(3a*SR*,10*SR*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-10-carboxylic acid (16g). Yield: 92.2 mg (80 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 13.85 (s, 1H, CO_2H), 7.97 (d, J = 7.6 Hz, 1H, H Ar), 7.91 (d, J = 8.1 Hz, 1H, H Ar), 7.55 (d, J = 9.1 Hz, 2H, H Ar), 7.41-7.34 (m, 2H, H Ar), 6.96 (d, J = 9.1 Hz, 2H, H Ar), 3.91-3.83 (m, 2H, H-3), 3.75 (s, 3H, CH_3), 3.44 (d, J = 13.1 Hz, 1H, H-10a), 3.22 (dd, J = 15.1, 3.0 Hz, 1H, H-4A), 3.02 (dd, J = 15.6, 12.1 Hz, 1H, H-4B), 2.93-2.86 (m, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 169.9, 168.2, 156.3, 144.7, 138.2, 137.5, 133.4, 125.0, 124.7, 124.3 (q, $J_{C,F}$ = 283.2 Hz), 123.2 (2C), 122.8, 121.3 (2C), 114.4 (2C), 55.8, 54.7 (q, $J_{C,F}$ = 23.1 Hz), 50.4, 49.5, 36.8, 29.1. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ –67.1. IR (KBr, cm^{-1}): ν_{max} = 1753 (CO_2), 1658 (N-C=O). MS (ESI): m/z = 462 $[M+H]^+$. Anal. Calcd for $C_{23}H_{18}F_3NO_4S$: C, 59.86; H, 3.93; N, 3.04; S, 6.95. Found: C, 59.68; H, 4.07; N, 2.89; S, 7.04.

(3a*SR*,10*SR*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-10-carboxylic acid (16h). Yield: 78.6 mg (70 %); colourless powder. M.p. >250 °C; ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 13.90 (s, 1H, CO_2H), 7.97 (d, J = 7.6 Hz, 1H, H Ar), 7.93 (d, J = 8.1 Hz, 1H, H Ar), 7.68 (dd, J = 9.1, 5.0 Hz, 2H, H Ar), 7.41-7.34 (m, 2H, H Ar), 7.24 (t, J = 9.1 Hz, 2H, H Ar), 3.94 (dd, J = 8.6, 7.1 Hz, 1H, H-3A), 3.87 (dd, J = 10.6, 8.6 Hz, 1H, H-3B), 3.49 (d, J = 13.6 Hz, 1H, H-10a), 3.25 (dd, J = 15.6, 3.5 Hz, 1H, H-4A), 3.02 (dd, J = 15.6, 12.1 Hz, 1H, H-4B), 2.94-2.88 (m, 1H, H-3a). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ *there are no signal CF_3* 178.3, 170.3, 168.2, 159.0 (d, $J_{C,F}$ = 241.3 Hz), 144.6, 138.2, 137.5, 136.6 (d, $J_{C,F}$ = 2.9 Hz), 125.0, 124.8, 123.2, 122.7, 121.5 (d, $J_{C,F}$ = 7.2 Hz, 2C), 115.9 (d, $J_{C,F}$ = 23.1 Hz, 2C), 54.8, 50.4, 49.5, 36.6, 29.1. ^{19}F NMR (564.7 MHz, DMSO-d_6, 25 °C) δ -118.4, -67.1. IR (KBr, cm^{-1}): ν_{max} = 1754 (CO_2), 1666 (N-C=O). MS (ESI):

m/z = 450 $[M+H]^+$. Anal. Calcd for $C_{22}H_{15}F_4NO_3S$: C, 58.79; H, 3.36; N, 3.12; S, 7.13. Found: C, 59.03; H, 3.49; N, 3.37; S, 7.01.

(3a*RS*,9b*RS*,10*RS*,10a*RS*)-9b-Methyl-1-oxo-2-phenyl-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (17). Maleic anhydride (0.091 g, 0.93 mmol) was added to a solution of the allylamine **7t** [10] (0.26 g, 0.93 mmol) in dry 1,4-dioxane (10 mL). The mixture was heated at reflux (ca. 100 °C) for 8 h. The reaction mixture was cooled to r.t., concentrated, diluted with Et_2O (5 mL) and the obtained solid was filtered, washed with Et_2O (3 × 3 mL), and air dried. Yield: 52.6 mg (15%); colourless powder. M.p. 247-248 °C; ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 13.03 (s, 1H, CO_2H), 7.61 (d, *J* = 8.6 Hz, 2H, H Ar), 7.71-7.70 (m, 1H, H Ar), 7.38–7.33 (m, 3H, H Ar), 7.25-7.23 (m, 2H, H Ar), 7.12 (t, *J* = 7.6 Hz, 1H, H Ar), 6.27 (d, *J* = 2.6 Hz, 1H, H-4), 4.07 (dd, *J* = 8.6, 7.9 Hz, 1H, H-3A), 3.67 (dd, *J* = 11.0, 8.8 Hz, 1H, H-3B), 3.47 (d, *J* = 7.6 Hz, 1H, H-10), 3.41–3.36 (m, 1H, H-3a), 2.52 (dd, *J* = 12.6, 7.6 Hz, 1H, H-10a), 1.34 (s, 3H, CH_3). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.9, 172.4, 147.4, 145.6, 140.3, 136.4, 129.1 (2C), 128.5, 126.1, 124.1, 123.7, 122.4, 121.9, 119.4 (2C), 52.2, 50.5, 50.2, 46.2, 33.8, 28.0. IR (KBr, cm^{-1}): ν_{max} = br. 1697 (N-C=O, CO_2). MS (ESI): *m/z* = 378 $[M+H]^+$. Anal. Calcd for $C_{22}H_{19}NO_3S$: C, 70.00; H, 5.07; N, 3.71; S, 8.50. Found: C, 69.89; H, 4.82; N, 3.96; S, 8.37.

(*E*)-3-(Thieno[3,2-*b*]thiophen-2-yl)acrylaldehyde (18). *See synthesis of **13***. Eluent: EtOAc/heptane (1:50). Yield: 358.5 mg (84 %); orange oil. R_f 0.35 (EtOAc/hexane, 1:6). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 9.66 (d, *J* = 7.4 Hz, 1H, CHO), 7.63 (d, *J* = 15.5 Hz, 1H, H-3), 7.55 (d, *J* = 5.3 Hz, 1H, H-5 Thien), 7.52 (s, 1H, H-3 Thien), 7.28 (d, *J* = 5.3 Hz, 1H, H-6 Thien), 6.52 (dd, *J* = 15.5, 7.6 Hz, 1H, H-2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 192.6, 145.1, 142.4, 141.2, 139.8, 131.2, 127.0, 124.6, 119.8. IR (KBr, cm^{-1}): ν_{max} = 1658 (C=O), 1603 (C=C). MS (ESI): *m/z* = 195 $[M+H]^+$.

(*E*)-*N*-(3-(Thieno[3,2-*b*]thiophen-2-yl)allyl)aniline (19). *See synthesis of 7*. Yield: 96.7 mg (51 %); light yellow oil. ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 7.35 (d, *J* = 5.3 Hz, 1H, H-5 Thien), 7.23–7.17 (m, 3H, H Ar), 7.08 (s, 1H, H-3 Thien), 6.80–6.68 (m, 5H, H Ar), 6.21 (dt, *J* = 5.7, 15.5 Hz, 1H, H-2), 3.95 (dd, *J* = 5.7, 1.4 Hz, 1H, H-1), 3.85 (s, 1H, NH). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 147.9, 144.2, 139.2, 137.8, 129.3 (2C), 127.3, 127.0, 125.4, 119.6, 118.0, 117.8, 113.1 (2C), 45.9. IR (KBr, cm^{-1}): ν_{max} = 3414 (NH), 1599 (C=C). GC-MS (EI): m/*z* (%) = 271 (34) $[M]^+$, 268 (12), 179 (100), 153 (10), 135 (24), 77 (9).

(5a*RS*,8a*RS*,9*RS*,9a*SR*)-8-Oxo-7-phenyl-5a,7,8,8a,9,9a-hexahydro-6*H*-thieno[2',3':4,5]thieno[2,3-*f*]isoindole-9-carboxylic acid (20). *See synthesis of **8***. Reflux for 4 hours. Yield: 107.0 mg (58 %); orange powder. M.p. 234–237 °C. ^{1}H NMR (700.2 MHz, DMSO-

d_6 , 25 °C) δ 12.89 (br.s, 1H, CO_2H), 7.64–7.61 (м, 3H, H Ar), 7.37 (t, J = 7.6 Hz, 2H, H Ar), 7.12 (t, J = 7.6 Hz, 1H, H Ar), 7.02 (d, J = 5.0 Hz, 1H, H-3), 6.41 (t, J = 3.8 Hz, 1H, H-5), 4.25–4.23 (m, 1H, H-9a), 4.08 (dd, J = 8.3, 7.6 Hz, 1H, H-6A), 3.75 (dd, J = 10.7, 9.1 Hz, 1H, H-6B), 3.04–2.99 (m, 1H, H-5a), 2.96 (dd, J = 8.6, 7.2 Hz, 1H, H-9), 2.57 (dd, J = 12.6, 8.6 Hz, 1H, H-8a). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 175.1, 171.7, 143.9, 140.2, 134.4, 134.2, 130.9, 129.1 (2C), 124.2, 123.1, 121.1, 119.5 (2C), 50.0, 49.1, 48.6, 43.2, 36.5. IR (KBr, cm^{-1}): ν_{max} = 1742 (CO_2), 1659 (N-C=O). MS (ESI): m/z = 370 $[M+H]^+$.

General Procedure for the Synthesis of 2-Bromocycloalk-1-ene-1-carbaldehydes 21a-d. A solution of DMF (3.87 mL, 50 mmol) in anhydrous $CHCl_3$ (15 ml) was placed in a 100 ml three-necked flask. The resulting reaction mixture was stirred while cooling to 0°C in an ice bath. Then PBr_3 (1.9 mL, 20 mmol) were added dropwise over 10 minutes. The resulting white suspension was warmed to room temperature and stirred for 30 minutes. A solution of the carbonyl compound (10 mmol) dissolved in $CHCl_3$ (15 mL) was added dropwise and the resulting reaction mixture was stirred for 12 hours at room temperature. Then the reaction mixture was poured into ice water (50 mL) and neutralized with $NaHCO_3$. The mixture was extracted with DCM (3 × 15 mL). The organic layer was further dried over *anhyd*. Na_2SO_4. The solvent was distilled off under reduced pressure to constant weight. Compounds **21a-d** were used in the next step without further purification. **2-Bromocyclopent-1-ene-1-carbaldehyde (21a)**. Yield: 1.70 g (97 %); yellow oil. **2-Bromocyclohex-1-ene-1-carbaldehyde (21b)**. Yield: 1.78 g (94 %); yellow oil. **2-Bromocyclohept-1-ene-1-carbaldehyde (21c)**: Yield: 0.73 g (36 %); yellow oil. **2-Bromocyclooct-1-ene-1-carbaldehyde (21d):** Yield: 0.82 g (38 %); yellow oil.

General Procedure for the Synthesis of 2-Thiophenecarboxaldehydes 22a-d and Characterization Data. Triethylamine (1.50 mL, 10.8 mmol) and 2,5-dithiandiol (0.27 g, 1.8 mmol) were added to a bromaldehyde **21a-d** (3.6 mmol) in 10 ml of EtOAc and boiled for 4-6 hours (TLC control). The solvent was distilled off under reduced pressure. The residual yellow oil was purified by column chromatography (SiO_2: 20×1.0 cm).

5,6-Dihydro-4*H*-cyclopenta[*b*]thiophene-2-carbaldehyde (22a). Eluent: EtOAc/heptane (1:50). Yield: 180.6 mg (33 %); yellow oil. R_f 0.52 (EtOAc/hexane, 1:8). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.77 (s, 1H, CHO), 7.49 (s, 1H, H-3), 2.97 (t, J = 7.1 Hz, 2H, CH_2), 2.79 (t, J = 7.1 Hz, 2H, CH_2), 2.50 (pent, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 182.9, 155.0, 148.0, 147.0, 132.1, 29.8, 29.3, 27.9. IR (KBr, cm^{-1}): ν_{max} = 1666 (CO). GC-MS (EI, 70 eV): m/z (%) = 152 (78) $[M]^+$, 151 (80), 123 (100), 79 (18), 45 (14), 39 (14).

4,5,6,7-Tetrahydrobenzo[*b*]thiophene-2-carbaldehyde (22b). Eluent: EtOAc/heptane (1:50). Yield: 107.6 mg (18 %); yellow oil. R_f 0.59 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$,

25 °C) δ 9.77 (s, 1H, CHO), 7.41 (s, 1H, H-3), 2.82 (t, *J* = 5.6 Hz, 2H, CH_2), 2.64 (t, *J* = 5.6 Hz, 2H, CH_2), 1.87–1.78 (m, 4 H, $(CH_2)_2$). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 182.9, 148.1, 140.2, 137.7, 137.2, 26.0, 25.4, 23.1, 22.6. IR (KBr, cm^{-1}): ν_{max} = 1665 (CO). GC-MS (EI): *m/z* (%) = 166 $(M]^+$ (100), 138 (54), 109 (10), 45 (9), 39 (10).

5,6,7,8-Tetrahydro-4*H*-cyclohepta[b]thiophene-2-carbaldehyde (22c). Eluent: heptane. Yield: 362.9 mg (56 %); yellow oil. R_f 0.51 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.70 (s, 1H, CHO), 7.41 (s, 1H, H-3), 2.87–2.85 (m, 2H, CH_2), 2.72–2.71 (m, 2H, CH_2), 1.88–1.85 (m, 2H, CH_2), 1.71–1.61 (m, 4H, $(CH_2)_2$). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 182.6, 152.8, 143.0, 139.5, 138.3, 32.3, 31.1, 30.7, 27.9, 27.7. IR (KBr, cm^{-1}): 1665 (CO). MS (ESI): *m/z* = 181 $[M+H]^+$.

4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophene-2-carbaldehyde (22d). Eluent: EtOAc/heptane (1:50). Yield: 370.1 mg (53 %); yellow oil. R_f 0.60 (EtOAc/hexane, 1:20). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.77 (s, 1H, CHO), 7.46 (s, 1H, H-3), 2.90 (t, *J* = 6.2 Hz, 2H, CH_2), 2.70 (t, *J* = 6.2 Hz, 2H, CH_2), 1.73–1.63 (m, 4H, $(CH_2)_2$), 1.44–1.37 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 182.6, 151.4, 140.9, 139.6, 138.5, 31.9, 31.0, 27.7, 27.0, 25.7, 25.4. IR (KBr, cm^{-1}): ν_{max} = 1665 (CO). GCMS (EI): *m/z* (%) = 194 $[M]^+$ (100), 165 (58), 151 (34), 138 (59), 125 (20), 97 (10), 45 (8).

General Procedure for the Preparation of Thienylacroleins 23a-d and Characterization Data. *See synthesis of **13***. Thienylacroleins **23a-d** were purified by column chromatography (SiO_2, 20 × 1.5 cm).

(*E*)-3-(5,6-Dihydro-4H-cyclopenta[*b*]thiophen-2-yl)acrylaldehyde (23a). Eluent: EtOAc/heptane (1:50). Yield: 78.3 mg (20 %); yellow oil. R_f 0.42 (EtOAc/hexane, 1:8). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.58 (d, *J* = 7.7 Hz, 1H, CHO), 7.48 (d, *J* = 15.5 Hz, 1H, H-3), 7.09 (s, 1H, H-3 Thien), 6.42 (dd, *J* = 15.5, 7.7 Hz, 1H, H-2), 2.94 (t, *J* = 7.2 Hz, 2H, CH_2), 2.76 (t, *J* = 7.2 Hz, 2H, CH_2), 2.47 (pent, *J* = 7.2 Hz, 2H, CH_2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 193.0 ,149.8, 148.2, 145.8, 142.2, 127.8, 125.1, 29.6, 29.1, 28.0. IR (KBr, cm^{-1}): ν_{max} = 1666 (C=O), 1608 (C=C). MS (ESI): *m/z* = 179 $[M+H]^+$.

(*E*)-3-(4,5,6,7-Tetrahydrobenzo[*b*]thiophen-2-yl)acrylaldehyde (23b). Eluent: heptane. Yield: 76.0 mg (12 %); brown oil. R_f 0.56 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.59 (d, *J* = 7.7 Hz, 1H, CHO), 7.47 (d, *J* = 15.4 Hz, 1H, H-3), 7.03 (s, 1H, H-3 Thien), 6.39 (dd, *J* = 15.4, 7.7 Hz, 1H, H-2), 2.80 (t, *J* = 5.9 Hz, 2H, CH_2), 2.62 (t, *J* = 5.9 Hz, 2H, CH_2), 1.90–1.79 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 192.9, 145.1, 142.8, 137.3, 135.7, 133.4, 126.0, 25.6, 25.3, 23.2, 22.6. IR (KBr, cm^{-1}): ν_{max} = 1666 (C=O), 1607 (C=C). MS (ESI): *m/z* = 193 $[M+H]^+$.

(*E*)-3-(5,6,7,8-Tetrahydro-4*H*-cyclohepta[*b*]thiophen-2-yl)acrylaldehyde (23c). Eluent: EtOAc/heptane (1:50). Yield: 104.2 mg (23 %); yellow oil. R_f 0.51 (EtOAc/hexane, 1:4). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.55 (d, *J* = 7.6 Hz, 1H, CHO), 7.41 (d, *J* = 15.4 Hz, 1H, H-3), 7.02 (s, 1H, H-3 Thien), 6.36 (dd, *J* = 15.4, 7.6 Hz, 1H, H-2), 2.83–2.81 (m, 2H, CH_2), 2.69–2.67 (m, 2H, CH_2), 1.87–1.84 (m, 2H, CH_2), 1.71–1.60 (m, 4H, $(CH_2)_2$). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 193.1, 147.3, 145.2, 143.0, 135.9, 133.7, 125.7, 32.3, 30.6 (2C), 28.1, 27.7. IR (KBr, cm^{-1}): ν_{max} = 1667 (C=O), 1609 (C=C). GC-MS (EI): *m/z* (%) = 206 $[M]^+$ (100), 177 (38), 165 (12), 163 (36), 149 (12), 145 (13), 135 (11), 123 (8), 45 (7).

(*E*)-3-(4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophen-2-yl)acrylaldehyde (23d). Eluent: EtOAc/heptane (1:50). Yield: 82.3 mg (17 %); yellow oil. R_f 0.42 (EtOAc/hexane, 1:10). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.58 (d, *J* = 7.9 Hz, 1H, CHO), 7.47 (d, *J* = 15.5 Hz, 1H, H-3), 7.05 (s, 1H, H-3 Thien), 6.39 (dd, *J* = 15.5, 7.9 Hz, 1H, H-2), 2.87 (t, *J* = 6.2 Hz, 2H, CH_2), 2.66 (t, *J* = 6.2 Hz, 2H, CH_2), 1.72–1.62 (m, 4H, $(CH_2)_2$), 1.45–1.39 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 192.0, 145.0, 144.2, 139.8, 134.0, 133.6, 124.7, 30.9, 29.9, 26.3, 25.9, 24.7, 24.5. IR (KBr, cm^{-1}): ν_{max} = 1664 (C=O), 1603 (C=C). GC-MS (EI): *m/z* (%) = 220 $[M]^+$ (50), 219 (100), 191 (41), 177 (32), 163 (37), 151 (14), 149 (23), 134 (44), 123 (15), 115 (17), 91 (20), 77 (14).

General Procedure for the Synthesis of Products 9a-d and Characterization Data. *See synthesis of 7*. Thienylallylamines **9a-d** were purified by column chromatography (SiO_2, 20 × 1.5 cm).

(*E*)-*N*-(3-(5,6-Dihydro-4H-cyclopenta[*b*]thiophen-2-yl)allyl)aniline (9a). Eluent: EtOAc/heptane (1:50). Yield: 83.9 mg (47 %); orange powder. R_f 0.41 (EtOAc/hexane, 1:6). M.p. 169 °C. ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 7.20 (t, *J* = 7.6 Hz, 2H, H Ph), 6.73 (t, *J* = 7.6 Hz, 1H, H Ph), 6.68–6.65 (m, 4H, H-3, H-3 Thien, H Ph), 6.07–6.03 (dt, *J* = 5.4, 15.6 Hz, 1H, H-2), 3.89 (d, *J* = 5.4 Hz, 2H, H-1), 3.83 (s, 1H, NH), 2.87 (t, *J* = 7.2 Hz, 2H, CH_2), 2.69 (t, *J* = 7.2 Hz, 2H CH_2), 2.44–2.40 (pent, *J* = 7.2 Hz, 2H, CH_2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 148.1, 146.4, 144.9, 141.4, 129.3 (2C), 125.9, 124.5, 121.0, 117.9, 113.0 (2C), 46.1, 29.3, 29.0, 28.2. IR (KBr, cm^{-1}): ν_{max} = 3316 (NH), 1601, 1509 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 255 (22) $[M]^+$, 163 (100), 135 (24), 129 (10), 77 (13).

(*E*)-*N*-(3-(4,5,6,7-Tetrahydrobenzo[*b*]thiophen-2-yl)allyl)aniline (9b). Eluent: heptane. Yield: 122.4 mg (65 %); yellow oil. R_f 0.45 (EtOAc/hexane, 1:40). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 7.20 (dd, *J* = 8.3, 7.4 Hz, 2H, H Ar), 6.73 (t, *J* = 7.4 Hz, 1H, H Ar), 6.67–6.65 (m, 3H, H Ar, H-2), 6.59 (s, 1H, H-3 Thien), 6.04 (dt, *J* = 15.5, 5.7 Hz, 1H, H-2), 3.89 (dd, *J* = 1.2, 5.7 Hz,

2H, CH_2), 3.82 (s, 1H, NH), 2.72 (t, *J* = 6.0 Hz, 2H, H-1), 2.55 (t, *J* = 6.0 Hz, 2H, CH_2), 1.86–1.76 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 148.0, 138.2, 135.6, 134.9, 129.3 (2C), 126.5, 125.1 (2C), 117.6, 113.0 (2C), 46.0, 25.5, 25.2, 23.6, 22.9. IR (KBr, cm^{-1}): ν_{max} = 3307 (NH), 1601 (C=C). GC-MS (EI): *m/z* (%) = 269 $[M]^+$ (13), 177 (100), 135 (5).

(*E*)-*N*-(3-(5,6,7,8-Tetrahydro-4*H*-cyclohepta[*b*]thiophen-2-yl)allyl)aniline (9c). Eluent: heptane. Yield: 122.4 mg (58 %); yellow oil. R_f 0.43 (EtOAc/hexane, 1:40). ^1H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 7.19 (t, *J* = 7.6 Hz, 2H, H Ar), 6.72 (t, *J* = 7.6 Hz, 1H, H Ar), 6.66 (d, *J* = 7.6 Hz, 2H, H Ar), 6.61 (s, 1H, H-3 Thien), 6.60 (d, *J* = 15.5 Hz, 1H, H-3), 6.01 (dt, *J* = 15.5, 5.7 Hz, 1H, H-2), 3.87 (d, *J* = 5.7 Hz, 2H, H-1), 3.81 (s, 1H, NH), 2.77–2.75 (m, 2H, CH_2), 2.63–2.61 (m, 2H, CH_2), 1.86–1.82 (m, 2H, CH_2), 1.70–1.60 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 148.0, 141.0, 138.9, 136.1, 128.4, 128.3 (2C), 125.0, 124.8, 117.6, 113.0 (2C), 46.0, 32.4, 30.7, 30.1, 28.4, 27.9. IR (KBr, cm^{-1}): ν_{max} = 3301 (NH), 1601 (C=C). GC-MS (EI): *m/z* (%) = 283 $[M]^+$ (7), 191 (100), 157 (8), 44 (21).

(*E*)-*N*-(3-(4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophen-2-yl)allyl)aniline (9d). Eluent: heptane. Yield: 68.6 mg (33 %); yellow oil. R_f 0.57 (EtOAc/hexane, 1:40). ^1H NMR (700.2 MHz, $CDCl_3$, 25 °C) *δ* 7.20 (t, *J* = 7.6 Hz, 2H, H Ar), 6.73 (t, *J* = 7.6 Hz, 1H, H Ar), 6.66 (d, *J* = 7.6 Hz, 2H, H Ar), 6.63 (d, *J* = 15.7, 1H, H-3), 6.62 (s, 1H, H-3 Thien), 6.03 (dt, *J* = 15.7, 5.7 Hz, 1H, H-2), 3.88 (d, *J* = 5.7 Hz, 2H, H-1), 3.82 (s, 1H, NH), 2.79 (t, *J* = 6.2 Hz, 2H, CH_2), 2.60 (t, *J* = 6.2 Hz, 2H, CH_2), 1.67–1.59 (m, 4H, $(CH_2)_2$), 1.45–1.39 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) *δ* 148.1, 138.9, 137.6, 137.4, 129.3 (2C), 128.0, 125.2, 124.8, 117.6, 113.0 (2C), 46.0, 32.0, 30.9, 27.0, 26.8, 25.8, 25.6. IR (KBr, cm^{-1}): ν_{max} = 3306 (NH), 1601 (C=C). MS (ESI): *m/z* = 298 $[M+H]^+$.

General Procedure for the Synthesis of Products 10a-d and Characterization Data. *See synthesis of **8**.*

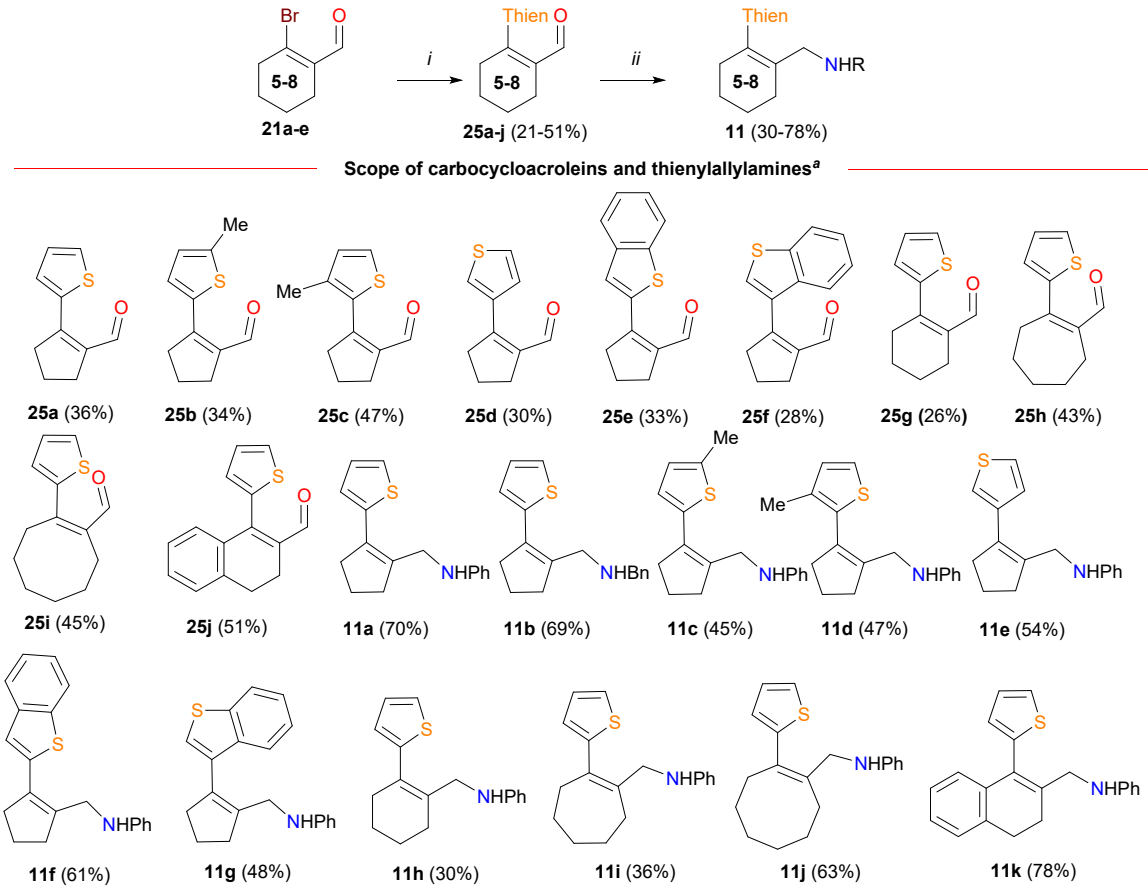
(3a*SR*,9*RS*,9a*RS*)-1-Oxo-2-phenyl-1,2,3,3a,4,6,7,8,9,9a-decahydrocyclopenta[4,5]thieno[2,3-*f*]isoindole-9-carboxylic acid (10a). Yield: 114.7 mg (65 %); colourless powder. ^1H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.54 (br.s, 1H, CO_2H), 7.67 (d, *J* = 7.9 Hz, 2H, H Ar), 7.38 (t, *J* = 7.9 Hz, 2H, H Ar), 7.13 (t, *J* = 7.9 Hz, 1H, H Ar), 4.01 (t, *J* = 8.8 Hz, 1H, H-3A), 3.85 (d, *J* = 5.0 Hz, 1H, H-9), 3.69 (t, *J* = 8.8 Hz, 1H, H-3B), 3.22–3.15 (m, 1H, H-3a), 3.04 (dd, *J* = 15.3, 5.0 Hz, 1H, H-4a), 2.83–2.64 (m, 5H, CH_2), 2.39-2.31 (m, 3H, CH_2). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.1, 172.6, 145.6, 140.3, 139.9, 138.9, 129.2 (2C), 129.1, 127.0, 124.1, 119.3 (2C), 51.9, 48.0, 32.6, 29.4, 29.2, 28.7, 28.2. IR (KBr, cm^{-1}): ν_{max} = 1731 (CO_2), 1656 (N-C=O). MS (ESI):

m/z = 354 $[M+H]^+$. Anal. Calcd for $C_{20}H_{19}NO_3S$: C, 67.97; H, 5.42; N, 3.96; S, 9.07. Found: C, 67.69; H, 5.79; N, 3.63; S, 8.79.

(3a*SR*,10*RS*,10a*RS*)-1-Oxo-2-phenyl-2,3,3a,4,6,7,8,9,10,10a-decahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (10b). Yield: 135.8 mg (74 %); colourless powder. M.p. 241 – 243 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.57 (s, 1H, CO_2H), 7.67 (d, *J* = 7.6 Hz, 2H, H Ar), 7.38 (t, *J* = 7.6 Hz, 2H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 4.00 (t, *J* = 7.9 Hz, 1H, H-3A), 3.85 (d, *J* = 5.0 Hz, 1H, H-10), 3.67 (t, *J* = 9.7 Hz, 1H, H-3B), 3.29–3.22 (m, 1H, H-3a), 3.03 (dd, *J* = 15.5, 5.0 Hz, 1H, H-10a), 2.79 (dd, *J* = 13.1, 5.3 Hz, 1H, H-4A), 2.71–2.53 (m, 9H, H-4B, $(CH_2)_4$). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.0 (2C), 140.3, 134.5, 133.9, 133.2, 130.9, 129.2 (2C), 124.1, 119.4 (2C), 51.9, 48.3, 40.0, 39.6, 32.4, 28.5, 25.1, 24.6, 23.5, 22.7. IR (KBr, cm^{-1}): ν_{max} = 1731 (CO_2), 1664 (N-C=O). MS (ESI): *m/z* = 368 $[M+H]^+$.

(3a*RS*,11*SR*,11a*SR*)-1-Oxo-2-phenyl-1,2,3,3a,4,6,7,8,9,10,11,11a-dodecahydrocyclohepta[4,5]thieno[2,3-*f*]isoindole-11-carboxylic acid (10c). Yield: 179.1 mg (94 %); colourless powder. M.p. 242 – 244 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6 , 25 °C) δ 12.33 (c, 1H, CO_2H), 7.66 (d, *J* = 7.6 Hz, 2H, H Ar), 7.38 (t, *J* = 7.6 Hz, 2H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 4.01 (dd, *J* = 8.6, 7.6 Hz, 1H, H-3A), 3.92 (d *J* = 5.3 Hz, 1H, H-11), 3.66 (t, *J* = 9.6 Hz, 1H, H-3B), 3.28–3.22 (m, 1H, H-3a), 3.03 (dd, *J* = 15.5, 5.3 Hz, 1H, H-11a), 2.81–2.67 (m, 6H, H-4, $(CH_2)_2$), 1.84–1.82 (m, 2H, CH_2), 1.63–1.54 (m, 4H, $(CH_2)_2$). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 172.8 (2C), 140.4, 139.8, 137.3, 132.5, 132.2, 129.1 (2C), 124.1, 119.6 (2C), 52.1, 48.5, 39.9, 32.3, 32.2, 29.8, 28.5, 28.3, 27.9, 27.5. IR (KBr, cm^{-1}): ν_{max} = 1727 (CO_2), 1661 (N-C=O). MS (ESI): *m/z* = 382 $[M+H]^+$. Anal. Calcd for $C_{22}H_{23}NO_3S$: C, 69.26; H, 6.08; N, 3.67; S, 8.41. Found: C, 69.41; H, 5.82; N, 3.60; S, 8.35.

(3a*SR*,12*RS*,12a*RS*)-1-Oxo-2-phenyl-2,3,3a,4,6,7,8,9,10,11,12,12a-dodecahydro-1*H*-cycloocta[4,5]thieno[2,3-*f*]isoindole-12-carboxylic acid (10d). Yield: 96.8 mg (49 %); colourless powder. M.p. 241 – 243 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6 , 25 °C) δ 12.60 (s, 1H, CO_2H), 7.67 (d, *J* = 7.6 Hz, 2H, H Ar), 7.38 (t, *J* = 7.6 Hz, 2H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 3.99 (t, *J* = 7.9 Hz, 1H, H-3A), 3.88 (d, *J* = 5.3 Hz, 1H, H-12), 3.66 (t, *J* = 9.6 Hz, 1H, H-3B), 3.30–3.23 (m, 1H, H-3a), 3.05 (dd, *J* = 15.5, 5.0 Hz, 1H, H-12a), 2.86 (dd, *J* = 13.1, 5.3 Hz, 1H, H-4A), 2.82–2.66 (m, 5H, H-4B, $(CH_2)_2$), 1.61–1.21 (m, 8 H, 2 $(CH_2)_2$). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.5, 172.9, 140.3, 137.0, 136.1, 133.8, 131.7, 129.3 (2C), 124.2, 119.4 (2C), 51.9, 48.6, 40.3, 32.3, 32.2, 30.2, 28.6, 26.8, 26.1, 25.9, 24.6. IR (KBr, cm^{-1}): ν_{max} = 1742 (CO_2), 1661 (N-C=O). MS (ESI): *m/z* = 396 $[M+H]^+$. Anal. Calcd for $C_{23}H_{25}NO_3S$: C, 69.84; H, 6.37; N, 3.54; S, 8.11. Found: C, 69.76; H, 6.42; N, 3.61; S, 8.23.



Scheme S3. Substrates and products scope of carbocycloacroleins **25** and thienylallylamines **11**. Reaction conditions: ***i*** corresponding bromoaldehyde (1.0 equiv), ThienB(OH)$_2$ (2.0 equiv), 2M *aq.* Na_2CO_3 (10 mL), $Pd(PPh_3)_4$ (0.05 equiv), EtOH (30 mL) / PhMe (30 mL) mixture, Δ, 6−10 h ***ii*** $ArNH_2$ (1.0 equiv), MS 4Å (1 g), abs. DCM (10 mL), r.t, 24 h; ***iii*** $NaBH_4$ (2.0 equiv), MeOH (10 mL), r.t, 24 h. [a] Isolated yields after column chromatography.

General Procedure for the Synthesis of Products 25a-j and Characterization Data.

Method A. In a 50 ml Schlenk flask 5.7 mmol of bromaldehyde **21a-c** and 6.3 mmol of the corresponding boronic acid were dissolved in 1.95 mL (14 mmol) of triethylamine and 15 mL of freshly distilled DMF with constant stirring in an argon atmosphere. Then 0.07 g (0.057 mmol) of tetrakis(triphenylphosphine)palladium was added, the mixture was heated at 110–120°C for 6 hours in an argon atmosphere. After completion of the reaction (TLC control), 50 mL water was added, the mixture was extracted with ethyl acetate (3 × 10 mL), dried over *anhyd*. $MgSO_4$, filtered off and evaporated under reduced pressure. After column chromatography (SiO_2, 20×1.5 cm), carbocycloacroleins **25a,g,h** were isolated as light yellow oils in the yields given below.

Method B. In a 50 ml Schlenk flask 9.8 mmol of bromaldehyde **21a-e** dissolved in 30 ml of ethanol and 30 ml of toluene, 19.6 mmol of the corresponding boronic acid and 2 M sodium carbonate aqua solution were degassed with constant stirring in an argon atmosphere for 10 min. Then 0.57 g (0.49 mmol) of tetrakis(triphenylphosphine)palladium was added, the mixture was

heated at 110 °C for 6 hours in an argon atmosphere. After completion of the reaction (TLC control), 50 mL water was added, the mixture was extracted with ethyl acetate (3 × 10 mL), dried over *anhyd*. $MgSO_4$, filtered off and evaporated under reduced pressure. After column chromatography (SiO_2, 20×1.5 cm), carbocycloacroleins **25a-e** were isolated as light yellow oils in the yields given below.

2-(Thiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25a) [11]**.** Eluent: heptane. According to general procedure **A**, 0.31 g of **25a** was obtained as yellow oil (31% yield). According to general procedure **B**, 0.63 g of **25a** was obtained as yellow oil (36% yield). R_f 0.34 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 10.30 (s, 1H, CHO), 7.45 (dd, J = 5.0, 1.0 Hz, 1H, H-5 Thien), 7.24 (dd, J = 3.5, 1.0 Hz, 1H, H-3 Thien), 7.09 (dd, J = 5.0, 3.5 Hz, 1H, H-4 Thien), 3.04-3.01 (m, 2H, CH_2), 2.77-2.74 (m, 2H, CH_2), 1.97 (pent, J = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 189.3, 152.3, 138.3, 136.9, 129.6, 128.9, 127.7, 39.9, 31.7, 21.6. IR (KBr, cm^{-1}): ν_{max} = 1650 (CHO). GC-MS (EI, 70 eV): *m/z* (%) = 178 (100) $[M]^+$, 150 (21), 149 (36), 134 (25), 122 (11), 117 (28), 65 (10).

2-(5-Methylthiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25b). Eluent: heptane. According to general procedure **B**, 0.64 g of **25b** was obtained as yellow oil (34% yield). R_f 0.33 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 10.29 (s, 1H, CHO), 7.06 (d, J = 3.5 Hz, 1H, H-3 Thien), 6.74 (d, J = 3.5 Hz, 1H, H-4 Thien), 2.98 (t, J = 7.6 Hz, 2H, CH_2), 2.73 (t, J = 7.6 Hz, 2H, CH_2), 2.50 (s, 3 H, CH_3), 1.94 (pentet, J = 7.6 Hz, 2H, H-4). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 189.3, 152.7, 144.5, 137.1, 134.7, 130.1, 126.1, 39.5, 31.5, 21.5, 15.6. IR (KBr, cm^{-1}): ν_{max} = 1649 (CHO). GC-MS (EI, 70 eV): *m/z* (%) = 192 (100) $[M]^+$, 177 (31), 163 (18), 149 (11), 131 (12), 115 (6), 59 (9).

2-(3-Methylthiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25c). Eluent: heptane. According to general procedure **B**, 0.88 g of **25c** was obtained as yellow oil (47% yield). R_f 0.48 (EtOAc/hexane, 1:20). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.75 (s, 1H, CHO), 7.33 (d, J = 5.0 Hz, 1H, H-5 Thien), 6.93 (d, J = 5.0 Hz, 1H, H-4 Thien), 2.94–2.92 (m, 2H, CH_2), 2.77–2.74 (m, 2H, CH_2), 2.25 (s, 3H, CH_3), 2.04 (pent, J = 7.6 Hz, 2H, CH_2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 190.2, 154.9, 140.5, 137.0, 131.1, 130.9, 126.0, 41.2, 30.6, 21.9, 15.3. IR (KBr, cm^{-1}): ν_{max} = 1660 (CHO). GC-MS (EI, 70 eV): *m/z* (%) = 192 (35) $[M]^+$, 177 (100), 163 (14), 147 (8), 131 (10).

2-(Thiophen-3-yl)cyclopent-1-ene-1-carbaldehyde (25d) [11]**.** Eluent: heptane. According to general procedure **B**, 0.52 g of **25d** was obtained as yellow oil (30% yield). R_f 0.42 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 10.05 (s, 1H, CHO), 7.40-7.37 (m, 2H, H Ar), 7.19 (dd, J = 5.0, 1.5 Hz, 1H, H-4 Thien), 2.98-2.95 (m, 2H, CH_2), 2.75-2.71 (m, 2H,

CH_2), 1.98 (pent, J = 7.6 Hz, 1H, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 189.9, 155.9, 139.1, 136.0, 127.9, 126.5, 126.1, 39.6, 31.2, 21.6. IR (KBr, cm^{-1}): ν_{max} = 1650 (CHO). MS (ESI): m/z = 179 $[M+H]^+$.

2-(Benzo[*b*]thiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25e). Eluent: EtOAc/heptane (1:20). According to general procedure **B**, 0.74 g of **25e** was obtained as yellow oil (33% yield). R_f 0.39 (EtOAc/hexane, 1:15). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 10.41 (s, 1H, CHO), 7.82–7.79 (m, 2H, H Ar), 7.45 (s, 1H, H-3 Thien), 7.39–7.36 (m, 2H, H Ar), 3.12-3.09 (m, 2H, CH_2), 2.82-2.79 (m, 2H, CH_2), 2.03 (pent, J = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 189.5, 152.3, 140.8, 140.3, 139.1, 136.5, 126.7, 125.9, 125.1, 124.5, 122.3, 39.8, 31.9, 21.6. IR (KBr, cm^{-1}): ν_{max} = 1641 (CHO). GC-MS (EI, 70 eV): m/z (%) = 228 (100) $[M]^+$, 199 (35), 185 (21), 167 (33), 134 (16), 39 (13).

2-(Benzo[*b*]thiophen-3-yl)cyclopent-1-ene-1-carbaldehyde (25f). Eluent: EtOAc/heptane (1:20). According to general procedure **B**, 0.62 g of **25f** was obtained as yellow oil (28% yield). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.75 (s, 1H, CHO), 7.90–7.89 (m, 1H, H Ar), 7.74–7.73 (m, 1H, H Ar), 7.41–7.33 (m, 3H, H Ar), 3.08-3.05 (m, 2H, CH_2), 2.81-2.78 (m, 2H, CH_2), 2.10 (pent, J = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 189.9, 157.1, 142.0, 140.4, 138.0, 131.3, 126.6, 125.0, 124.2, 123.1, 122.9, 40.0, 30.6, 22.3. IR (KBr, cm^{-1}): ν_{max} = 1650 (CHO). GC-MS (EI, 70 eV): m/z (%) = 228 (100) $[M]^+$, 211 (16), 200 (48), 185 (17), 171 (32), 165 (16), 134 (10), 39 (8).

2-(Thiophen-2-yl)cyclohex-1-ene-1-carbaldehyde (25g). Eluent: heptane. According to general procedure **A**, 76.6 mg of **25g** was obtained as yellow oil (7% yield). According to general procedure **B**, 0.49 g of **25g** was obtained as yellow oil (26% yield). R_f 0.43 (EtOAc/hexane, 1:20). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.80 (s, 1H, CHO), 7.44 (d, J = 5.0 Hz, 1H, H-5 Thien), 7.06 (dd, J = 5.0, 3.0 Hz, 1H, H-4 Thien), 7.02 (d, J = 3.0 Hz, 1H, H-3 Thien), 2.63–2.51 (m, 2H, CH_2), 2.39–2.37 (m, 2H, CH_2), 1.80–1.77 (m, 2H, CH_2), 1.72–1.68 (m, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 193.1, 150.4, 141.0, 137.4, 129.7, 127.5, 127.2, 34.6, 23.2, 22.6, 21.4. IR (KBr, cm^{-1}): ν_{max} = 1663 (CHO). GC-MS (EI, 70 eV): m/z (%) = 192 (100) $[M]^+$, 191 (35), 163 (69), 149 (19), 135 (53), 131 (46), 129 (22), 121 (18), 115 (23), 97 (34), 91 (30), 77 (28), 65 (15), 51 (23), 45 (26), 39 (27).

2-(Thiophen-2-yl)cyclohept-1-ene-1-carbaldehyde (25h). Eluent: EtOAc/heptane (1:50). According to general procedure **A**, 47.0 mg of **25h** was obtained as yellow oil (4% yield). According to general procedure **B**, 0.87 g of **25h** was obtained as yellow oil (43% yield). R_f 0.43 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.62 (s, 1H, CHO), 7.43 (dd, J = 5.0, 1.0 Hz, 1H, H-5 Thien), 7.01 (dd, J = 5.0, 3.5 Hz, 1H, H-4 Thien), 6.96 (dd, J = 3.5, 1.0 Hz,

1H, H-3 Thien), 2.82–2.80 (m, 2H, CH_2), 2.62–2.60 (m, 2H, CH_2), 1.85–1.81 (m, 2H, CH_2), 1.71–1.67 (m, 2H, CH_2), 1.52–1.48 (m, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 192.4, 156.8, 143.0, 142.1, 130.4, 128.2, 1271, 39.8, 32.2, 26.0, 25.9, 25.4. IR (KBr, cm^{-1}): ν_{max} = 1660 (CHO). GC-MS (EI, 70 eV): *m/z* (%) = 206 (100), 177 (18), 163 (72), 149 (14), 145 (18), 135 (25), 121 (11), 115 (12), 97 (29), 91 (20), 77 (13), 39 (13).

2-(Thiophen-2-yl)cyclooct-1-ene-1-carbaldehyde (25i). Eluent: EtOAc/heptane (1:100). According to general procedure **B**, 0.97 g of **25i** was obtained as yellow oil (45% yield). R_f 0.49 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 9.66 (s, 1H, CHO), 7.42 (d, *J* = 5.0, 1.0 Hz, 1H, H-5 Thien), 7.02 (dd, *J* = 5.0, 3.5 Hz, 1H, H-4 Thien), 6.96 (dd, *J* = 3.5, 1.0 Hz, 1H, H-3 Thien), 2.77–2.75 (m, 2H, CH_2), 2.57–2.55 (m, 2H, CH_2), 1.73–1.69 (m, 2H, CH_2), 1.64–1.60 (m, 2H, CH_2), 1.50–1.48 (m, 4H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 192.8, 153.7, 140.9, 140.8, 130.6, 127.9, 127.1, 36.3, 30.1, 29.2, 26.8, 26.2, 25.1. IR (KBr, cm^{-1}): ν_{max} = 1660 (CHO). GC-MS (EI, 70 eV): *m/z* (%) = 220 (100) $[M]^+$, 191 (16), 177 (35), 163 (55), 135 (25), 123 (14), 115 (16), 97 (27), 91 (20), 77 (21), 65 (13), 45 (12), 39 (17).

1-(Thiophen-2-yl)-3,4-dihydronaphthalene-2-carbaldehyde (25j). Eluent: heptane. According to general procedure **B**, 1.20 g of **25j** was obtained as yellow powder (51% yield). R_f 0.43 (EtOAc/hexane, 1:20). M.p. 86 – 88 °C. ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 9.79 (s, 1H, CHO), 7.52 (dd, *J* = 5.2, 1.0 Hz, 1H, H-5 Thien), 7.32 (t, *J* = 7.4 Hz, 1H, H Ar), 7.26 (d, *J* = 7.4 Hz, 1H, H Ar), 7.20–7.12 (m, 4H, H Ar), 2.90 (dd, *J* = 8.3, 7.6 Hz, 2H, CH_2), 2.70 (dd, *J* = 8.3, 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 193.0, 146.8, 138.5, 137.0, 135.4, 135.1, 130.8, 130.5, 128.2, 127.9, 127.8, 127.1, 126.8, 27.5, 20.8. IR (KBr, cm^{-1}): ν_{max} = 1656 (CHO). MS (ESI): *m/z* = 241 $[M+H]^+$.

General Procedure for the Synthesis of Products 11a-k and Characterization Data. *See synthesis of 7.* Thienylcycloalkenylamines **11a-k** were purified by column chromatography (SiO_2, 20 × 1.5 cm).

***N*-((2-(Thiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11a).** Eluent: heptane. Yield: 124.9 mg (70 %); orange oil. R_f 0.58 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.25 (dd, *J* = 5.1, 1.0 Hz, 1H, H-5 Thien), 7.18 (dd, *J* = 8.6, 7.6 Hz, 2H, H Ar), 7.03 (dd, *J* = 5.1, 3.5 Hz, 1H, H-4 Thien), 7.01 (br.d, *J* = 3.5 Hz, 1H, H-3 Thien), 6.74 (t, *J* = 7.6 Hz, 1H, H Ar), 6.65 (dd, *J* = 8.6, 1.0 Hz, 2H, H Ar), 4.22 (br.s, 1H, NH), 4.13 (s, 2H, CH_2N), 2.85 (t, *J* = 7.6 Hz, 2H, CH_2), 2.66 (t, *J* = 7.6 Hz, 2H, CH_2), 1.95 (pent, *J* = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.0, 139.7, 136.4, 131.8, 129.4 (2C), 127.1, 125.3, 124.8, 117.9, 113.3 (2C), 43.6, 38.0, 36.8, 21.9. IR (KBr, cm^{-1}): ν_{max} = 3409 (NH), 1602, 1504 (C=C). MS (ESI): *m/z* = 256 $[M+H]^+$.

***N*-Benzyl-1-(2-(thiophen-2-yl)cyclopent-1-en-1-yl)methanamine (11b).** Eluent: heptane. Yield: 129.9 mg (69 %); orange oil. R_f 0.49 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) 7.34-7.21 (m, 6H, H-Ar), 6.99 (dd, *J* = 5.1, 3.5 Hz, 1H, H-4 Thien), 6.92 (d, *J* = 3.5 Hz, 1H, H-3 Thien), 3.80 (s, 2H, CH_2N), 3.65 (s, 2H, CH_2N), 2.81 (t, *J* = 7.6 Hz, 2H, CH_2), 2.66 (t, *J* = 7.6 Hz, 2H, CH_2), 1.94 (pent, *J* = 7.6 Hz, 2H, CH_2), 1.67 (br.s, 1H, NH). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) *δ* 140.4, 140.0, 137.8, 131.1, 128.5, 128.4 (2C), 127.0, 126.9 (2C), 125.0, 124.2, 53.9, 47.9, 38.0, 37.0, 22.0. IR (KBr, cm^{-1}): ν_{max} = 3325 (NH), 1601 (C=C), 1504. MS (ESI): *m/z*= 270 [M+H]$^+$.

***N*-((2-(5-Methylthiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11c).** Eluent: heptane. Yield: 84.7 mg (45 %); orange oil. R_f 0.51 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) *δ* 7.17 (dd, *J* = 8.6, 7.1 Hz, 2H, H Ar), 6.78 (d, *J* = 3.5 Hz, 1H, H-3 Thien), 6.71 (t, *J* = 7.6 Hz, 1H, H Ar), 6.67 (dd, *J* = 3.5, 1.0 Hz, 1H, H-4 Thien), 6.62 (d, *J* = 7.6 Hz, 2H, H Ar), 4.09 (s, 2H, CH_2N), 3.78 (br.s, 1H, NH), 2.80 (t, *J* = 7.6 Hz, 2H, CH_2), 2.62 (t, *J* = 7.6 Hz, 2H, CH_2), 2.47 (s, 3H, Me), 1.94 (pent, *J* = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) *δ* 148.6, 139.4, 137.6, 135.3, 131.8, 129.3 (2C), 125.3, 125.2, 117.5, 112.9 (2C), 43.3, 37.7, 36.8, 21.9, 15.4. IR (KBr, cm^{-1}): ν_{max} = 3408 (NH), 1602, 1504 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 269 (21) [M]$^+$, 178 (10), 177 (100), 161 (5), 111 (5).

***N*-((2-(3-Methylthiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11d).** Eluent: heptane. Yield: 88.5 mg (47 %); orange oil. R_f 0.53 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) *δ* 7.18 (d, *J* = 5.5 Hz, 1H, H-5 Thien), 7.13 (dd, *J* = 8.6, 7.6 Hz, 2H, H Ar), 6.86 (d, *J* = 5.5 Hz, 1H, H-4 Thien), 6.68 (t, *J* = 7.6 Hz, 1H, H Ar), 6.53 (dd, *J* = 8.6, 1.0 Hz, 2H, H Ar), 3.79 (s, 2H, CH_2N), 3.73 (s, 1H, NH), 2.69 (t, *J* = 7.6 Hz, 2H, CH_2), 2.58 (t, *J* = 7.6 Hz, 2H, CH_2), 2.14 (s, 3 H, CH_3), 1.96 (pent, *J* = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) *δ* 148.4, 147.0, 139.1, 130.2 (2C), 129.2 (2C), 123.6 (2C), 117.4, 112.9 (2C), 43.1, 39.3, 35.1, 22.3, 14.8. IR (KBr, cm^{-1}): ν_{max} = 3412 (NH), 1602 (C=C), 1504. MS (ESI): *m/z*= 270 [M+H]$^+$.

***N*-((2-(Thiophen-3-yl)cyclopent-1-en-1-yl)methyl)aniline (11e).** Eluent: heptane. Yield: 96.4 mg (54 %); orange oil. R_f 0.37 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) *δ* 7.30 (dd, *J* = 5.1, 3.0 Hz, 1H, H-5 Thien), 7.19–7.16 (m, 4H, H Ar), 6.72 (t, *J* = 7.6 Hz, 1H, H Ar), 6.60 (dd, *J* = 8.6, 1.0 Hz, 2H, H Ar), 3.98 (s, 2H, CH_2N), 3.73 (br.s, 1H, NH), 2.80 (t, *J* = 7.6 Hz, 2H, CH_2), 2.63 (t, *J* = 7.6 Hz, 2H, CH_2), 1.95 (pent, *J* = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) *δ* 148.5, 138.2, 135.5, 133.9, 129.3 (2C), 127.3, 125.4, 121.9, 117.5, 112.9 (2C), 43.2, 37.6, 36.7, 22.0. IR (KBr, cm^{-1}): ν_{max} = 3404 (NH), 1602 (C=C), 1503. GC-MS (EI, 70 eV): *m/z* (%) = 255 (100) [M]$^+$, 226 (18), 212 (33), 163 (71), 147 (51), 129 (79), 115 (42), 93 (88), 79 (71), 65 (23), 51 (23), 45 (17).

***N*-((2-(Benzo[*b*]thiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11f).** Eluent: heptane. Yield: 130.2 mg (61 %); orange oil. R_f 0.50 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.78 (d, J = 7.6 Hz, 1H, H Ar), 7.73 (d, J = 7.6 Hz, 1H, H Ar), 7.33 (t, J = 7.6 Hz, 1H, H Ar), 7.29 (t, J = 7.6 Hz, 1H, H Ar), 7.19–7.16 (m, 3H, H Ar), 6.72 (t, J = 7.6 Hz, 1H, H Ar), 6.63 (d, J = 8.1 Hz, 2H, H Ar), 4.21 (s, 2H, CH_2N), 3.83 (br.s, 1H, NH), 2.92 (t, J = 7.6 Hz, 2H, CH_2), 2.69 (t, J = 7.6 Hz, 2H, CH_2), 1.97 (pent, J = 7.6 Hz, 2H, H-4). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.4, 139.7, 139.6 (3C), 131.9, 129.4 (2C), 124.5, 124.3, 123.5, 122.1, 121.9, 117.7, 112.9 (2C), 43.3, 37.9, 37.0, 21.9. IR (KBr, cm^{-1}): ν_{max} = 3414 (NH), 1602, 1503 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 276 (26) $[M-29]^+$, 264 (58), 226 (47), 212 (54), 198 (100), 171 (48), 160 (23), 142 (12), 134 (23), 107 (13), 93 (12), 65 (10).

***N*-((2-(Benzo[*b*]thiophen-3-yl)cyclopent-1-en-1-yl)methyl)aniline (11g).** Eluent: heptane. Yield: 102.5 mg (48 %); orange oil. R_f 0.42 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.87 (dd, J = 7.6, 2.0 Hz, 1H, H Ar), 7.69 (dd, J = 7.6, 2.0 Hz, 1H, H Ar), 7.38–7.34 (m, 2H, H Ar), 7.18 (s, 1H, H-2 Thien), 7.06 (dd, J = 8.6, 7.6 Hz, 2H, H Ar), 6.64 (t, J = 7.6 Hz, 1H, H Ar), 6.46 (d, J = 8.6 Hz, 2H, H Ar), 3.79 (s, 2H, CH_2N), 3.69 (br.s, 1H, NH), 2.81 (t, J = 7.6 Hz, 2H, CH_2), 2.63 (t, J = 7.6 Hz, 2H, CH_2), 2.03 (pent, J = 7.6 Hz, 2H, CH_2). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.3, 140.0, 139.0, 138.6, 134.3, 134.1, 129.2 (2C), 124.4, 124.1, 123.2, 123.1, 122.9, 117.4, 112.9 (2C), 43.0, 38.4, 35.1, 22.6. IR (KBr, cm^{-1}): ν_{max} = 3385 (NH), 1601, 1502 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 305 (62) $[M]^+$, 213 (100), 185 (27), 171 (9), 147 (10), 77 (8).

***N*-((2-(Thiophen-2-yl)cyclohex-1-en-1-yl)methyl)aniline (11h).** Eluent: heptane. Yield: 102.5 mg (30 %); orange powder. R_f 0.58 (EtOAc/hexane, 1:40). M.p. 67 °C. ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.23 (d, J = 5.0 Hz, 1H, H-5 Thien), 7.16 (t, J = 7.6 Hz, 2H, H Ar), 6.98 (dd, J = 5.0, 3.6 Hz, 1H, H-4 Thien), 6.94 (br.d, J = 3.6 Hz, 1H, H-3 Thien), 6.70 (t, J = 7.6 Hz, 1H, H Ar), 6.57 (d, J = 7.6 Hz, 2H, H Ar), 3.80 (s, 2H, CH_2N), 3.70 (br.s, 1H, NH), 2.43-2.41 (m, 2H, CH_2), 2.28-2.26 (m, 2H, CH_2), 1.76-1.69 (m, 4H, $2CH_2$). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 148.4, 144.4, 133.6, 129.2 (3C), 126.8, 125.2, 124.2, 117.2, 112.8 (2C), 47.5, 33.2, 28.8, 23.1, 22.5. IR (KBr, cm^{-1}): ν_{max} = 3394 (NH), 1601 (C=C), 1504. GC-MS (EI, 70 eV): *m/z* (%) = 269 (71) $[M]^+$, 177 (100), 147 (10), 135 (11), 97 (30), 91 (11), 77 (15).

***N*-((2-(Thiophen-2-yl)cyclohept-1-en-1-yl)methyl)aniline (11i).** Eluent: heptane. Yield: 71.3 mg (36 %); orange oil. R_f 0.43 (EtOAc/hexane, 1:20). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.22 (d, J = 5.3 Hz, 1H, H-5 Thien), 7.15 (t, J = 7.6 Hz, 2H, H Ar), 6.95 (dd, J = 5.3, 3.6 Hz, 1H, H-4 Thien), 6.85 (br.d, J = 3.6 Hz, 1H, H-3 Thien), 6.69 (t, J = 7.6 Hz, 1H, H Ar), 6.57 (d, J = 7.6 Hz, 2H, H Ar), 3.77 (s, 2H, CH_2N), 3.73 (br.s, 1H, NH), 2.63-2.61 (m, 2H, CH_2), 2.44-2.42 (m, 2H,

CH_2), 1.84-1.81 (m, 2H, CH_2), 1.65-1.62 (m, 2H, $2CH_2$), 1.56-1.53 (m, 2H, CH_2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 148.4, 145.7, 139.6, 135.7, 129.1 (2C), 126.7, 125.0, 124.2, 117.2, 112.9 (2C), 48.7, 37.5, 32.6, 32.5, 26.5 (2C). IR (KBr, cm^{-1}): ν_{max} = 3402 (NH), 1601 (C=C), 1503. GC-MS (EI, 70 eV): *m/z* (%) = 283 (100) $[M]^+$, 240 (20), 190 (100), 161 (12), 149 (17), 135 (12), 123 (23), 111 (12), 106 (23), 97 (52), 91 (18), 77 (26), 65 (13).

***N*-((2-(Thiophen-2-yl)cyclooct-1-en-1-yl)methyl)aniline (11j).** Eluent: heptane. Yield: 131.0 mg (63 %); orange oil. R_f 0.45 (EtOAc/hexane, 1:20). ^{1}H NMR (600.2 MHz, $CDCl_3$, 25 °C) δ 7.21 (dd, *J* = 5.1, 1.0 Hz, 1H, H-5 Thien), 7.13 (dd, *J* = 8.6, 7.6 Hz, 2H, H Ar), 6.95 (dd, *J* = 5.1, 3.5 Hz, 1H, H-4 Thien), 6.86 (dd, *J* = 3.5, 1.0 Hz, 1H, H-3 Thien), 6.67 (t, *J* = 7.6 Hz, 1H, H Ar), 6.53 (d, *J* = 7.6 Hz, 2H, H Ar), 3.75 (s, 2H, CH_2N), 3.67 (br.s, 1H, NH), 2.56–2.54 (m, 2H, CH_2), 2.44–2.42 (m, 2H, CH_2), 1.68–1.63 (m, 4H, $(CH_2)_2$), 1.57–1.54 (m, 4H, $(CH_2)_2$). ^{13}C NMR (150.9 MHz, $CDCl_3$, 25 °C) δ 148.5, 144.3, 137.2, 132.2, 129.2 (2C), 126.7, 125.4, 124.3, 117.2, 112.9 (2C), 46.7, 34.3, 30.1, 29.9, 29.1, 27.0, 26.4. IR (KBr, cm^{-1}): ν_{max} = 3400 (NH), 1601, 1504 (C=C). GC-MS (EI, 70 eV): *m/z* (%) = 297 (80) $[M]^+$, 240 (14), 212 (14), 205 (100), 123 (19), 106 (22), 97 (32), 93 (13), 77 (18).

***N*-((1-(Thiophen-2-yl)-3,4-dihydronaphthalen-2-yl)methyl)aniline (11k).** Eluent: EtOAc/heptane (1:50). Yield: 173.1 mg (78 %); orange oil. R_f 0.56 (EtOAc/hexane, 1:20). ^{1}H NMR (700.2 MHz, $CDCl_3$, 25 °C) δ 7.40 (dd, *J* = 5.1, 0.9 Hz, 1H, H-5 Thien), 7.17–7.10 (m, 6H, H Ar), 6.96 (dd, *J* = 3.3, 0.9 Hz, 1H, H-3 Thien), 6.88 (d, *J* = 7.4 Hz, 1H, H Ar), 6.71 (t, *J* = 7.4 Hz, 1H, H Ar), 6.61 (d, *J* = 7.6 Hz, 2H, H Ar), 3.89 (s, 2H, CH_2), 3.78 (s, 1H, NH), 2.86 (t, *J* = 8.0 Hz, 2H, CH_2), 2.54 (t, *J* = 8.0 Hz, 2H, CH_2). ^{13}C NMR (176.1 MHz, $CDCl_3$, 25 °C) δ 148.3, 139.6, 138.9, 136.3, 135.3, 129.2 (2C), 128.9, 127.9, 127.1 (2C), 127.0, 126.4, 125.8, 125.7, 117.5, 113.1 (2C), 47.2, 28.1, 26.0. IR (KBr, cm^{-1}): ν_{max} = 3413 (NH), 1601, 1503 (C=C). MS (ESI): *m/z* = 318 [M+H]$^+$.

General Procedure for the Synthesis of Products 30a-c,e-k and Characterization Data. *See synthesis of* ***8*.**

(3a*RS*,6a*RS*,7*SR*,7a*SR*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12a). Reflux for 4 hours. Yield: 168.6 mg (95 %); colourless powder. M.p. 233–234 °C (decomp.). ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.50 (s, 1H, CO_2H), 7.62 (d, *J* = 7.6 Hz, 2H, H Ar), 7.35 (t, *J* = 7.6 Hz, 2H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 6.46 (dd, *J* = 6.1, 2.5 Hz, 1H, H-9), 6.06 (dd, *J* = 6.1, 2.5 Hz, 1H, H-8), 3.82 (d, *J* = 9.6 Hz, 1H, H-4A), 3.70 (d, *J* = 9.6 Hz, 1H, H-4B), 3.59–3.55 (m, 1H, H-7a), 3.47 (d, *J* = 4.0 Hz, 1H, H-6a), 2.41–3.35 (m, 2H, H-7, CH_2), 2.08–2.03 (m, 1H, CH_2), 1.97-1.94 (m, 1H, CH_2), 1.88–1.79 (m, 2H, CH_2), 1.67–1.65 (m, 1H, CH_2). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25

°C) δ 173.3, 172.1, 139.0, 134.5, 130.7, 128.6 (2C), 125.9, 124.7, 124.3, 119.7 (2C), 57.4, 47.5, 47.4, 45.9, 43.8, 35.7, 27.3, 20.6. IR (KBr, cm^{-1}): ν_{max} = 1742 (CO_2), 1662 (N-C=O). MS (ESI): *m/z* = 354 $[M+H]^+$. Anal. Calcd for $C_{20}H_{19}NO_3S$: C, 67.97; H, 5.42; N, 3.96; S, 9.07. Found: C, 67.93; H, 5.43; N, 3.88; S, 9.16.

(3a*RS*,6a*RS*,7*SR*,7a*SR*)-5-Benzyl-6-oxo-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12b). Reflux for 4.5 hours. Yield: 132.1 mg (72 %); colourless powder. M.p. 94–95 °C. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.46 (s, 1H, CO_2H), 7.32 (t, *J* = 7.6 Hz, 2H, H Ar), 7.26 (t, *J* = 7.6 Hz, 1H, H Ar), 7.16 (d, *J* = 7.6 Hz, 2H, H Ar), 6.46 (dd, *J* = 6.1, 2.5 Hz, 1H, H-9), 6.03 (dd, *J* = 6.1, 2.5 Hz, 1H, H-8), 4.41 (d, *J* = 15.1 Hz, 1H, CH_2), 4.31 (d, *J* = 15.1 Hz, 1H, CH_2), 3.50–3.46 (m, 1H, H-7a), 3.22 (d, *J* = 4.5 Hz, 1H, H-6a), 3.17 (d, *J* = 9.6 Hz, 1H, H-4A), 3.10 (d, *J* = 9.6 Hz, 1H, H-4B), 2.30 (dd, *J* = 11.1, 4.5 Hz, 1H, H-7), 2.33–2.18 (m, 1H, CH_2), 2.03–1.98 (m, 1H, CH_2), 1.83-1.54 (m, 4H, $(CH_2)_2$). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.8, 172.7, 137.1, 135.1, 130.7, 129.1 (2C), 127.9 (2C), 127.8, 126.4, 125.3, 57.0, 48.6, 48.2, 45.9, 45.0, 44.6, 36.7, 27.8, 21.2. IR (KBr, cm^{-1}): ν_{max} = 1733 (CO_2), 1659 (N-C=O). MS (ESI): *m/z* = 368 $[M+H]^+$. Anal. Calcd for $C_{21}H_{21}NO_3S$: C, 68.64; H, 5.76; N, 3.81; S, 8.73. Found: C, 68.72; H, 5.48; N, 3.89; S, 8.47.

(3a*RS*,6a*RS*,7*SR*,7a*SR*)-9-Methyl-6-oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12c). *Contains an impurity of benzene* Reflux for 6 hours. Yield: 168.8 mg (92 %); colourless powder. M.p. 190 – 191 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.46 (s, 1H, CO_2H), 7.62 (d, *J* = 7.6 Hz, 2H, H Ar), 7.36 (t, *J* = 7.6 Hz, 2H, H Ar), 7.14 (t, *J* = 7.6 Hz, 1H, H Ar), 5.76 (dd, *J* = 2.4, 1.7 Hz, 1H, H-8), 3.81 (d, *J* = 9.6 Hz, 1H, H-4A), 3.70 (d, *J* = 9.6 Hz, 1H, H-4B), 3.64–3.60 (m, 1H, H-7a), 3.47 (d, *J* = 4.5 Hz, 1H, H-6a), 2.39–3.34 (m, 2H, H-7, CH_2), 2.09–2.04 (m, 1H, CH_2), 1.96-1.93 (m, 4H, CH_3, CH_2), 1.86–1.79 (m, 2H, CH_2), 1.67–1.62 (m, 1H, CH_2). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.8, 172.6, 139.5, 136.0, 134.4, 132.4, 129.1 (2C), 124.7, 122.1, 120.2 (2C), 57.7, 48.8, 47.7, 46.5, 44.5, 36.1, 27.7, 21.0, 16.7. IR (KBr, cm^{-1}): ν_{max} = 1719 (CO_2), 1698 (N-C=O). MS (ESI): *m/z* = 368 $[M+H]^+$.

(3a*RS*,6a*RS*,7*RS*,7a*RS*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[3,2-*f*]isoindole-7-carboxylic acid (12e). Reflux for 4 hours. Contains around 13% on an impurity of "aromatic" isomer**.** Yield: 116.5 mg (66 %); colourless powder. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.63 (s, 1H, CO_2H), 7.62 (d, *J* = 7.6 Hz, 2H, H Ar), 7.36–7.34 (t, *J* = 7.6 Hz, 2H, H Ar), 7.14 (t, *J* = 7.6 Hz, 1H, H Ar), 6.71 (d, *J* = 6.1 Hz, 1H, H-9), 6.10 (d, *J* = 6.1 Hz, 1H, H-8), 4.27-4.24 (m, 1H, H-7a), 3.83 (d, *J* = 9.6 Hz, 1H, H-4A), 3.70 (d, *J* = 9.6 Hz, 1H, H-4B), 3.46 (d, *J* = 4.5 Hz, 1H, H-6a), 2.71 (dd, *J* = 11.1, 4.5 Hz, 1H, H-7), 2.50–

2.47 (m, 1H, CH_2), 2.31–2.26 (m, 1H, CH_2), 2.00-1.68 (m, 4H, $2CH_2$). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.9, 172.4, 139.5, 136.9, 135.6, 134.1, 129.2 (2C), 124.9, 122.1, 120.4 (2C), 119.6, 58.5, 47.5, 47.1, 46.5, 37.1, 26.2, 21.1. IR (KBr, cm^{-1}): ν_{max} = 1742 (CO_2), 1665 (N-C=O). MS (ESI): *m/z* = 354 $[M+H]^+$. Anal. Calcd for $C_{20}H_{19}NO_3S$: C, 67.97; H, 5.42; N, 3.96; S, 9.07. Found: C, 68.23; H, 5.17; N, 3.78; S, 8.87.

(3a*RS*,6a*RS*,7*SR*,7a*SR*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-benzo[4,5]thieno[2,3-*f*]cyclopenta[*d*]isoindole-7-carboxylic acid (12f). Reflux for 6 hours. Yield: 167.2 mg (83 %); colourless powder. M.p. 228 – 229 °C. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.83 (s, 1H, CO_2H), 7.65 (d, *J* = 8.1 Hz, 2H, H Ar), 7.53 (d, *J* = 7.6 Hz, 1H, H Ar), 7.36 (t, *J* = 8.1 Hz, 2H, H Ar), 7.33 (d, *J* = 7.6 Hz, 1H, H Ar), 7.22 (t, *J* = 7.6 Hz, 1H, H Ar), 7.14 (t, *J* = 7.6 Hz, 1H, H Ar), 7.09 (t, *J* = 8.1 Hz, 1H, H Ar), 4.26–4.23 (m, 1H, H-7a), 3.80 (d, *J* = 9.6 Hz, 1H, H-4A), 3.71 (d, *J* = 9.6 Hz, 1H, H-4B), 3.33 (d, *J* = 6.6 Hz, 1H, H-6a), 2.75 (dd, *J* = 10.6, 6.6 Hz, 1H, H-7), 2.47–2.42 (m, 1H, CH_2), 2.26–2.21 (m, 1H, CH_2), 2.00–1.64 (m, 4H, CH_2). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 174.1, 172.7, 140.1, 139.6, 139.4, 135.3, 129.3, 129.2 (2C), 128.7, 126.7, 125.4, 124.8, 122.3, 120.4 (2C), 57.4, 48.0, 47.9, 47.1, 46.9, 37.0, 28.5, 21.7. IR (KBr, cm^{-1}): ν_{max} = 1741 (CO_2), 1627 (N-C=O). MS (ESI): *m/z* = 404 $[M+H]^+$. Anal. Calcd for $C_{24}H_{21}NO_3S$: C, 71.44; H, 5.25; N, 3.47; S, 7.95. Found: C, 71.49; H, 5.13; N, 3.30; S, 8.12.

(3a*RS*,6a*RS*,7*RS*,7a*RS*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-benzo[4,5]thieno[3,2-*f*]cyclopenta[*d*]isoindole-7-carboxylic acid (12g). Reflux for 3 hours. Yield: 167.2 mg (74 %); colourless powder. M.p. > 250 °C. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.75 (s, 1H, CO_2H), 7.64 (d, *J* = 8.1 Hz, 2H, H Ar), 7.37–7.34 (m, 2H, H Ar), 7.25 (d, *J* = 7.6 Hz, 1H, H Ar), 7.22 (d, *J* = 7.6 Hz, 1H, H Ar), 7.16–7.12 (m, 2H, H Ar), 7.05 (t, *J* = 7.6 Hz, 1H, H Ar), 4.51–4.48 (m, 1H, H-7a), 3.91 (d, *J* = 9.6 Hz, 1H, H-4A), 3.78 (d, *J* = 9.6 Hz, 1H, H-4B), 3.62 (d, *J* = 4.5 Hz, 1H, H-6a), 2.91–2.87 (m, 1H, CH_2), 2.85 (dd, *J* = 11.1, 4.5 Hz, 1H, H-7), 2.44–2.38 (m, 1H, CH_2), 2.02–1.69 (m, 4H, $2CH_2$). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.9, 172.3, 143.9, 140.8, 139.5, 136.9, 133.1, 129.2 (2C), 128.9, 125.7, 124.9, 124.4, 122.0, 120.3 (2C), 58.3, 48.2, 47.7, 47.3, 46.7, 35.6, 27.2, 21.6. IR (KBr, cm^{-1}): ν_{max} = 1739 (CO_2), 1672 (N-C=O). MS (ESI): *m/z* = 404 $[M+H]^+$. Anal. Calcd for $C_{24}H_{21}NO_3S$: C, 71.44; H, 5.25; N, 3.47; S, 7.95. Found: C, 71.26; H, 5.00; N, 3.23; S, 8.24.

(4a*RS*,7a*RS*,8*SR*,8a*SR*)-7-Oxo-6-phenyl-1,2,3,4,5,6,7,7a,8,8a-decahydrobenzo[*d*]thieno[2,3-*f*]isoindole-8-carboxylic acid (12h). Reflux for 5 hours. Yield: 33.0 mg (18 %); colourless powder. M.p. 209 – 210 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.56 (s, 1H, CO_2H), 7.65 (d, *J* = 7.6 Hz, 2H, H Ar), 7.36 (t, *J* = 7.6 Hz, 2H, H Ar), 7.14 (t, *J* = 7.6 Hz, 1H, H Ar), 6.46 (dd, *J* = 6.4, 2.6 Hz, 1H, H-10), 6.06 (dd, *J* = 6.4, 2.6 Hz, 1H, H-9), 3.82 (d, *J* = 10.0 Hz, 1H, H-5A),

3.70 (d, *J* = 10.0 Hz, 1H, H-5B), 3.61–3.58 (m, 1H, H-8a), 3.25 (d, *J* = 3.6 Hz, 1H, H-7a), 2.63 (dd, *J* = 11.4, 3.6 Hz, 1H, H-8), 2.33–2.27 (m, 1H, CH_2), 2.15–2.12 (m, 1H, CH_2), 1.99-1.96 (m, 1H, CH_2), 1.72–1.57 (m, 4H, 2 CH_2), 1.25–1.20 (m, 1H, CH_2). ^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.8, 172.7, 139.6, 133.3, 130.9, 129.1 (2C), 126.1, 125.0, 124.6, 120.0 (2C), 56.9, 51.7, 47.2, 43.5, 41.1, 38.5, 30.4, 26.5, 22.7. IR (KBr, cm^{-1}): ν_{max} = 1715 (CO_2), 1681 (N-C=O). MS (ESI): *m/z* = 368 $[M+H]^+$. Anal. Calcd for $C_{21}H_{21}NO_3S$: C, 68.64; H, 5.76; N, 3.81; S, 8.73. Found: C, 68.31; H, 5.37; N, 3.45; S, 8.99.

(5a*RS*,8a*RS*,9*SR*,9a*SR*)-8-Oxo-7-phenyl-2,3,4,5,6,7,8,8a,9,9a-decahydro-1H-cyclohepta[*d*]thieno[2,3-*f*]isoindole-9-carboxylic acid (12i). Reflux for 6 hours. Yield: 15.2 mg (8 %); colourless powder. M.p. 236 – 237 °C. ^{1}H NMR (700.2 MHz, DMSO-d_6, 25 °C) δ 12.53 (s, 1H, CO_2H), 7.60 (d, *J* = 7.9 Hz, 2H, H Ar), 7.35 (t, *J* = 7.9 Hz, 2H, H Ar), 7.13 (t, *J* = 7.9 Hz, 1H, H Ar), 6.48 (dd, *J* = 6.0, 2.1 Hz, 1H, H-11), 6.06 (br.d, *J* = 6.0 Hz, 1H, H-10), 3.75 (br.s, 2H, H-6), 3.62 (d, *J* = 11.5 Hz, 1H, H-9a), 3.37 (br.s, 1H, H-8a), 2.57 (dd, *J* = 11.5, 3.6 Hz, 1H, H-9), 2.36-2.32 (m, 1H, CH_2), 2.15-2.08 (m, 2H, CH_2), 1.86–1.32 (m, 7H, CH_2).^{13}C NMR (176.1 MHz, DMSO-d_6, 25 °C) δ 173.6, 172.8, 139.6, 136.8, 132.2, 129.2 (2C), 126.9, 124.9, 124.6, 120.0 (2C), 58.2, 53.3, 47.7, 45.2, 42.7, 40.5, 31.1, 30.3, 25.5, 24.6. IR (KBr, cm^{-1}): ν_{max} = 1735 (CO_2), 1662 (N-C=O). MS (ESI): *m/z* = 382 $[M+H]^+$. Anal. Calcd for $C_{22}H_{23}NO_3S$: C, 69.26; H, 6.08; N, 3.67; S, 8.41. Found: C, 69.01; H, 5.84; N, 3.87; S, 8.56.

(6a*RS*,9a*RS*,10*SR*,10a*SR*)-9-Oxo-8-phenyl-1,2,3,4,5,6,7,8,9,9a,10,10a-dodecahydrocycloocta[*d*]thieno[2,3-*f*]isoindole-10-carboxylic acid (12j). Yield: 11.8 mg (6 %); colourless powder. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.56 (s, 1H, CO_2H), 7.59 (d, *J* = 7.6 Hz, 2H, H Ar), 7.35 (t, *J* = 7.6 Hz, 2H, H Ar), 7.13 (t, *J* = 7.6 Hz, 1H, H Ar), 6.46 (br.d, *J* = 4.5 Hz, 1H, H-12), 6.06 (br.d, *J* = 4.5 Hz, 1H, H-11), 3.82 (d, *J* = 9.6 Hz, 1H, H-7A), 3.61-3.58 (m, 2H, H-7B, H-10a), 3.46 (br.d, *J* = 2.5 Hz, 1H, H-9a), 2.29-2.07 (m, 4H, CH_2), 1.83–1.31 (m, 9H, CH_2). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.5, 172.9, 139.5, 135.6, 131.7, 129.2 (2C), 126.6, 124.9, 124.8, 120.0 (2C), 59.1, 50.6, 48.1, 44.4, 43.4, 34.8, 30.2, 26.2, 24.9, 24.7, 24.4. IR (KBr, cm^{-1}): ν_{max} = 1739 (CO_2), 1709 (N-C=O). MS (ESI): *m/z* = 396 $[M+H]^+$.

(6a*RS*,9a*RS*,10*SR*,10a*SR*)-9-Oxo-8-phenyl-5,6,7,8,9,9a,10,10a-octahydronaphtho[2,1-*d*]thieno[2,3-*f*]isoindole-10-carboxylic acid (12k). Reflux for 4 hours. Yield: 66.4 mg (32 %); colourless powder. M.p. > 250 °C. ^{1}H NMR (600.2 MHz, DMSO-d_6, 25 °C) δ 12.66 (s, 1H, CO_2H), 7.55 (d, *J* = 7.6 Hz, 2H, H Ar), 7.30 (t, *J* = 7.6 Hz, 2H, H Ar), 7.22-7.18 (m, 4H, H-Ar), 7.08 (t, 1H, *J* = 7.6 Hz, H Ar), 6.47 (dd, *J* = 6.6, 2.4 Hz, 1H, H-12), 6.21 (dd, *J* = 6.6, 2.5 Hz, 1H, H-11), 4.06 (d, *J* = 10.1 Hz, 1H, H-7A), 3.86 (dt, *J* = 11.6, 2.5 Hz, 1H, H-10a), 3.55 (d, *J* = 3.4 Hz, 1H, H-9a), 3.42 (d, *J* = 10.1 Hz, 1H, H-7B), 3.16–3.01 (m, 2H, CH_2), 2.83 (dd, *J* = 11.6, 3.4 Hz,

1H, H-10), 2.30 – 2.19 (m, 2H, CH_2). ^{13}C NMR (150.9 MHz, DMSO-d_6, 25 °C) δ 173.8, 172.6, 139.6, 136.2, 135.6, 134.2, 130.7, 129.2 (3C), 129.1, 127.9, 126.3, 125.9, 125.4, 124.7, 119.8 (2C), 56.7, 51.7, 49.3, 42.7 (2C), 33.8, 26.2. IR (KBr, cm^{-1}): ν_{max} = 1746 (CO_2), 1657 (N-C=O). MS (ESI): *m/z* = 416 $[M+H]^+$. Anal. Calcd for $C_{25}H_{21}NO_3S$: C, 72.27; H, 5.09; N, 3.37; S, 7.72. Found: C, 72.13; H, 4.86; N, 3.50; S, 7.87.

4. Antibacterial and antifungal assays

Antibacterial activity

The majority of the obtained benzo-, carbocyclo- and thieno[2,3-*f*]isoindolecarboxylic acids (**8a-j, l-q, s-x**, **16b-h**, **17**, **20**, **10a-d**, **12a-k**) has been undertaken against reference bacterial strains combination (*Escherichia coli* C 600*, Staphylococcus aureus* ATCC-25923). Minimum inhibitory concentrations (MICs) were determined by using micro broth dilution method in accordance to the Clinical Laboratory Standards Institute (CLSI), with *pefloxacin* as negative control [12]. Evaluated samples exhibited weak or no antibacterial activity. MIC values for active compounds are summarized in Table S4.

Table S4. Antimicrobial activity of the obtained thieno[2,3-*f*]isoindolescarboxylic acids

ID Compound	Antimicrobial activity MIC (μg mL^{-1})	
	S. aureus ATCC-25923	*E. coli C600*
8b	32	64
8c	64	64
8d	>256	256
8e	>256	256
8i	128	64
8j	64	64
8l	256	128
8s	128	128
8t	>256	256
8w	128	64
8x	256	256
10b	256	128
16b	256	>256
16c	256	256
Pefloxacin	<2	<2

The results presented in Table S4 show that compounds **8b, 8c, 8i, 8j, 8w** possess moderate antibacterial activities (growth inhibition of *S. aureus* at 32-128 μg mL^{-1}, *E.coli* at 64-128 μg mL^{-1}) and compound **8s** (MIC=128 μg mL^{-1} against both bacterial cultures). Compounds **8l**, **8x**, **10b**, **16b**, **16c** showed bacteriostatic activity against *S. aureus* in the highest level of test concentration 256 μg mL^{-1}.

Hit compound **8b** has been undertaken against expanded bacterial panel – seven strains: Gram-positive multiresistant clinical isolate of *Staphylococcus aureus*, *Enterococcus faecium* K1, *Bacillus cereus IP* 5832, *Micrococcus luteus* 2665 and Gram-negative multiresistant clinical *Escherichia coli C1*, *Pseudomonas fluorescens* A1 and *Escherichia coli* F. MIC values are summarized in Table S5. Compound **8b** exhibited good inhibitory activity against nonpathogenic gram positive and gram-negative bacterial strains up to MIC = 4 μg mL^{-1} against *Bacillus cereus IP 5832* and MIC = 16 against *Pseudomonas fluorescens* A1 and showed low activity against multiresistant clinical strains *S. aureus* and *E. coli* (MIC = 256 μg mL^{-1} against both bacterial cultures).

Table S5. MIC values **8b** against bacterial strains

Entry	Gram "+"				Gram "–"		
	MIC *Staphylococcus aureus multiresistant clinical,* μg/mL	MIC *Bacillus cereus IP 5832,* μg/mL	MIC *Enterococcus faecium K1* μg/mL	MIC *Micrococcus luteus* 2665 μg/mL	MIC *Escherichia coli C1 multiresistant clinical,* μg/mL	MIC *Pseudomonas fluorescens A1*, μg/mL	MIC *Escherichia coli F*, μg/mL
8b	256	4	32	32	256	16	32
Pefl	<2	<2	<2	<2	<2	<2	<2

The minimum bactericidal concentration (MBC) - the lowest concentration of antimicrobial compound to kill 99.9% of the initial viable cells - was determined based on document M26 CLSI [13]. Table S6 shows, the hit compound **8b** was a bacteriostatic agent (MBC/MIC value is more than four or 4), except for *Escherichia coli* C600.

Table S6. MBC values **8b** against bacterial strains

Entry	Gram "+"					Gram "–"			
	MBC *Staphylococcus aureus multiresistant clinical,* μg/mL	MBC *Staphylococcus aureus* ATCC-25923, μg/mL	MBC *Bacillus cereus IP 5832,* μg/mL	MBC *Enterococcus faecium K1* μg/mL	MBC *Micrococcus luteus* 2665 μg/mL	MBC *Escherichia coli C1 multiresistant clinical,* μg/mL	MBC *Escherichia coli* C600, μg/mL	MBC *Pseudomonas fluorescens A1*, μg/mL	MBC *Escherichia coli F*, μg/mL
8b	>256	128	32	>256	>256	>256	128	>256	128
Pefl	<2	<2	<2	<2	<2	<2	<2	<2	<2

Due to the low antibacterial activity, we were unable to trace the relationship between structure and activity in the series of obtained thieno[2,3-*f*]isoindolescarboxylic acids. It should only be noted that the implementation of a trifluoromethyl group in the geminal position relative to the carboxyl group (for example, compounds **8s**, **8w**) or in the *meta*-position of the phenyl ring (compounds **8b**, **8i**, **8j**) increases the chance of the compounds developing antibacterial activity.

Antifungal activity

Some benzo-, carbocyclo- and thieno[2,3-*f*]isoindolecarboxylic acids (**8d, g, j, n-p, t, v, w, x, 16c, f-h, 20, 10c, d, 12a-c, f-h, k**) were studied for the possession of antifungal activity against the yeast culture *Candida albicans* ATCC 14053 and the culture of the imperfect fungus *Aspergillus niger* ATCC 16404. Minimum inhibitory concentrations (MICs) were determined using micro broth dilution method in accordance with the requirements of the Institute of Clinical and Laboratory Standards (CLSI/NCCLS) and according to previous studies [14-16]. *Amphotericin B* (Sigma, USA) was used as a reference drug.

The majority of the compounds did not possess significant antifungal activity. Their MICs, as a rule, in relation to both test cultures used exceeded 64 μM - the highest concentration of drugs in the experiment. At the same time, compound **12k** showed noticeable antifungal activity. Its MIC against yeast culture *C. albicans* was 32 μM.

Experimental section

The obtained compounds **8a-j, l-q, s-x**, **10a-d**, **12a-k**, **16b-h**, **20** were evaluated for their *in vitro* antibacterial activity against *Staphylococcus aureus* ATCC 25923, *Staphylococcus aureus multiresistant clinical, Bacillus cereus IP 5832, Enterococcus faecium K1, Micrococcus luteus* 2665 *clinical*, *Escherichia coli* C600, *Escherichia coli C1 multiresistant clinical, Escherichia coli F*. The MICs ofthe compounds were measured using the twofold serial brothdilution method in a 96-well plate. Twofold serial dilutions of solutions of the test compounds were prepared at 256, 128, 64, 32, 16, 8, 4, 2, 1 and 0.5 μg mL^{-1}. Overnight cultures were grown at 37 °C in Lysogenybroth (LB) and diluted to obtain an opacity equivalent to 0.5 on the McFarland scale. Screening vials were filled with solutions of thetest compounds in 0.5% DMSO as prepared above with three replications for each treatment. API pefloxacin (0.5-256 μg mL^{-1} and 0.5% DMSO served as positive and negative controls, respectively. Test organisms were grown in suitable broth for 18 h at 37 °C. After incubation, the MICs of the test compounds were determined by measuring the absorption of the solution with a spectrophotometer FlexA-200 Microplate Reader (Hangzhou Allsheng Instruments Co., Ltd.), the optical density was determined at 625 nm.

The minimum bactericidal concentration (MBC) was determined by re-culturing (subculturing) broth dilutions that inhibit growth of a bacterial stains (i.e., those at or above the MIC). The LB-broth dilutions were plated onto Mueller-Hinton agar, incubated for 24 hours and enumerated to determine viable CFU/ml. MBC is the minimum concentration that kills > 99.9% of a bacterial species within 18–24 h of treatment. If the MBC value of an antibacterial agent is not more than four times the MIC value, then the antibacterial agent is considered to be bactericidal. If the MBC/MIC value is more than four, then the antibacterial agent is considered to be bacteriostatic.

The antifungal activity of compounds **8d, g, j, n-p, t, v, w, x, 16c, f-h, 20, 10c, d, 12a-c, f-h, k** was evaluated against the yeast culture *Candida albicans* ATCC 14053 and the culture of the imperfect fungus *Aspergillus niger* ATCC 16404. The MICs were determined in vitro in a liquid culture medium RPMI 1640 with *L*-glutamine without sodium bicarbonate by the microdilution method of two-fold serial dilutions in accordance with the requirements of the Institute of Clinical and Laboratory Standards (CLSI/NCCLS) and according to previous studies [14-16].

Microbial cultures were grown on solid nutrient media, which were required for their maintenance, as well as to obtain the seed material necessary for setting up experiments. Yeast

Candida albicans was grown on Sabouraud agar (peptone – 10 g, glucose – 40 g, agar – 20 g, distilled water – 1 L, pH 6.0), fungal culture *Aspergillus niger* – on potato-glucose agar (potato – 200 g, glucose – 20 g, agar – 15 g, distilled water – 1 L, pH 5.5-6.0). The antifungal activity of the tested compounds was evaluated in a liquid nutrient medium RPMI 1640 with *L*-glutamine, without sodium bicarbonate (ICN Biomedicals Inc., Ohio, USA) by dilution in distilled water followed by buffering with 0.165 M morpholine propane sulfonic acid (MOPS; ACROS ORGANICS, New Jersey, USA) and bringing the pH to 7.0 with 1 N NaOH. Sterilization was carried out by pressure filtration through 0.22 μm Sterivex-GV filters (Millipore, USA).

To set up the experiment, it was necessary to obtain seed material (inoculum), that was the cells or spores of cultures grown on appropriate solid nutrient media. For this purpose daily culture of the yeast *C. albicans*, grown at 35 °C, and a culture of the fungi *A. niger*, grown at 28 °C for 7 days, that showed abundant sporulation, were used. The preparation of yeast cell suspensions, as well as the preparation of a suspension of *A. niger* spores, was carried out in a sterile isotonic NaCl solution, bringing the density of the suspensions to certain values. The optical density of the yeast suspension was controlled spectrophotometrically, reaching D = 0.11 at a wavelength of 530 nm. This yeast cell suspension was diluted 1:1000 with standard medium (RPMI 1640) to obtain an inoculum suspension containing twice the concentration of cells compared to the experiment. The suspension of fungal spores was adjusted to an optical density of 0.09 – 0.11 and diluted with a standard medium (RPMI 1640) by 100 times. The final concentration of fungal spores/cells in the experiment was $0.4 – 5 \times 10^4$ cells/ml.

To assess the biological activity of the test compounds, they were dissolved in DMSO at an initial concentration of 6.4 mM, after which a series of two-fold dilutions of these preparations in the same solvent was prepared up to a concentration of compounds of 12.5 μM. After the transfer of these solutions into a liquid nutrient medium and the introduction of inoculum, they were diluted 100 times, and the solvent concentration (DMSO) decreased to 1%. The final concentration of drugs was in the range from 64 to 0.125 μM. Experiments to assess the antibiotic activity of the tested preparations were carried out using the micromethod in sterile 96-well flat-bottomed plates (Pan-Eco, Russia). The sample volume in the experiment was 200 μl.

Each tested compound was present in the experiment at least in three repetitions. Wells containing no test drugs or solvent were included in the experimental panel as controls. *Amphotericin B* (Sigma, USA) was used as a reference drug. The plates were incubated in the dark in a humid atmosphere at 35 °C. Growth assessment was performed visually. The minimum inhibitory concentration (MIC) was defined as the minimum drug concentration that completely prevents growth of the test organism. The MICs of preparations for the yeast culture *C. albicans* were read after 24 hours, for *A. niger* - after 48 hours of cultivation. Statistical processing of the

research results was carried out using the computer programs Statgraf and Microsoft Excel, calculating the arithmetic mean values, confidence intervals and standard deviation. The significance of differences between the means was assessed using Student's t-test ($P<0.05$).

5. DFT Calculations

DFT calculations of the IMDAV reaction were calculated using the B3LYP functional and 6-311G basis set applying the CPCM for benzene (353K) as an implicit solvent dielectric as implemented in the program package Orca [17]. The calculated energies are summarized in Table S7 and referenced to the starting point (structure **15l**) and energies are given in kcal/mol and kJ/mol. The corresponding scenarios of the calculations in benzene are visualized in the corresponding Figures S15-17.

Table S7. Calculated energies of structures, intermediates and transition states in benzene.

Structures	**Eh**	**kcal/mol**	**kJ/mol**	**dkJ/mol**
15l	-1488.0679	-933774.68	-3906913.3	0
4a*S*,10a*R*-**8l**	-1488.0809	-933782.84	-3906947.4	-34.128822
4a*R*,10a*S*-**8l**	-1488.0812	-933782.99	-3906948	-34.757391
endo-**8l**	-1488.0878	-933787.13	-3906965.3	-52.076829
exo-**8l**	-1488.0888	-933787.79	-3906968.1	-54.833257
TS_{IMDAV}	-1488.0269	-933748.94	-3906805.6	107.69461
14a	-1488.0712	-933776.76	-3906922	0
3a*S*,9b*R*-**8a**	-1488.0743	-933778.68	-3906930	-8.0161843
3a*R*,9b*S*-**8a**	-1488.0757	-933779.59	-3906933.8	-11.828585
endo-**8a**	-1488.0805	-933782.56	-3906946.2	-24.277706
exo-**8a**	-1488.0813	-933783.11	-3906948.5	-26.559155
24b	-1490.4199	-935250.59	-3913088.5	0
10b	-1490.4494	-935269.08	-3913165.8	-77.362226

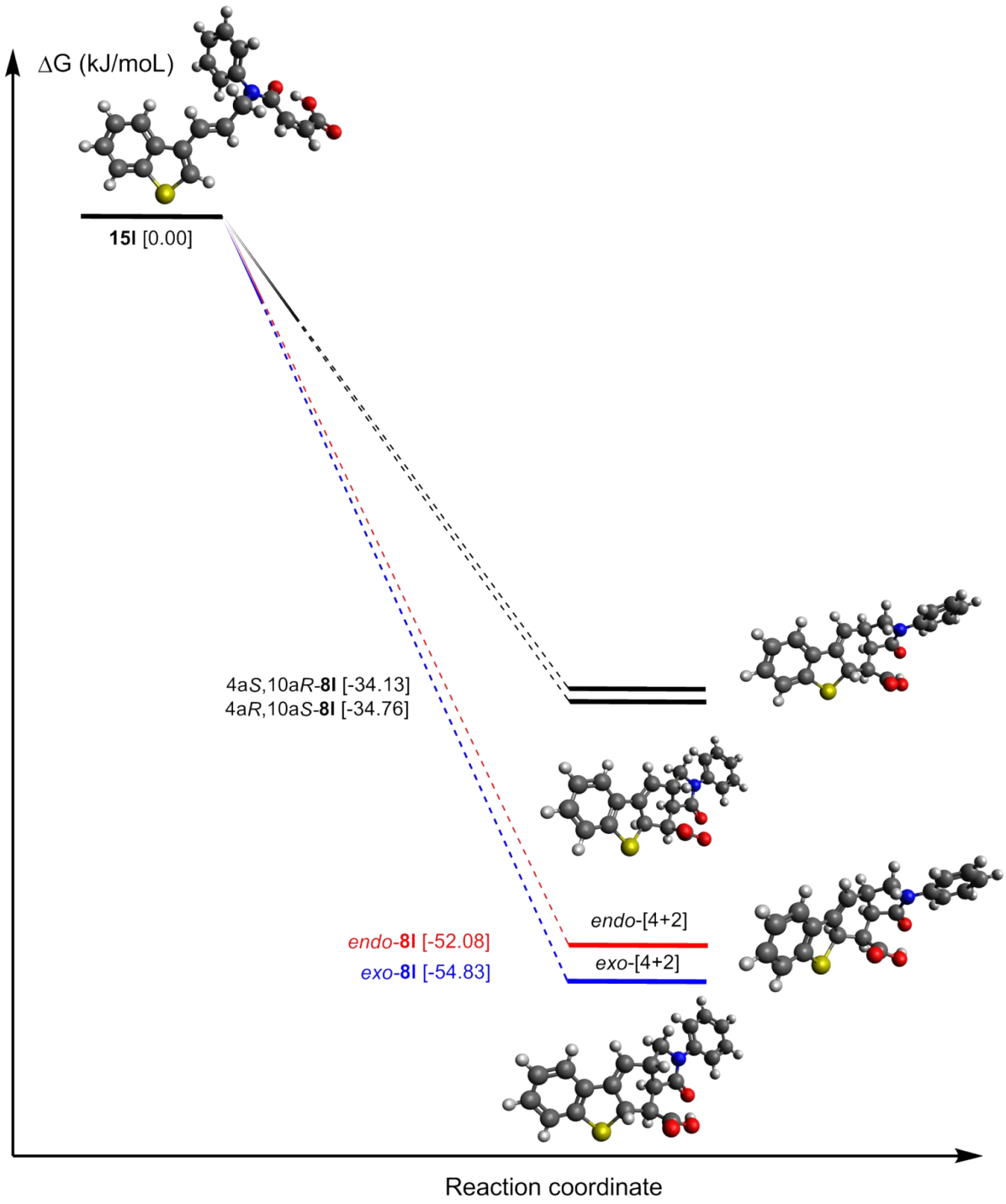


Figure S15. Calculation scenario of the IMDAV reaction of **15l** in benzene (referenced to the starting point - structure **15l** = 0.00 kJ/mol)

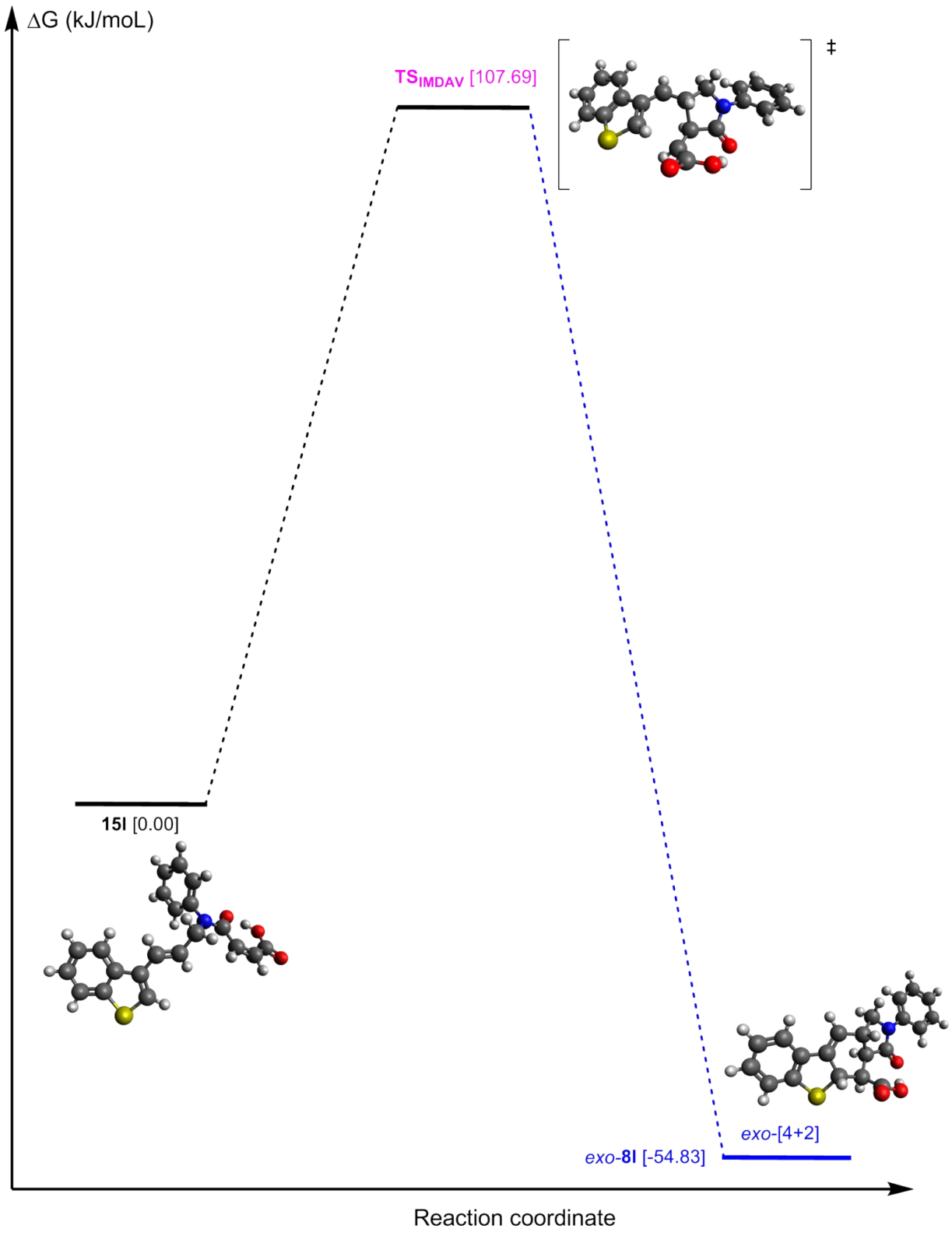


Figure S16. Calculation scenario of the IMDAV reaction of **15l** in benzene (with TS)

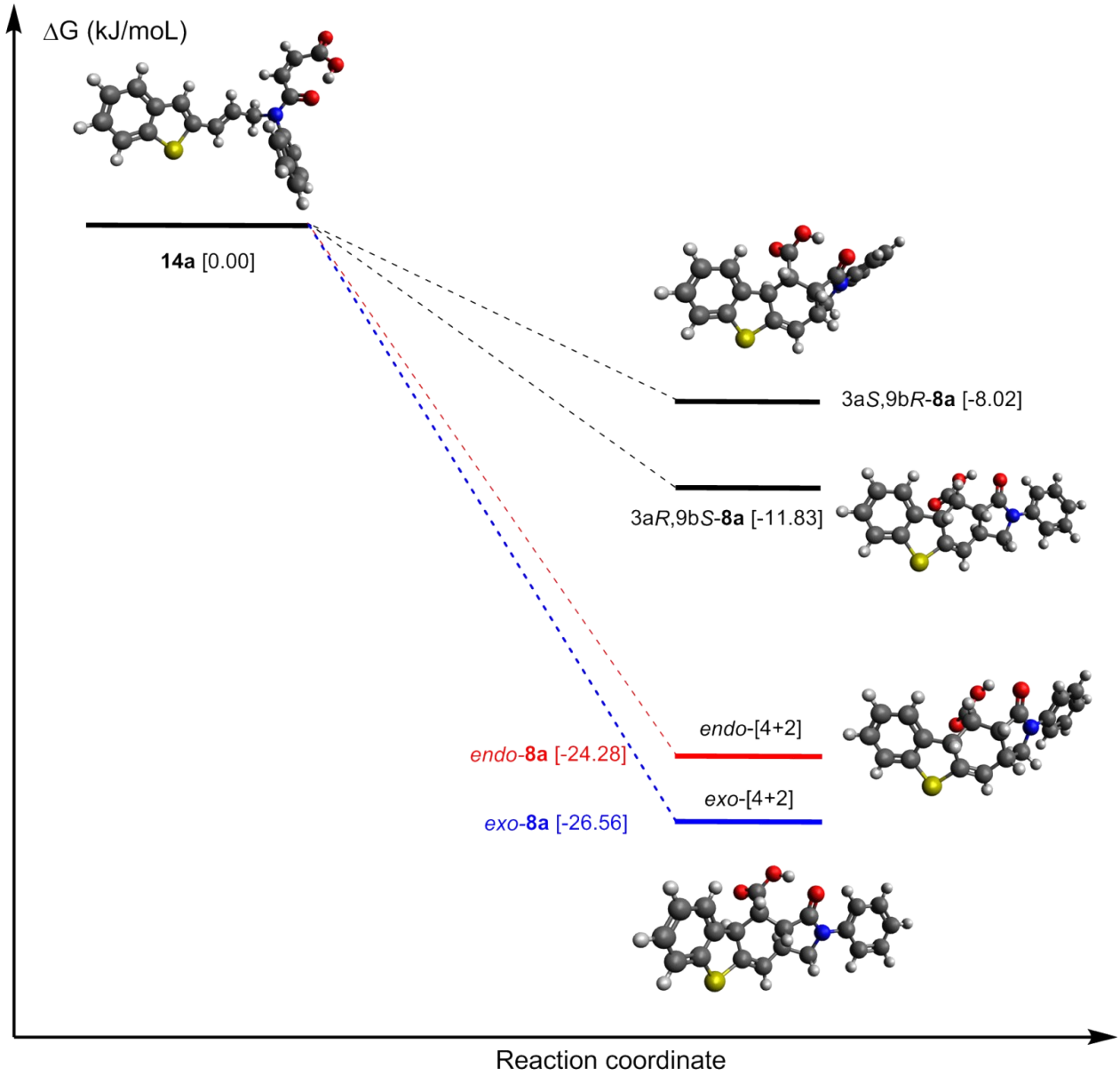


Figure S17. Calculation scenario of the IMDAV reaction of **14a** in benzene (referenced to the starting point - structure **14a** = 0.00 kJ/mol)

xyz-Coordinates and DFT-calculated energies

B3LYP 6-311G TightOpt Freq (353K) CPCM(benzene)

15l

C	-2.38642163815630	0.17894522336138	1.27543623340025
C	-2.47109713536496	-0.55925801854453	0.08088384386493
C	-1.31466212490351	-0.97634457667554	-0.57847529640268
C	-0.08168252548035	-0.64660999872688	-0.01800285408020
C	0.03396394073902	0.09027233164429	1.18251789460737
C	-1.14936875354279	0.50728195215348	1.82346259162538
S	1.56298863188405	-1.06741979775442	-0.68838844313506
C	2.32036936698211	-0.21396183345008	0.71702296308658
C	1.42000347929486	0.33205336595162	1.58266650930571
H	-3.29324735694254	0.49858840722053	1.77097602467248
H	-1.10028056120492	1.08663315087655	2.73568691519556
H	-3.43941549699959	-0.80469196585801	-0.33388379746806

H	-1.37534898113069	-1.53954991898307	-1.49939810970743
H	3.39366221292606	-0.22147765896354	0.79112292584997
C	1.77710710314463	1.06859753554102	2.80211896095616
C	2.90874763671399	1.76218841433533	3.00169659173119
H	1.04439227379205	1.03695323864375	3.60363691784003
C	3.24233470336199	2.45032548923011	4.29830109387714
H	3.64117482906778	1.85673597089984	2.20534668097697
N	3.42396099669711	3.92817191493299	4.14276967614930
H	4.13974238187969	2.03427997464431	4.75534903336714
H	2.43690872615347	2.31318603807318	5.01798482818600
C	4.59913098232850	4.55268057218951	3.84474237840421
O	4.62742805652235	5.82632433658603	3.76754201149279
C	5.80433098014308	3.72573945036283	3.60553447984492
C	7.05977696707485	4.12713860136513	3.32129885770548
H	5.66561549636790	2.65610199152929	3.64931282945928
C	7.70670942179367	5.46409257048051	3.15398626836695
H	7.79329206781841	3.34430509817295	3.17643711857732
O	8.92679053584893	5.50362390138751	2.92132441609687
O	6.98118107693585	6.59603518530434	3.24703130209813
H	5.99789267434753	6.43070890557824	3.44806737786581
C	2.22320194752620	4.73509017038882	4.28827071282157
C	1.48873693887322	5.10335345722844	3.15802374140510
C	0.31522355936287	5.84729417449795	3.31085007274390
C	-0.12029423031247	6.21936537610126	4.58656516419367
C	0.62114043224470	5.84856661881649	5.71326961026907
C	1.79574719681000	5.10582621134847	5.56635630289640
H	2.38194789527599	4.82394287857064	6.43054452213139
H	1.83572380842942	4.81592178284396	2.17569716112199
H	-0.25337934263164	6.13502572043874	2.43693141264453
H	-1.02796586751280	6.79641342351742	4.70171626990507
H	0.29130169384215	6.14007333473904	6.70128380605669

4a*S*,10a*R*-**8l**

C	-1.90220648009829	-2.31316114254229	0.33054229033791
C	-1.01972182141953	-3.35505061872784	0.01713262012891
C	0.33688038018130	-3.26183779144645	0.35053710685474
C	0.78690209289925	-2.11440978082575	0.99605849284418
C	-0.08055867932323	-1.05114482923625	1.31208819758952
C	-1.43600615212789	-1.16379727823294	0.97444739844470
S	2.53378583083503	-1.79068673336625	1.49285528998674
C	1.89693451220134	-0.30532159783401	2.57054693668768
C	0.59422483600853	0.10522030221057	1.93097568705028
H	-2.95070912236863	-2.40059941158020	0.07999835725205
H	-2.12370851566310	-0.36578975425060	1.22253521880161
H	-1.38594486199677	-4.24416158847987	-0.47854104455941
H	1.01698529633959	-4.06888978152048	0.11621582703563
H	1.67019296994384	-0.78122845553951	3.52285415853264
C	0.16032469562210	1.37472246873528	1.93482772609468
C	1.02363884417901	2.51634791270913	2.37648808544927
H	-0.80445552205792	1.62059063180614	1.50679536571881
C	0.81297883327910	3.10867945617720	3.79105326632886

H	0.86246127911689	3.34238484001688	1.67620265667023
N	2.10969416434529	3.80580143798988	4.03551539710319
H	0.65094571136553	2.33173659144485	4.54099455906210
H	-0.00852431129322	3.82023473041296	3.82923611217934
C	3.10590906731009	3.31539872167813	3.23389853797833
O	4.32197172574951	3.64844700509267	3.24953434118723
C	2.53929658569531	2.21652868190266	2.34630854780603
C	2.97760118569317	0.76767682936484	2.81629666685198
H	2.92699319561161	2.34750518591004	1.33818979364365
C	3.45757148925962	0.66972987627326	4.27795938800533
H	3.85626869675287	0.52896191995946	2.21392972961106
O	2.87418783488198	0.02993298998328	5.15483832375415
O	4.64633086328660	1.27424411200325	4.58164677299961
H	4.95258734400436	1.95392759791751	3.93655161535920
C	2.25209107944605	4.79551068041573	5.05702130235764
C	1.30181740641930	4.85367104976245	6.09063337593233
C	1.41274214403361	5.82208618699043	7.09047211719243
C	2.46597827676536	6.74005528381182	7.07435358322659
C	3.41092907180742	6.67950176904173	6.04564895003950
C	3.31199070174736	5.71905360204862	5.03729645860000
H	4.05080654025205	5.67150324787527	4.25591180310734
H	0.48909978826977	4.14356764128217	6.12992378343273
H	0.67605933776752	5.85152020070836	7.88212939773791
H	2.55031086032438	7.48789962156785	7.85106617224988
H	4.23162382495379	7.38400518848997	6.02141463333329

endo-**8l**

C	-2.21505074456036	-2.41557982696356	1.08674486874186
C	-1.34239473647245	-3.47438962139514	0.80246219732753
C	0.03653837300652	-3.25275355508567	0.71703066919689
C	0.51980048559584	-1.96356380988413	0.92188569441124
C	-0.33563153710092	-0.88558041652096	1.21452011536841
C	-1.71546083686586	-1.12787486151165	1.29171573058992
S	2.29906758013235	-1.49642582070266	0.84934575984899
C	1.82485487205691	0.35278767852996	1.06821068716869
C	0.34865819732948	0.39609809935761	1.43735695821019
H	-3.28011243677632	-2.59451763889453	1.14510361495915
H	-2.39619635300349	-0.31427437234976	1.50564245015539
H	-1.73236524754623	-4.47090738813374	0.64374532832612
H	0.71094143413684	-4.06820325221526	0.49546109897779
H	1.98118526166093	0.78216039347534	0.07830368756717
C	-0.17621766843944	1.52151772728873	1.94753275284533
C	0.62880108815604	2.77434597815266	2.18247187106559
H	-1.22387703733098	1.56173486348187	2.22489086423966
C	0.43722994735914	3.37833382451385	3.60109291332943
H	0.31620593797592	3.53668815372094	1.46118168704377
N	1.77029857737336	3.93873694777445	3.94952002961347
H	0.16035563706071	2.61188418919241	4.32715204037895
H	-0.31461129787722	4.16503660388993	3.61413892371859
C	2.76307023866263	3.45984411328779	3.14003996946773
O	4.00456694576645	3.61820924081009	3.29078176318061

C	2.16546027024156	2.60850373232866	2.03275022581248
C	2.69272125012842	1.12824950612032	2.06366029690453
H	2.50335149447475	3.01974982358006	1.08061394775342
C	2.72035277695959	0.52524858025638	3.46758626271546
H	3.72466762918548	1.15648564603308	1.70771974862687
O	1.91528692792807	-0.28225514999513	3.92201601407384
O	3.76832397801766	0.94442969621892	4.25962857584536
H	4.28749044459341	1.69314871257440	3.88966240675511
C	1.94440192312026	4.77313188725541	5.09747993380024
C	0.91379451112374	4.85517969557027	6.05021794894797
C	1.05449219686378	5.68008219307050	7.16824536944706
C	2.21701150538968	6.43191563827299	7.35323044207855
C	3.24103129836208	6.34994120024774	6.40478054477511
C	3.11484740734048	5.53188618646407	5.28104484212857
H	3.91461001711255	5.46596050318316	4.56403221253786
H	0.01047080218409	4.27567064859351	5.93568527612404
H	0.25295499350887	5.72831579958837	7.89322920978567
H	2.32427145368842	7.06858461315424	8.22088264945206
H	4.14727643947721	6.92651483766444	6.53453741670327

endo-**8l**

C	-2.03949502523292	-2.00353739805098	0.30879349058732
C	-1.24322634299606	-2.48988600072081	-0.73614115548767
C	0.13312645051215	-2.23423061249826	-0.75870472933534
C	0.68925788360151	-1.48657234443685	0.27445662826858
C	-0.09332649474889	-0.97882092361787	1.32904018860861
C	-1.46881467236952	-1.25010113965973	1.33800803053702
S	2.46894934299309	-1.02286448468095	0.40950316551573
C	2.14951583658760	-0.46310031777132	2.23645355463507
C	0.65823822588155	-0.15767564823079	2.29476105886575
H	-3.09933688190596	-2.21876514923010	0.32434570465159
H	-2.08673456086785	-0.88699601232592	2.14904320455661
H	-1.68872712284964	-3.07607407299622	-1.52874359228425
H	0.74974559063303	-2.61721667903262	-1.55994460620225
H	2.34105204746537	-1.36486970480363	2.81564235327315
C	0.15001164948126	0.76882253534235	3.12868647492118
C	1.09832231703384	1.61529656223625	3.92807184415971
H	-0.91781639805008	0.94175191586116	3.19457693027442
C	0.67641905120565	3.03829643706728	4.33401353899954
H	1.41750724958426	1.09312507588225	4.83948242559324
N	1.99468446680216	3.74256353254059	4.45107299553423
H	0.15470669691949	3.07701927589118	5.28699973549882
H	0.06074867843898	3.51242318234982	3.56513906307567
C	2.98454428203071	3.07349878021180	3.78081011577757
O	4.20723121269672	3.38594777248317	3.72502956821568
C	2.34373800615643	1.90027797295149	3.06901074235860
C	3.14401442450897	0.63309733081433	2.71010479966620
H	1.98231007100908	2.30370883184076	2.11338300699448
C	4.03565490142098	0.09931600627987	3.84085658695188
H	3.82202044253433	0.88961833055445	1.89220332094761
O	3.90382334627427	-1.01053518513925	4.36202135275376
O	5.05774443852522	0.91223989575904	4.22690660976763

H	5.00938122208086	1.84296161370822	3.87460628444617
C	2.11868799732662	4.98736813201789	5.14229089480188
C	0.95910656239125	5.73321896074379	5.41691520305979
C	1.04984230121658	6.94438095948813	6.10610021440752
C	2.29084504600137	7.42959976126105	6.52581476589790
C	3.44352717420454	6.68886346843493	6.24779496438207
C	3.36936071125842	5.47429885708902	5.56340465891291
H	4.26289347028776	4.91517010329270	5.34689772944561
H	-0.00927565655249	5.38400772105094	5.09101611317045
H	0.14789761496702	7.50612469004504	6.30945281080379
H	2.35879788037067	8.36799604322287	7.05910211004033
H	4.41137056317163	7.05203292477484	6.56683484295135

4a*R*,10a*S*-**8l**

C	-1.97197797409856	-2.35110239933067	0.43107972616879
C	-1.14179412067064	-3.29507844363252	-0.18748659259779
C	0.24988036913416	-3.15439220628515	-0.14260667239678
C	0.79020688213511	-2.06213164328531	0.53018332927607
C	-0.02447055912904	-1.10526328730948	1.16607804458972
C	-1.41701924769253	-1.26089325767192	1.10521782430522
S	2.59512226132325	-1.73257295348723	0.71377628423100
C	2.16145651367048	0.03262002573356	1.36152042974555
C	0.71923026189533	-0.04257937118761	1.86513868061237
H	-3.04663788199912	-2.46275477170423	0.38182801547893
H	-2.06365751616985	-0.52999620268491	1.57315381708354
H	-1.57498700184675	-4.13739705414120	-0.71019585261167
H	0.89061611351138	-3.88041984900087	-0.62346446096355
H	2.16480511061954	0.61824238887768	0.44053528993636
C	0.24337704560946	0.77093324999505	2.82855145144937
C	1.17596000673161	1.67364378303428	3.58364087849694
H	-0.78361250812563	0.68477870519060	3.16465263543908
C	0.78658247895605	3.09864247909597	4.02237743218136
H	1.46925280113961	1.15274775325459	4.50623388174735
N	2.13843331422955	3.70113899923678	4.29216537914896
H	0.18839734461962	3.12113827379615	4.92966097906404
H	0.27127806099176	3.64877239428896	3.23074581961972
C	3.13228397215664	3.00262907024705	3.64740046204155
O	4.37775111124087	3.16875317263943	3.73879713368833
C	2.44642220857558	1.97182795501301	2.77743725801550
C	3.17815181534419	0.69462854404586	2.31157570470082
H	2.14615143906772	2.50565701498674	1.86564071687428
C	3.65021256623566	-0.12192855851249	3.50745748981641
H	4.06543544977249	0.97912284761375	1.74043501594381
O	3.15346595408181	-1.16875938885976	3.91272588011813
O	4.72330484931217	0.42763654822611	4.17140430276895
H	4.95015847363023	1.34799368497972	3.88948126214369
C	2.29550477997106	4.86845111465040	5.09910025832799
C	1.17112330955637	5.66705582040422	5.37329503557262
C	1.29681042880855	6.80803525697103	6.16840444320525
C	2.53855079649953	7.17194387253126	6.69530714537367
C	3.65666895852624	6.37998913723272	6.41735220908651

C	3.54717361045496	5.23356049439767	5.62822071743767
H	4.41405079679729	4.63249394725450	5.41480194331401
H	0.20421661637069	5.41419276617851	4.96430175289961
H	0.42154117692851	7.41135593540862	6.36943718616975
H	2.63342149512744	8.05638574957714	7.31044206399417
H	4.62464943670718	6.64893540223193	6.81886769850260

14a

C	-2.86901873213485	-1.06460296095209	0.64000630391211
C	-2.76114572288463	-1.51522460606619	-0.68981406747877
C	-1.73013948734386	-1.06352029501931	-1.51493836424084
C	-0.81243834220362	-0.15680895210424	-0.98659991364465
C	-0.89676725763085	0.31077995733685	0.34811439176142
C	-1.94977219463049	-0.15933496141477	1.16011490010006
S	0.61225099217493	0.58347395185058	-1.84368982399746
C	1.03707092883821	1.51309174965902	-0.30687322417286
C	0.14700469587871	1.24350976719105	0.68998491871310
H	-3.67633234681598	-1.42772163320404	1.26165435711095
H	-2.03496770052333	0.18539849312405	2.18255404401740
H	-3.48458858795076	-2.21860467513249	-1.07955170881702
H	-1.64908308881033	-1.40896852385792	-2.53627086901080
H	0.20724911040093	1.71033024211111	1.66340743782372
C	2.20648157755704	2.37602059899216	-0.33287608922026
C	2.83127435790797	2.88680124910223	0.74282342571810
H	2.59544308048734	2.61774897793809	-1.31756795215254
C	4.00872119665280	3.81815663542521	0.64124405717325
H	2.50003730234732	2.63697842628783	1.74615710465794
N	5.23738400865632	3.28029898618749	1.30185421380552
H	3.78532252555415	4.79361935497136	1.07138711513438
H	4.26495432973988	3.99087281393727	-0.40373480186373
C	5.67443180053716	3.62500776384414	2.54612613683711
O	6.79612409849972	3.18327547104253	2.96322807033965
C	4.80872284762230	4.47795487733038	3.39532823596619
C	5.14032166812818	5.15186599469803	4.51413584711681
H	3.77302919277603	4.55208957703533	3.09638834349090
C	6.42639037640929	5.34229843055788	5.25099195642806
H	4.34988718754187	5.71525915294438	4.99321583134633
O	6.47771136059511	6.20604071237671	6.14191017566299
O	7.50125352595437	4.57928148892797	4.96318105530192
H	7.33777681510038	3.91493280110012	4.21379418258676
C	6.03837253095174	2.36023948112208	0.51090402093205
C	5.87533266593316	0.98178206593812	0.66669038043800
C	6.62760853179673	0.10575785502696	-0.12122329911217
C	7.53619432300267	0.60694860759653	-1.05870408029278
C	7.69514681391977	1.98865156582449	-1.20805911916068
C	6.94634355244358	2.86873866396739	-0.42248579109419
H	7.07095817171650	3.93863699469083	-0.52183890441441
H	5.17382787369246	0.60336351752872	1.39663898292604
H	6.50362429924071	-0.96198467113492	-0.00159122318953
H	8.11768829181358	-0.07339520668156	-1.66619560845337
H	8.40181942705756	2.38040625990057	-1.92707864898478

3a*R*,9b*S*-**8a**

C	-1.87041935322412	0.21389800974061	3.19740181828077
C	-2.95858464548097	0.31824686937488	2.32536932302675
C	-2.75139023197531	0.51842621474804	0.95427249724845
C	-1.44454288106716	0.61307992100934	0.49035796741555
C	-0.34045191691921	0.51379992833357	1.34590004870421
C	-0.56125072459521	0.30717028334107	2.70837488160012
S	-0.96241992376051	0.87053152853884	-1.28018698277203
C	0.78952837343365	1.16083334943751	-0.74772878205218
C	1.00404764739661	0.55378500216557	0.64136394682796
H	-2.03796491130054	0.06488675167702	4.25544911294836
H	0.27430125835819	0.22355358382971	3.39151568987469
H	-3.96857282389643	0.25096829869743	2.70687363605364
H	-3.59024871190283	0.60622556297230	0.27793250393097
H	1.28545405691018	-0.49707904579685	0.47072344223348
C	1.69474023918994	1.82208602586065	-1.47588234464098
C	3.01898105026265	2.16497989561185	-0.84723829477816
H	1.44288809084799	2.24305233802815	-2.44143820221339
C	4.35361950027445	2.09474268374338	-1.61518865634470
H	2.94958014475097	3.19485264075016	-0.46972742012529
N	5.34053944482559	2.07786558156792	-0.47922778039665
H	4.53660760237184	2.96247589664843	-2.24375706791627
H	4.43825480801162	1.18434837849300	-2.21403584842165
C	4.74128934538079	1.67810727488341	0.69189160980696
O	5.23833277388916	1.66911545283463	1.85036996254926
C	3.33842532552117	1.23889776455218	0.33432668533788
C	2.21903215099264	1.16956423406880	1.38937968347184
H	3.44022499432606	0.22079108283672	-0.06589596489626
C	1.96618395571088	2.52425814640753	2.03510205081192
H	2.52865373041254	0.48465759209202	2.18428347981691
O	0.96928861577033	3.22262542107045	1.86631664163932
O	2.97204652082834	2.95520845127940	2.86766536740772
H	3.79148268216115	2.40058408195405	2.83684650207365
C	6.71393485112769	2.41802353281123	-0.66977913921403
C	7.24445369458251	2.41100870804123	-1.97183567357350
C	8.58281791754584	2.74643189322234	-2.18655138254545
C	9.40917375620449	3.08780978801841	-1.11280190592042
C	8.88120832760741	3.09004972095465	0.18183796540271
C	7.54407751698772	2.76099448596501	0.41297383443147
H	7.14681845276246	2.75850905358483	1.41335487640638
H	6.62742292728055	2.13563219955601	-2.81429840655580
H	8.97574957070898	2.73520726138814	-3.19451368262159
H	10.44561257628105	3.34651392526206	-1.28170281407521
H	9.50912422140672	3.35335623044426	1.02260682176255

exo-**8a**

C	-1.78527993504481	0.70715906524427	3.14146489531943
C	-2.82891804532261	1.05214281234863	2.27704953433336
C	-2.61602871762347	1.10364705615208	0.89357556697120
C	-1.34756108285334	0.80796320842081	0.40647366184065
C	-0.28753083904284	0.46311420809451	1.25384539043839

C	-0.51584752705181	0.40821795070202	2.63036646981974
S	-0.87446184296445	0.81834701041440	-1.37855211472846
C	0.88778019591040	0.51329434984512	-0.91407956155162
C	1.00916488577417	0.11068224199846	0.54740652760934
H	-1.95635069802055	0.67084135340273	4.20879523183721
H	0.28523699401859	0.13584434494638	3.30605675268131
H	-3.80793317081441	1.28544687821758	2.67367596924009
H	-3.41995845993220	1.37456731094641	0.22342149926681
H	1.11809220666575	-0.98265152361500	0.58791761983556
C	1.92414731028846	0.65678672749130	-1.73816572544690
C	3.33884558961760	0.39267184296561	-1.28153005244207
H	1.78652749957920	0.96477700447221	-2.76787616442966
C	4.33100479512266	1.53196114095390	-1.63746530482362
H	3.70262002301613	-0.51868783738346	-1.76659027128485
N	5.29284984065112	1.54862426451151	-0.50277773844495
H	3.82360426484234	2.49605786478995	-1.70456704309685
H	4.85705688018477	1.34395658998796	-2.57136399461673
C	4.81701595265301	0.87922006508561	0.58959267197566
O	5.32169916254182	0.86677737376464	1.74637853425604
C	3.50543867989262	0.19153564320037	0.24951195480793
C	2.31502819273237	0.68522394008850	1.14515856521278
H	3.62039474685767	-0.86855772357715	0.48086172699325
C	2.25781504969593	2.19866801457202	1.34385477604847
H	2.47889849590648	0.25037686484144	2.13454991242332
O	1.41963641716163	2.95166979254185	0.85487364517926
O	3.22024188889572	2.72274041045284	2.18007295819541
H	3.91885164581395	2.08580106266425	2.45459850522107
C	6.50026614752469	2.31219326491962	-0.56585114499993
C	6.64933977052340	3.28077766488386	-1.57346048666175
C	7.83039750560742	4.02053321437350	-1.66658082641040
C	8.87450381471174	3.80699852438281	-0.76367077785695
C	8.72474697334746	2.84291082844634	0.23804454403657
C	7.55123643678250	2.09470713039216	0.34334157548763
H	7.44075222858337	1.36524510040322	1.12700270594836
H	5.85335169551740	3.47142655807816	-2.27724484276664
H	7.92754438546164	4.76446748269127	-2.44598565233860
H	9.78754567771446	4.38187135966374	-0.83794446517166
H	9.52478596507379	2.66629856322351	0.94462397209280

endo-**8a**

C	-1.60358032516728	-0.61174537223621	2.93731198130781
C	-2.52930557555323	-0.97543323501379	1.95465822134087
C	-2.43088292438335	-0.44855466910431	0.66022764271729
C	-1.39340541068024	0.43406157940072	0.38207504986728
C	-0.45357840459350	0.81413904259481	1.35028380779193
C	-0.56980011870263	0.28552991702526	2.63819795215201
S	-1.09620991804013	1.23590884821580	-1.25811392285841
C	0.54573796719544	1.83749086595894	-0.64615565569300
C	0.56246227340501	1.84468844519670	0.88111104909857
H	-1.68517677099764	-1.02088827825864	3.93516061018890
H	0.12969409419633	0.57312071304146	3.41249577347467

H	-3.32563491264304	-1.66924052353701	2.18839972675393
H	-3.14184055102902	-0.73010163171423	-0.10412578981923
H	0.17732503505288	2.82907795022602	1.18158402459130
C	1.55215101872287	2.21592406265960	-1.43809517153810
C	2.85482385082617	2.55899046525140	-0.76423368610199
H	1.46703696498415	2.23192647449394	-2.51714195230753
C	4.17013853103035	2.35788180034868	-1.53698242577087
H	2.84494029443266	3.58968187181017	-0.38830362172172
N	5.15477948788668	2.10935870562337	-0.43487648367603
H	4.47133827285514	3.23275606186150	-2.10784678412410
H	4.12014301893580	1.49226548723452	-2.20282955756711
C	4.53090998424280	1.72203679273674	0.72093936970394
O	5.08175039042537	1.46655491245297	1.82915927376898
C	3.04996012485566	1.60070838513008	0.42599662102681
C	1.98880531439647	1.75309212987062	1.53457717950929
H	2.91776699230807	0.58451997050334	0.03048819893744
C	2.22386570696804	2.93725358258352	2.48308470865513
H	2.03759437536546	0.85747459608736	2.15894808265724
O	1.45161371221230	3.89148731879044	2.60650608081262
O	3.33648514989649	2.86462610263696	3.26647347700634
H	3.99480718365363	2.16835641230573	2.99074234125377
C	6.56329721248214	2.22027623032166	-0.65115958961661
C	7.05567089195855	2.19204638417835	-1.96743455418682
C	8.42557151607355	2.31828827809165	-2.20749117541157
C	9.31990283655124	2.46999081553223	-1.14490539733478
C	8.82869059494440	2.49433710498427	0.16386926095673
C	7.46167618850218	2.37300914571859	0.42009310913164
H	7.09351523625218	2.38490947357985	1.43121065557063
H	6.38362283404601	2.06336034348805	-2.80290583998924
H	8.78864145035198	2.29413357896865	-3.22630904405440
H	10.38045079694365	2.56712102863668	-1.33305468896857
H	9.50955560983623	2.61264883232346	0.99622114246493

3a*S*,9b*R*-**8a**

C	-1.74550393714702	1.11254019262484	3.30752790055977
C	-2.83023363747858	0.79188391328622	2.48606033945313
C	-2.65490468990120	0.66517503740912	1.10228125323631
C	-1.38364719953999	0.86373533849089	0.57548657283329
C	-0.28088374971601	1.18930375881271	1.37718508615049
C	-0.47375883135671	1.31560256051643	2.75557401710439
S	-0.95144439461433	0.73012344277176	-1.21632652499072
C	0.84317752695105	0.83513612082033	-0.77222398943493
C	1.01635352411146	1.42587918699530	0.61034614446016
H	-1.88582610183229	1.20972719482699	4.37548078866045
H	0.34948196725668	1.58038801827879	3.40457047980418
H	-3.81072981914830	0.63603680920303	2.91559285308183
H	-3.48849612900936	0.41021527922808	0.46267376012719
H	1.10543935546265	2.51252491914333	0.48199302234448
C	1.83161717776843	0.45628943151660	-1.57863806068233
C	3.25232910033699	0.46830038094840	-1.09693501849914
H	1.63351289398255	0.06603054626749	-2.56849098319166

C	4.10612404237188	1.72028353657260	-1.40981187013015
H	3.77112166820737	-0.37973263332843	-1.55302604174917
N	5.19566132756305	1.62338290886811	-0.39625044216418
H	3.54213557219014	2.64548728584450	-1.27560381430851
H	4.52390943894211	1.69861228310286	-2.41362735321426
C	4.83197909302409	0.82857393678064	0.65557328982262
O	5.52433788888446	0.56847914877904	1.67906838871091
C	3.41852146439110	0.30229033659710	0.43671690194901
C	2.31380557735823	0.98141531028018	1.35929453159010
H	3.41983134683931	-0.75619381418601	0.68833285510127
C	2.79954056302962	2.15638815775784	2.23059699093780
H	2.03019228635805	0.20813647512024	2.07665066069192
O	2.30619337179879	3.28580682740985	2.18667466408406
O	3.75052010895907	1.88785921173950	3.17537509291825
H	4.34157450320240	1.12029049592427	2.97347074355387
C	6.41722064722823	2.35275345994949	-0.53383363875901
C	6.46396752596997	3.44166236085715	-1.42152796566419
C	7.64804051453487	4.16323539484255	-1.58455618565510
C	8.79569373215037	3.81265393019731	-0.86879518928733
C	8.74657052329162	2.73044043377979	0.01488338180604
C	7.57096545359827	1.99729124821301	0.18717640476453
H	7.53804698502543	1.17362295103311	0.87914719230808
H	5.58470097340527	3.73879457481072	-1.97352092643709
H	7.66699856023139	5.00087009348127	-2.26890431718843
H	9.71133171355634	4.37399667721839	-0.99575349865436
H	9.62753706176212	2.44843527721442	0.57594950395638

24b

C	-0.76294644782666	1.98680945616277	0.63924816320621
C	-1.73562093972680	0.86787694878465	0.22553826141027
C	-1.09913716955143	-0.52731787325533	0.41909606614981
H	-2.00528823710036	0.99644462965644	-0.82752897773181
H	-2.66047682947358	0.93132898685824	0.80325709945542
C	0.31764243479577	-0.52437465467270	-0.07465294972528
H	-1.68573231425071	-1.28138219166441	-0.11304415279772
H	-1.12331824440043	-0.81155710118432	1.47764559691794
C	1.06772988317007	0.54838763467558	-0.35552885854777
C	0.52652097522963	1.95470013946607	-0.20744489361906
H	0.33376040606924	2.37299170627436	-1.20321807956879
H	1.27566347992338	2.60894622254710	0.24880012109209
H	-0.50519754623093	1.86637729294126	1.69684346899198
H	-1.24286435980041	2.96292808138199	0.53807553205161
C	2.43833083840259	0.26700999841487	-0.95464590422155
C	2.72530982016172	-1.22503816986986	-0.80036850474175
S	1.17366389609410	-2.14511036970549	-0.41165292308296
C	3.93661268580764	-1.77590787340653	-0.93240244043081
C	5.08748517118107	-0.81517401188560	-1.08791716614545
C	4.84714650740016	0.36469387755242	-0.12164830550176
C	3.60403590717770	1.21428861214132	-0.47088388664463
H	2.35859983004616	0.46172785453688	-2.03357989236671
C	3.83443480769397	2.33009711480011	-1.50192654864957

H	3.29302179700665	1.72299828243671	0.44485700411987
O	3.24204075356860	2.40485731563002	-2.58276131373130
O	4.69389147326076	3.32115452346459	-1.13806834724296
C	6.49697665955162	-1.27398877329999	-0.68016220800508
H	5.14245867047811	-0.42168683805822	-2.11089813642101
N	7.14878230047387	0.00608110757480	-0.25583233766973
H	7.05875508060753	-1.71742679820628	-1.49866089539553
H	6.46554417943330	-1.97681262036081	0.15665784840412
C	6.22560393219005	0.97487222637056	0.03134527891787
H	4.62898876890138	-0.08396944230031	0.85657874078781
O	6.46937241865637	2.15468539409589	0.41511872801898
C	8.56794783210879	0.11014312525074	-0.11737233128438
C	9.21654505966283	1.35792208187271	-0.11453979569881
C	10.60647709941301	1.41416558192687	0.00349187794730
C	9.32980883102756	-1.06547869906964	-0.00235443385755
C	10.71980754971676	-0.99286489059186	0.11104464237545
C	11.36625168853376	0.24570127462830	0.11473756305609
H	5.28000637790002	3.10274333917263	-0.35931221023236
H	4.10886184272091	-2.84199968586233	-0.86032075426776
H	8.63943006016997	2.26292549844939	-0.19184717683694
H	8.84945939012072	-2.03255376632993	0.00823426565497
H	11.29199159584796	-1.90677842466376	0.19927151045004
H	12.44279756313576	0.29979887959726	0.20299518623149
H	11.09430652072168	2.37976299772286	0.00340246917972

10b

C	-0.90137775745027	2.03886015210075	0.63404404313556
C	-1.77660839451741	1.14255762517951	-0.26199472275884
C	-1.32786364985775	-0.33548293519700	-0.18508773093238
H	-1.70363813934376	1.48763812283964	-1.29810457647603
H	-2.82650969609873	1.21938649734432	0.02979438502199
C	0.16798570693018	-0.41887708956007	-0.26260809464243
H	-1.79136712724375	-0.90809471787807	-0.99272863444021
H	-1.68276816950883	-0.78070007177153	0.75201026452455
C	1.05173518122583	0.60449593264106	-0.09505563138328
C	0.57494873890745	2.01412775740446	0.18662543744206
H	0.69802845638976	2.62192919870381	-0.71624108550517
H	1.19888787832548	2.48056768613221	0.95568001601732
H	-0.97493442513716	1.69142879572883	1.67036157245543
H	-1.27065397800680	3.06682491291126	0.61620089007947
C	2.44317965206222	0.21178339942871	-0.23497558874902
C	2.62724091716235	-1.11523434218762	-0.51034710995036
S	1.03576858228458	-1.98388763550834	-0.61443750860028
C	3.92907484287489	-1.84934941726253	-0.70045734772362
C	5.03774166381954	-0.80584016111889	-0.88060409439489
C	4.88108071160011	0.31836901565488	0.15590337049939
C	3.61079253535961	1.17199694238226	-0.06206794775718
H	3.87846310948376	-2.51564336140968	-1.56477000656429
C	3.71214005614535	2.18085242716283	-1.21673067334817
H	3.45411728391595	1.77317523550014	0.84056333260277
O	3.02665753590931	2.14563993599931	-2.23876940637466

O	4.59818146783861	3.20726021660505	-1.02940714186575
C	6.49570726249155	-1.24242497687594	-0.66132372687123
H	4.95322945349624	-0.36690890696707	-1.87935178234620
N	7.16351265250057	0.03209744046335	-0.24539340939923
H	6.96917522408649	-1.62829218573171	-1.56103731531916
H	6.57747110565479	-1.98809886091968	0.13463332427923
C	6.25165373852681	0.96407390731332	0.17467233074411
H	4.76305910770924	-0.14806239092399	1.14406421115671
O	6.49310618386109	2.14746914767841	0.54551794496139
C	8.58644685271142	0.16506056982784	-0.24952017839509
C	9.20875839254991	1.42597408707531	-0.20919001075801
C	10.60225632928476	1.51037683705502	-0.22525029354553
C	9.37960322503813	-0.99462649818756	-0.30701445579681
C	10.77218898431479	-0.89310904640074	-0.32548869610007
C	11.39209963156354	0.35828220269993	-0.28445086526048
H	5.22300370546232	3.07508209752869	-0.26757586149059
H	4.14511120244535	-2.47777013773161	0.17199176469033
H	8.60883543249381	2.31755952418480	-0.15487437962630
H	8.92284372751453	-1.97276735136159	-0.32789758704654
H	11.36770409494178	-1.79532810105124	-0.36881385883126
H	12.47084886047621	0.43453560440302	-0.29820691754450
H	11.06855984980600	2.48609491609611	-0.19462024781275

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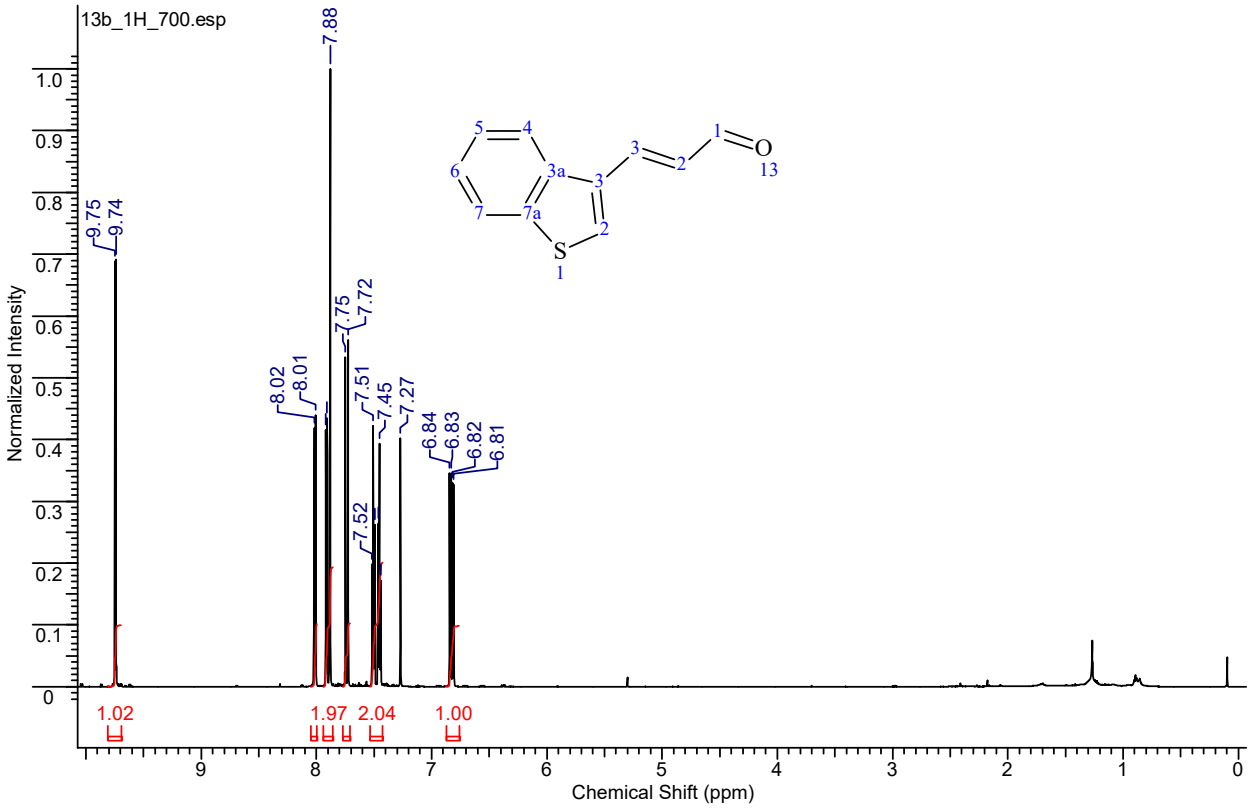
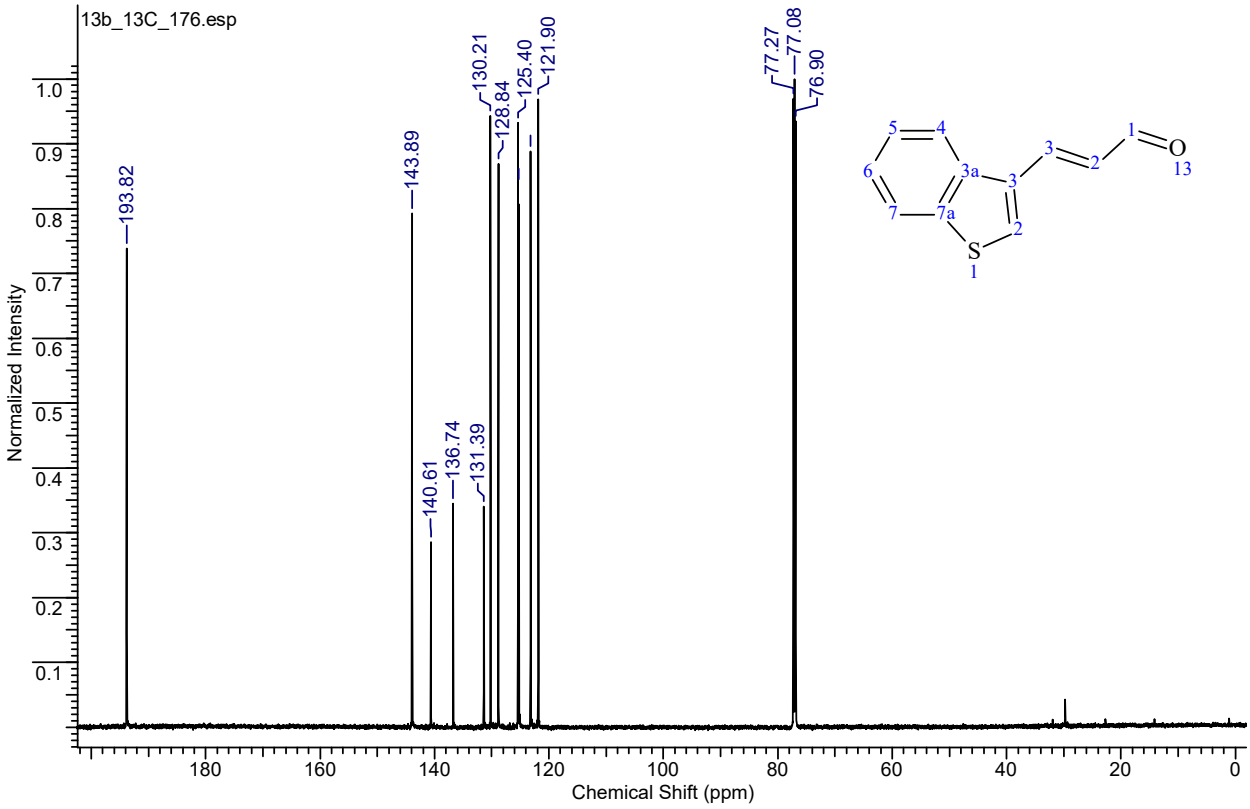
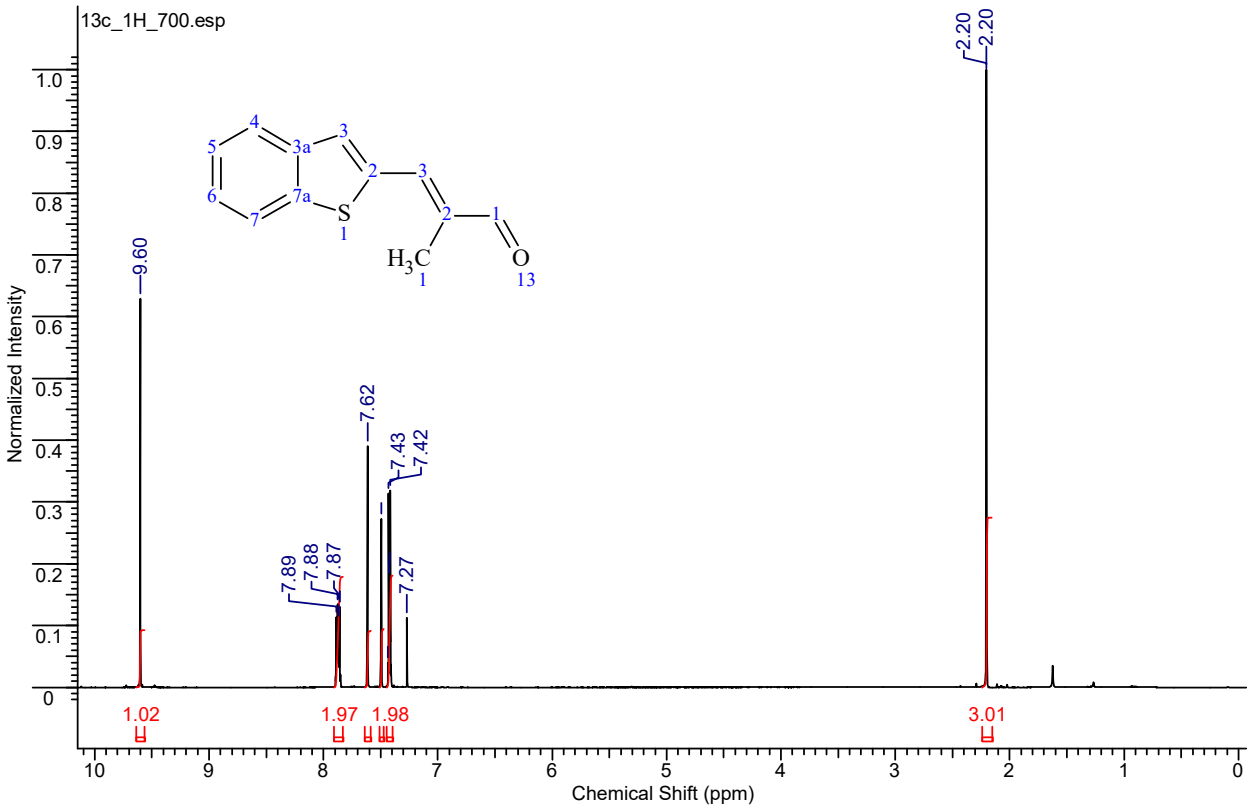
6. Copies of NMR spectra

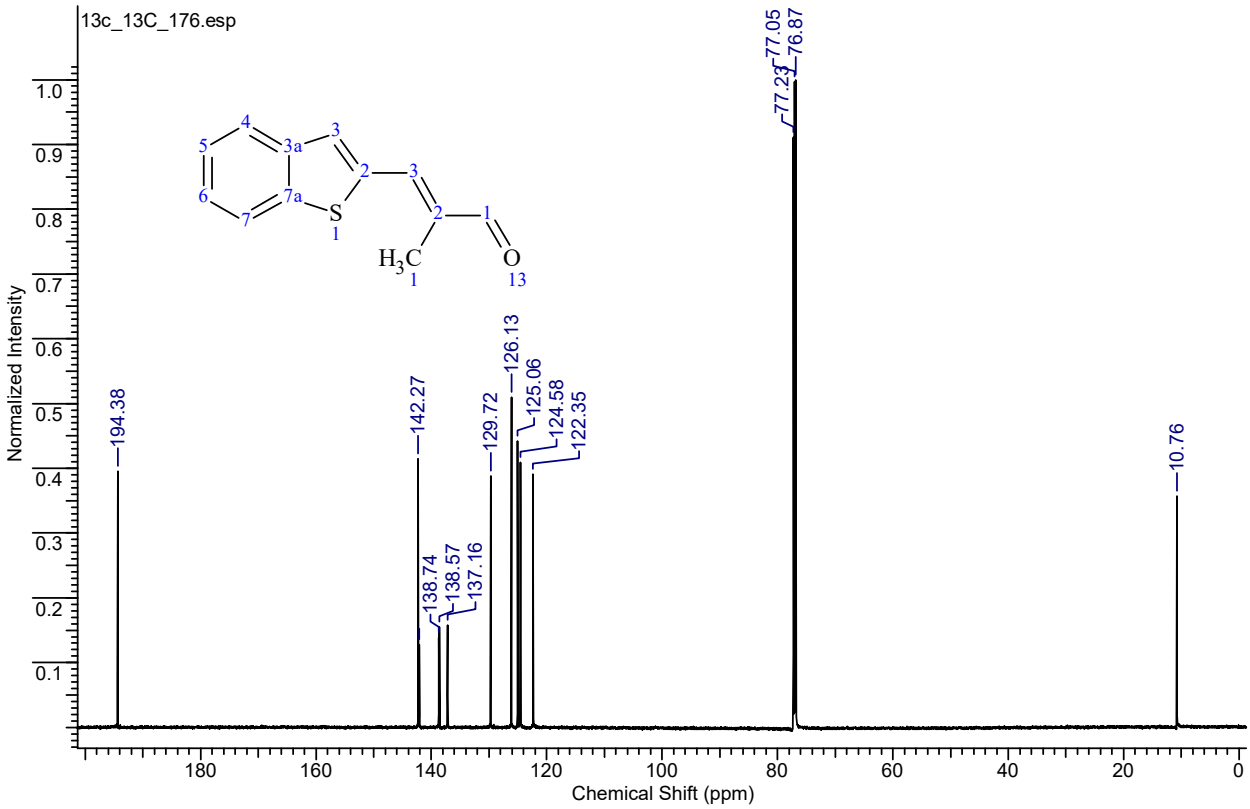
(*E*)-3-(Benzo[*b*]thiophen-3-yl)acrylaldehyde (13b).



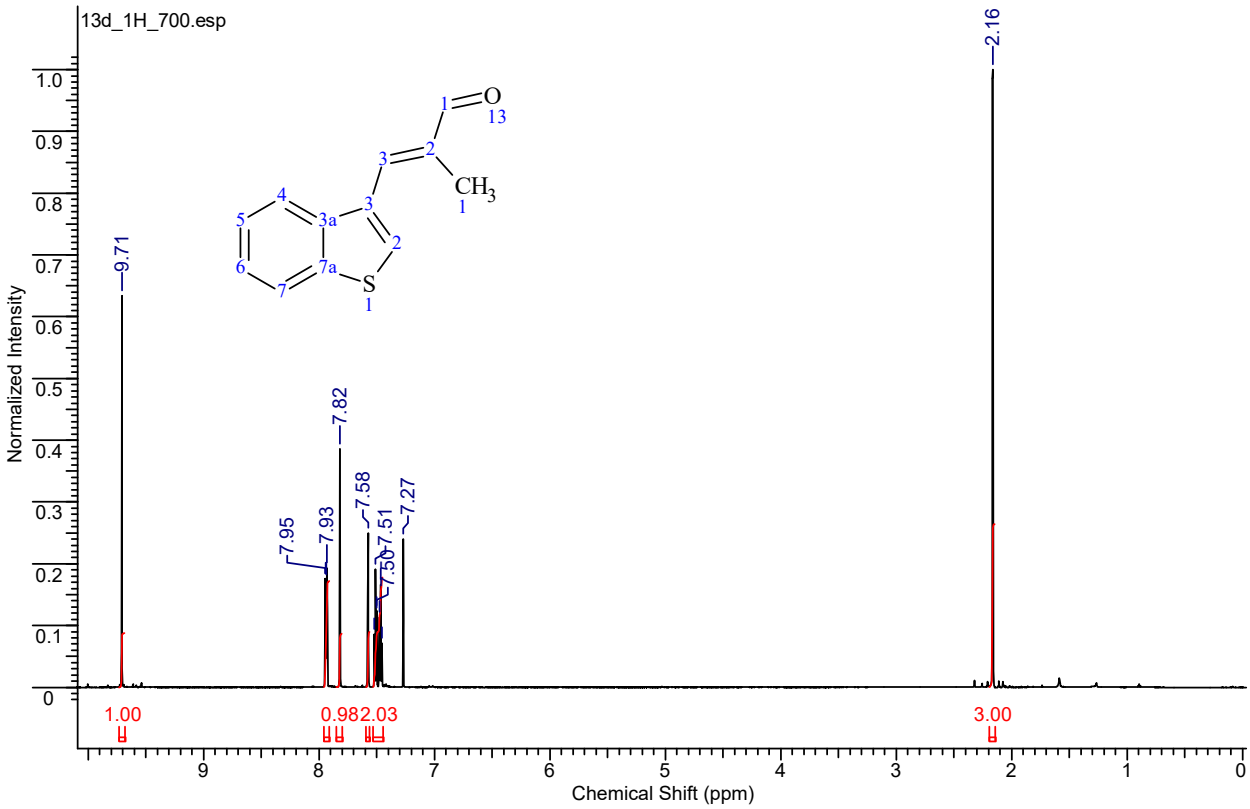


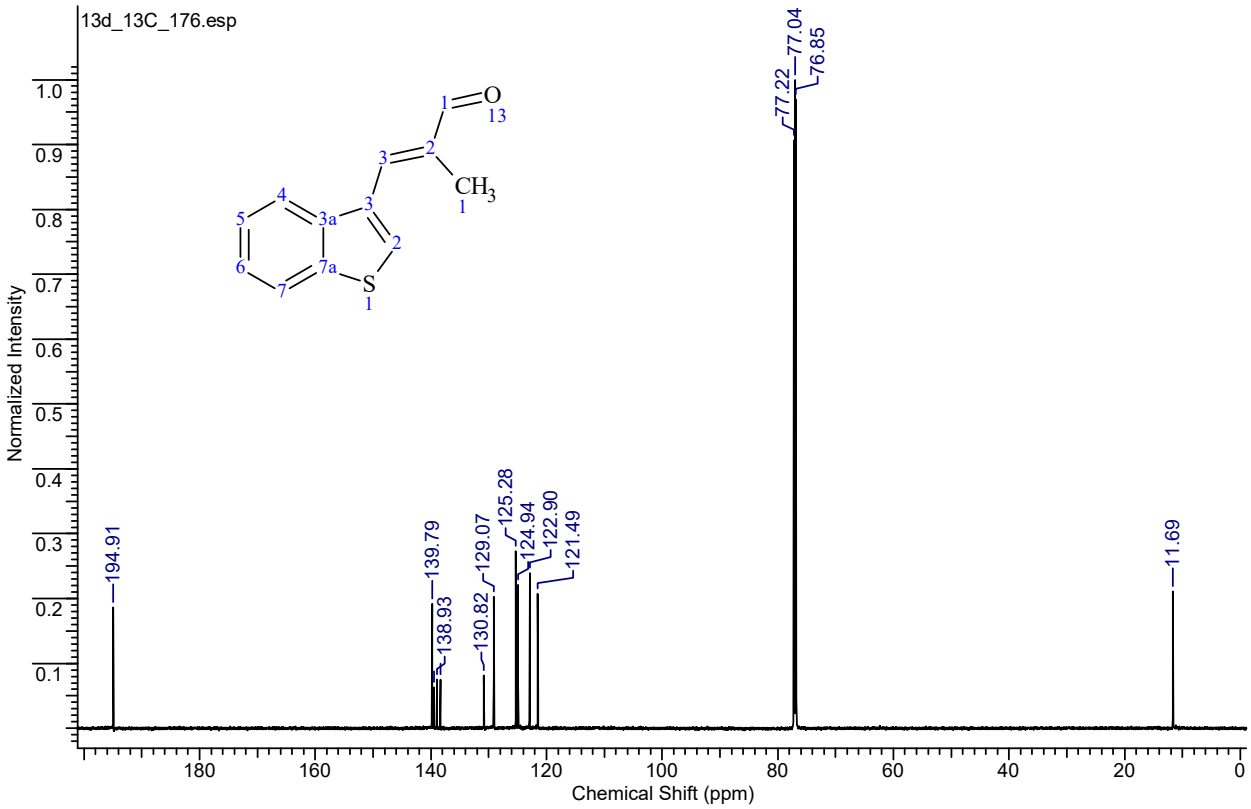
(*E*)-3-(Benzo[*b*]thiophen-2-yl)-2-methylacrylaldehyde (13c).



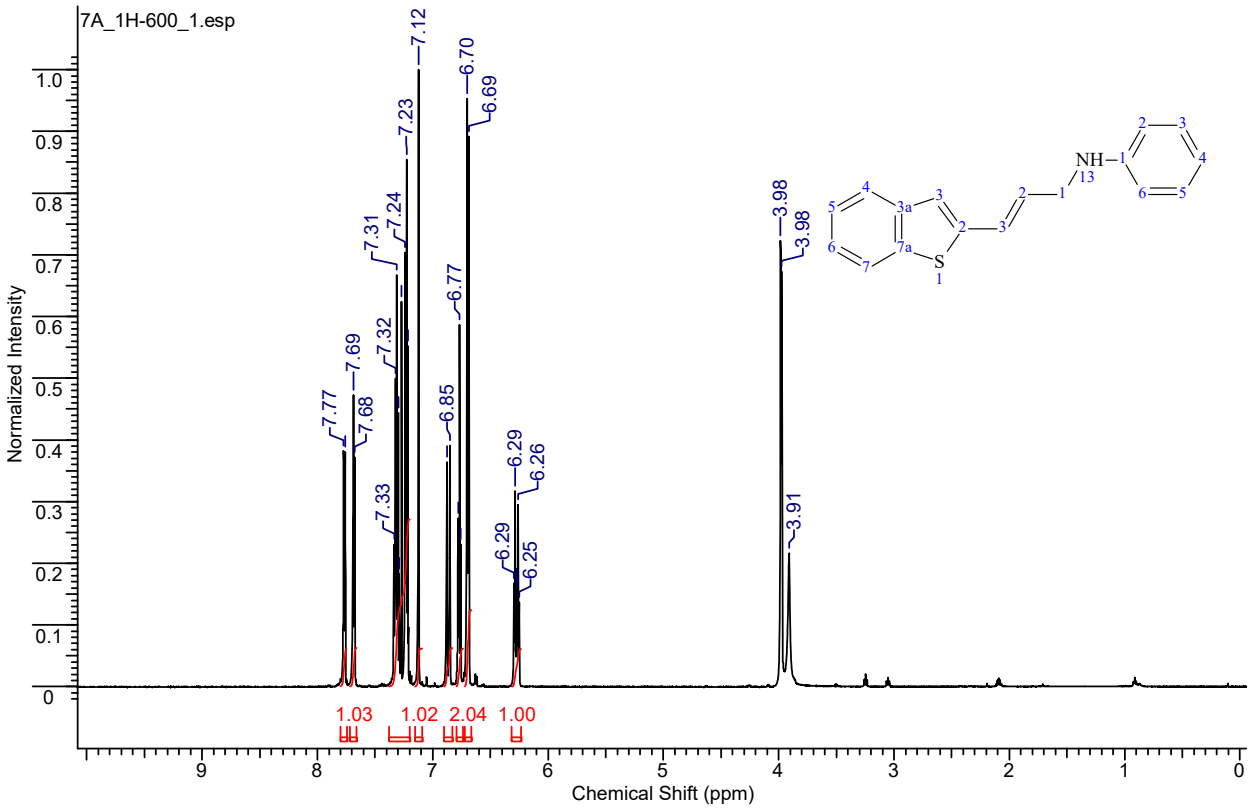


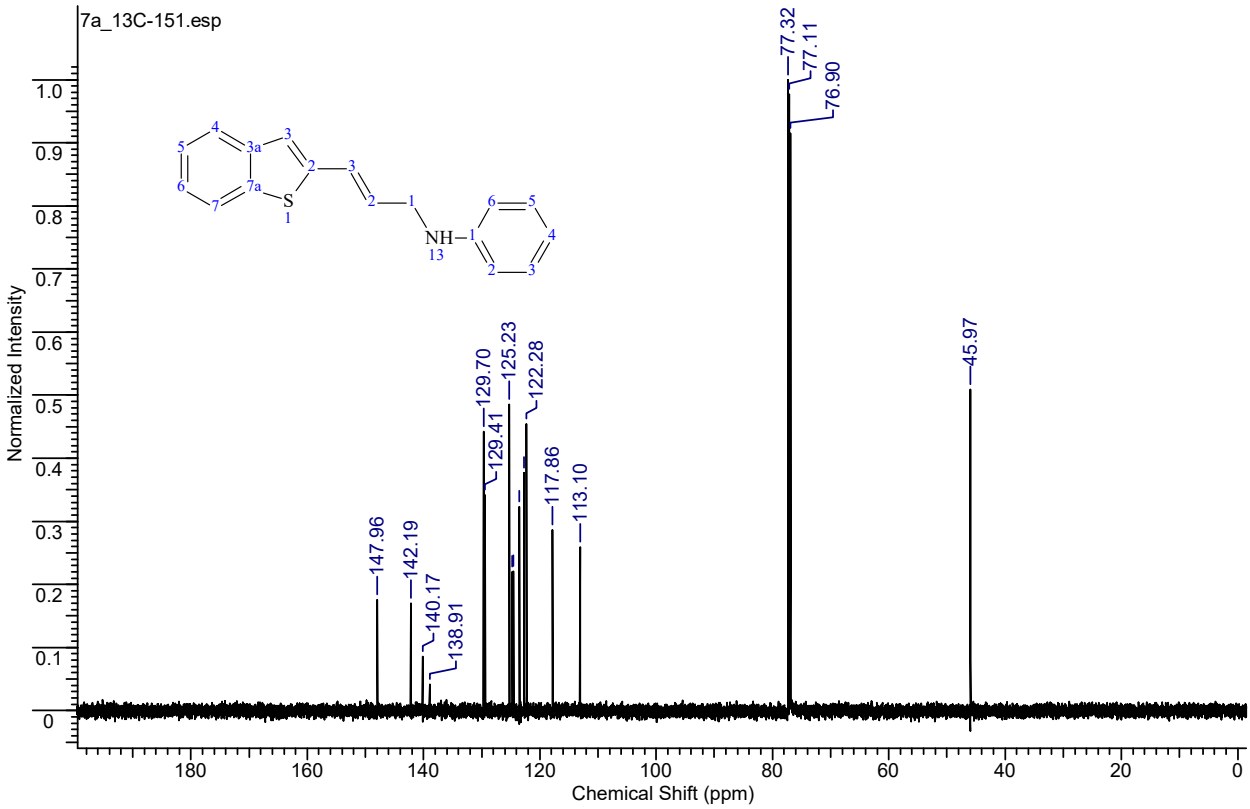
(*E*)-3-(Benzo[*b*]thiophen-3-yl)-2-methylacrylaldehyde (13d).



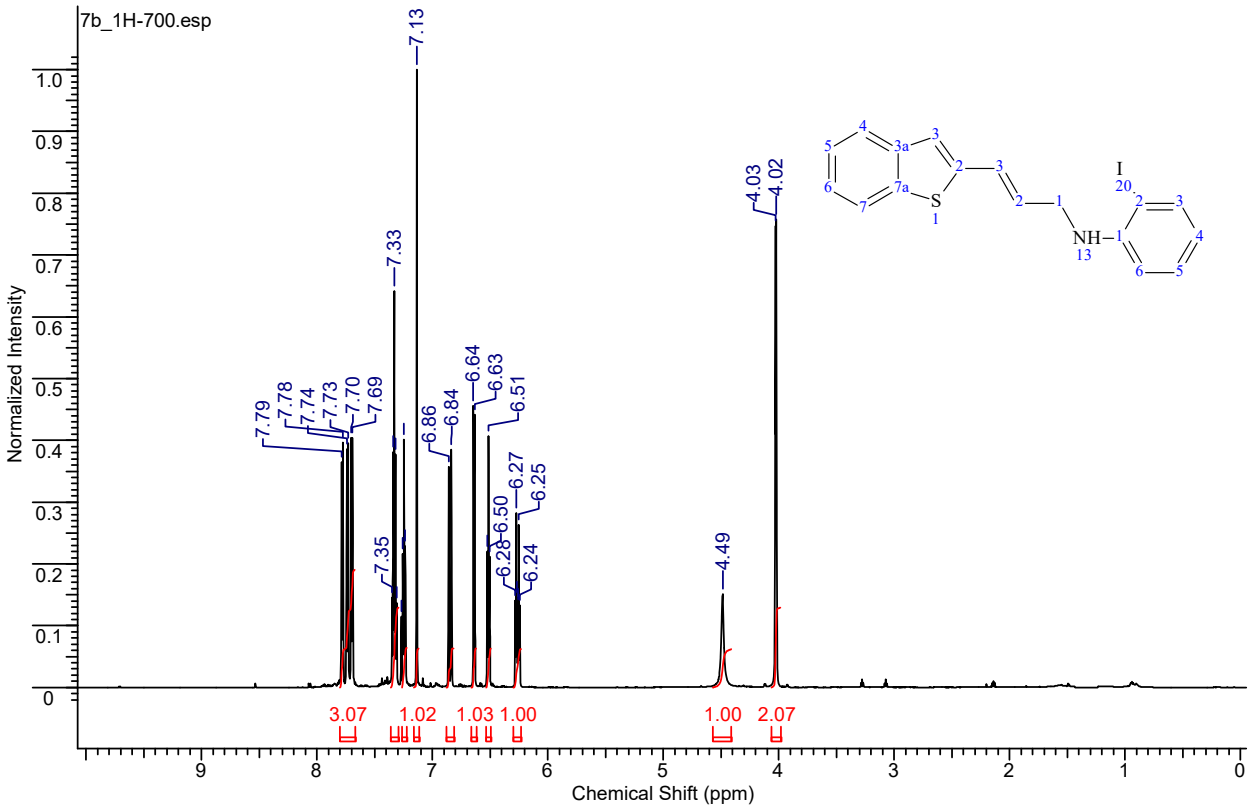


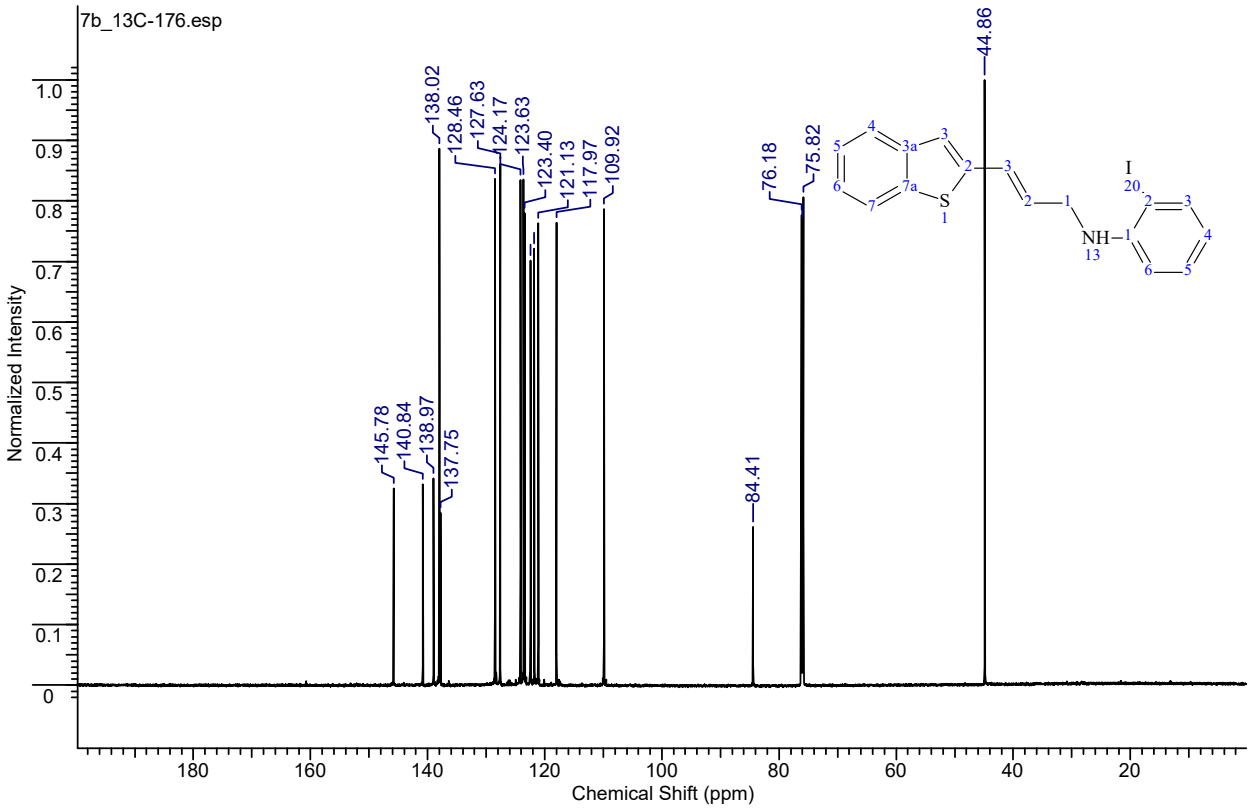
(*E*)-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)aniline (7a).



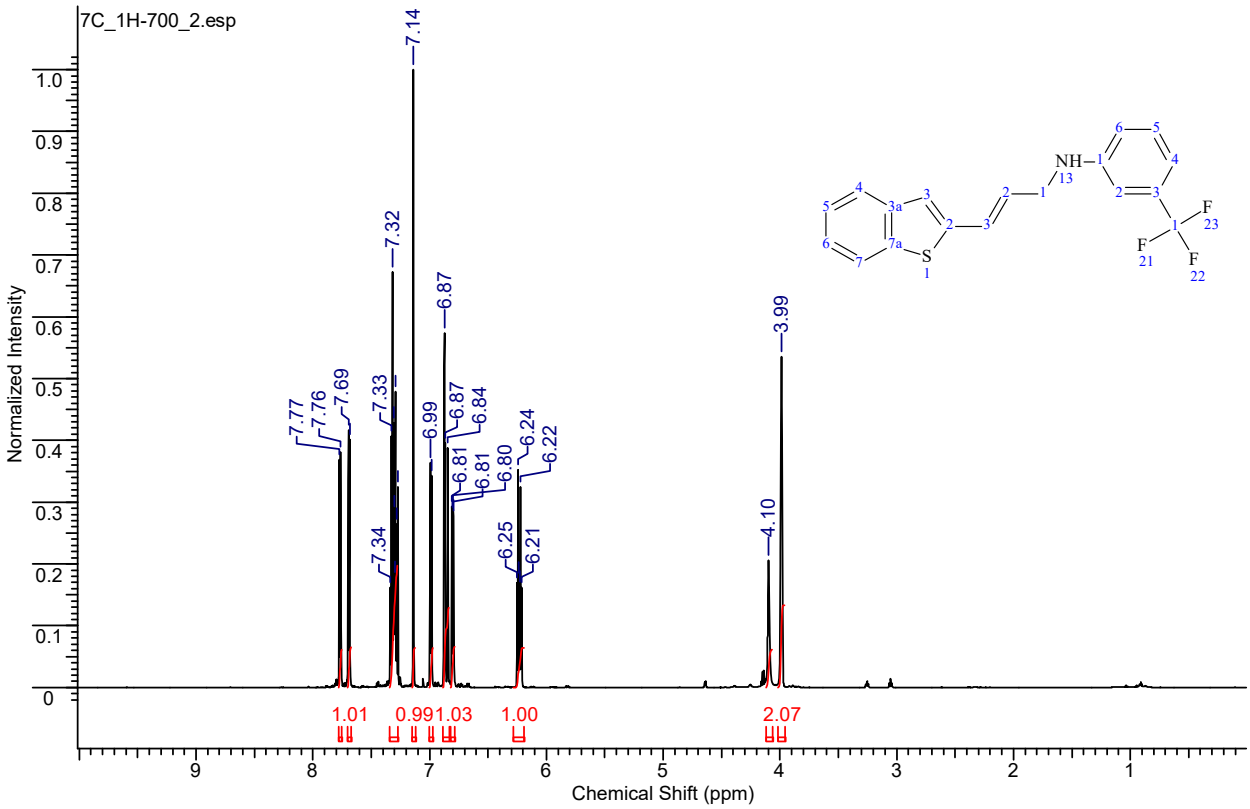


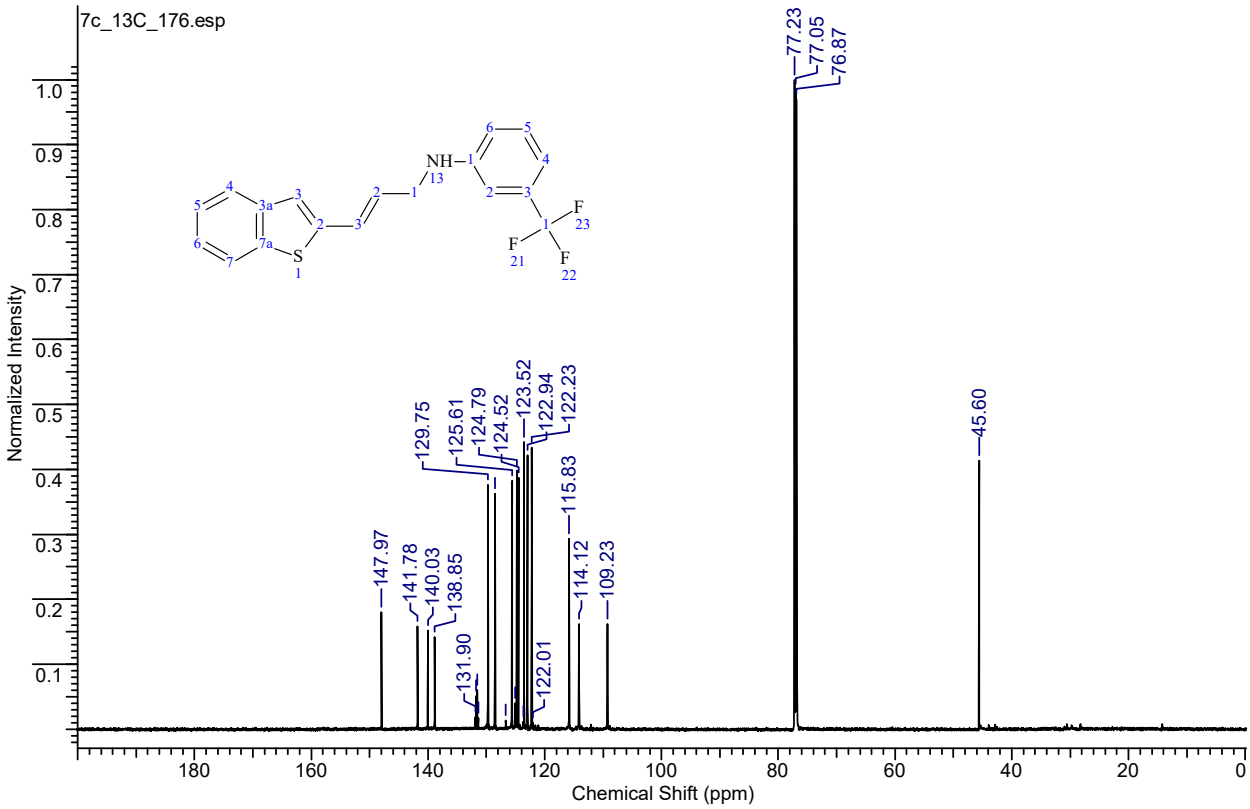
***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-2-iodoaniline (7b).**

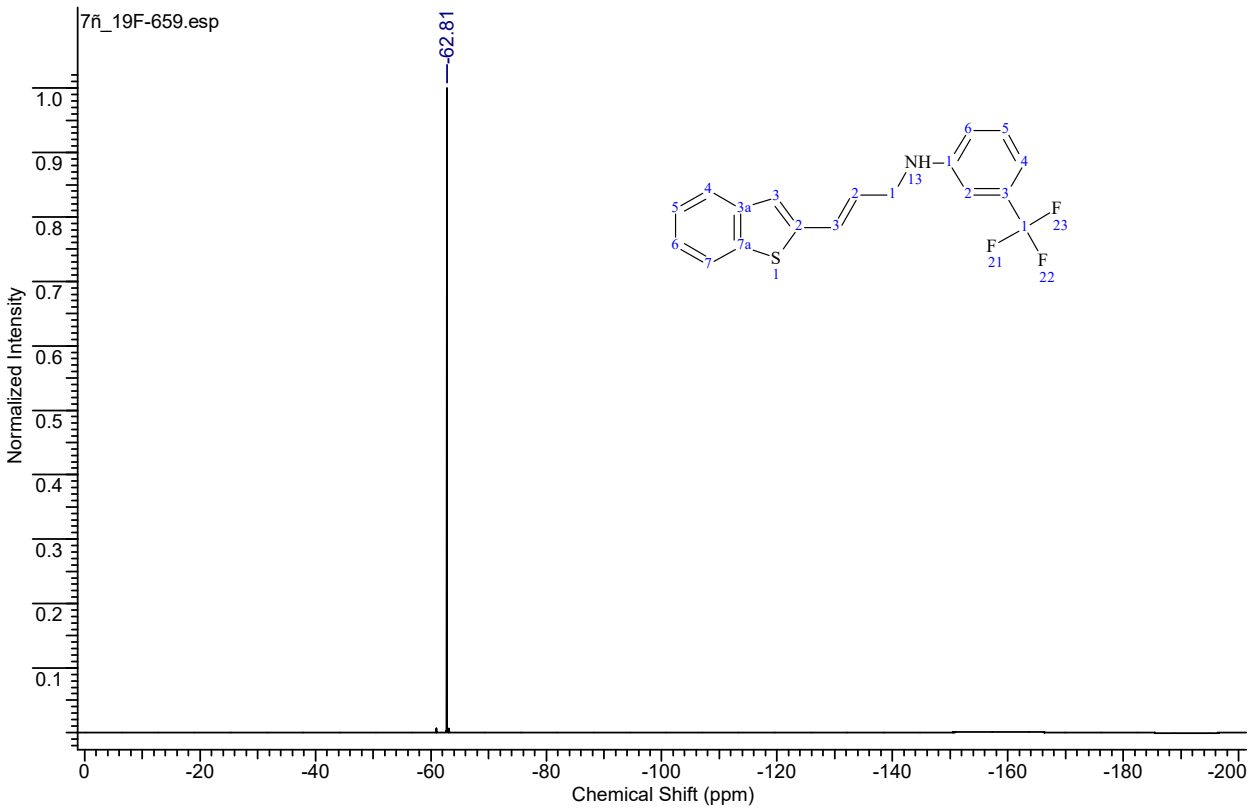




***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-3-(trifluoromethyl)aniline (7c).**



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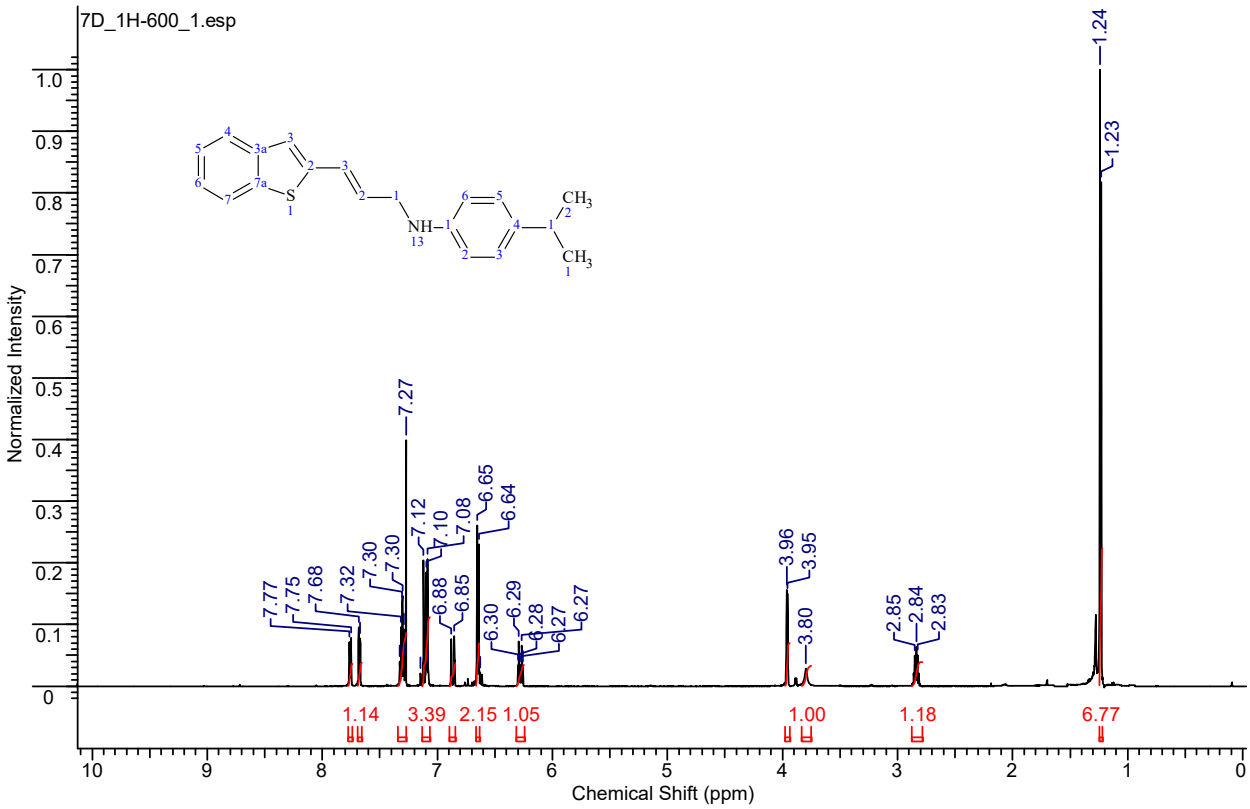
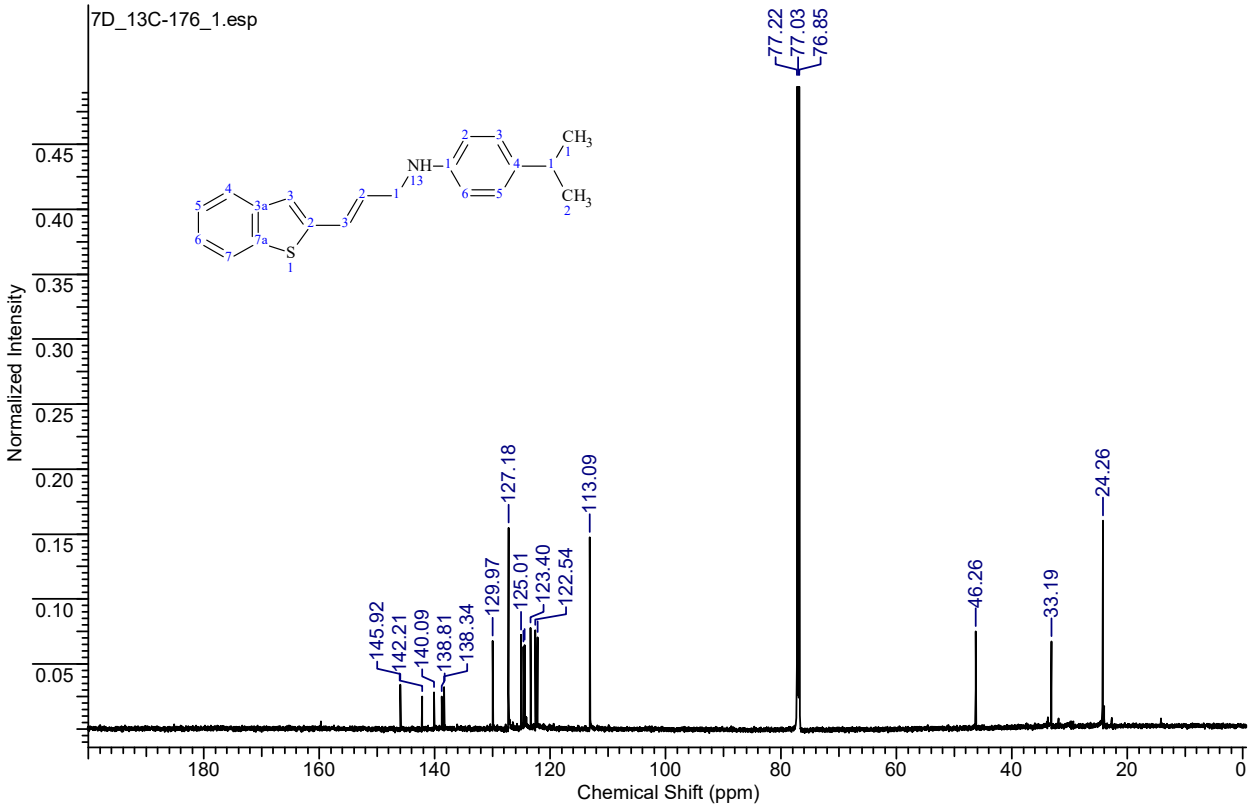
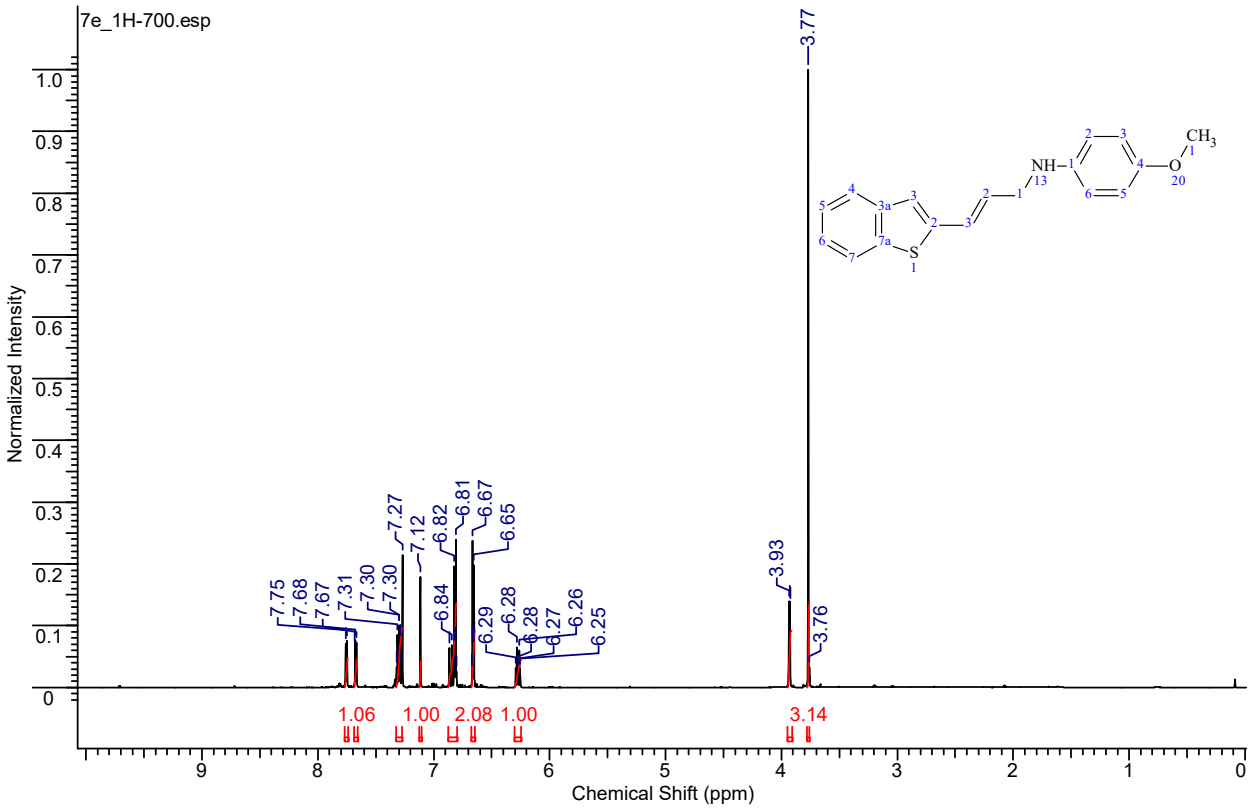
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
NH
S
F
F
F

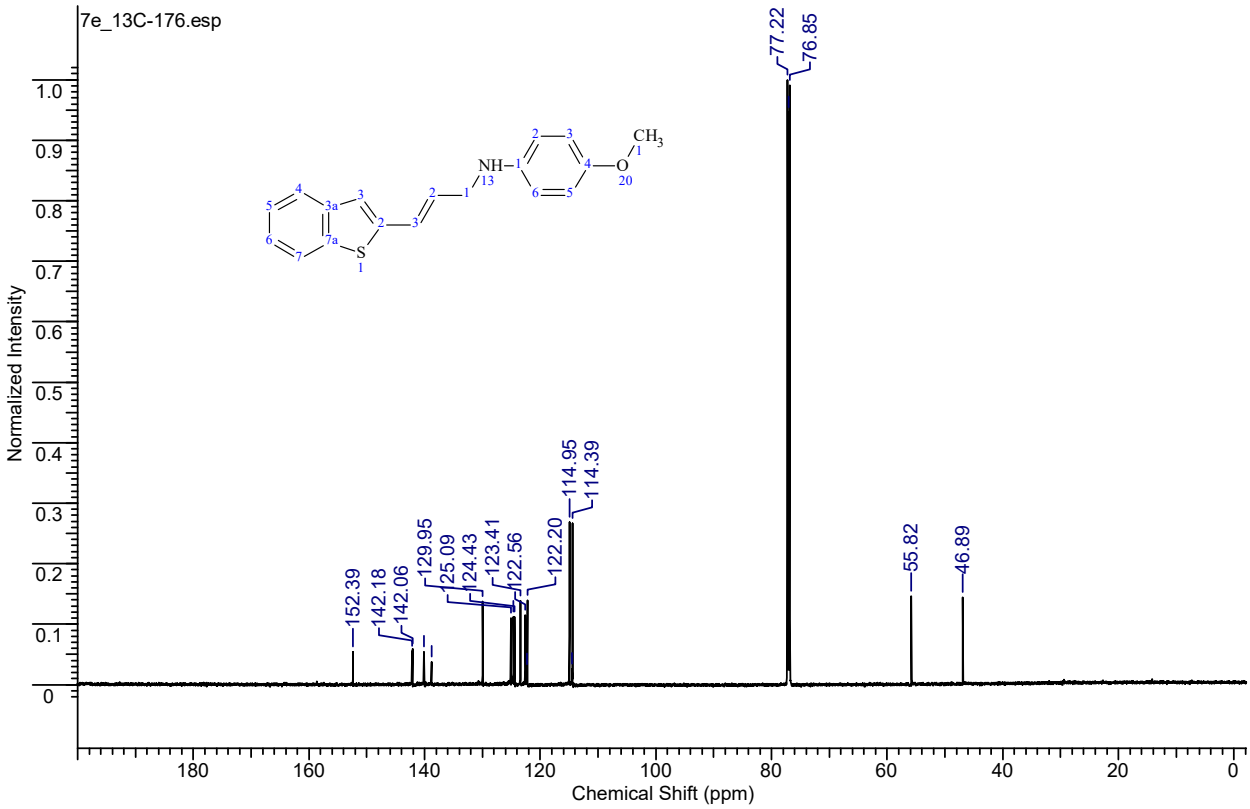
***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-isopropylaniline (7d)**.



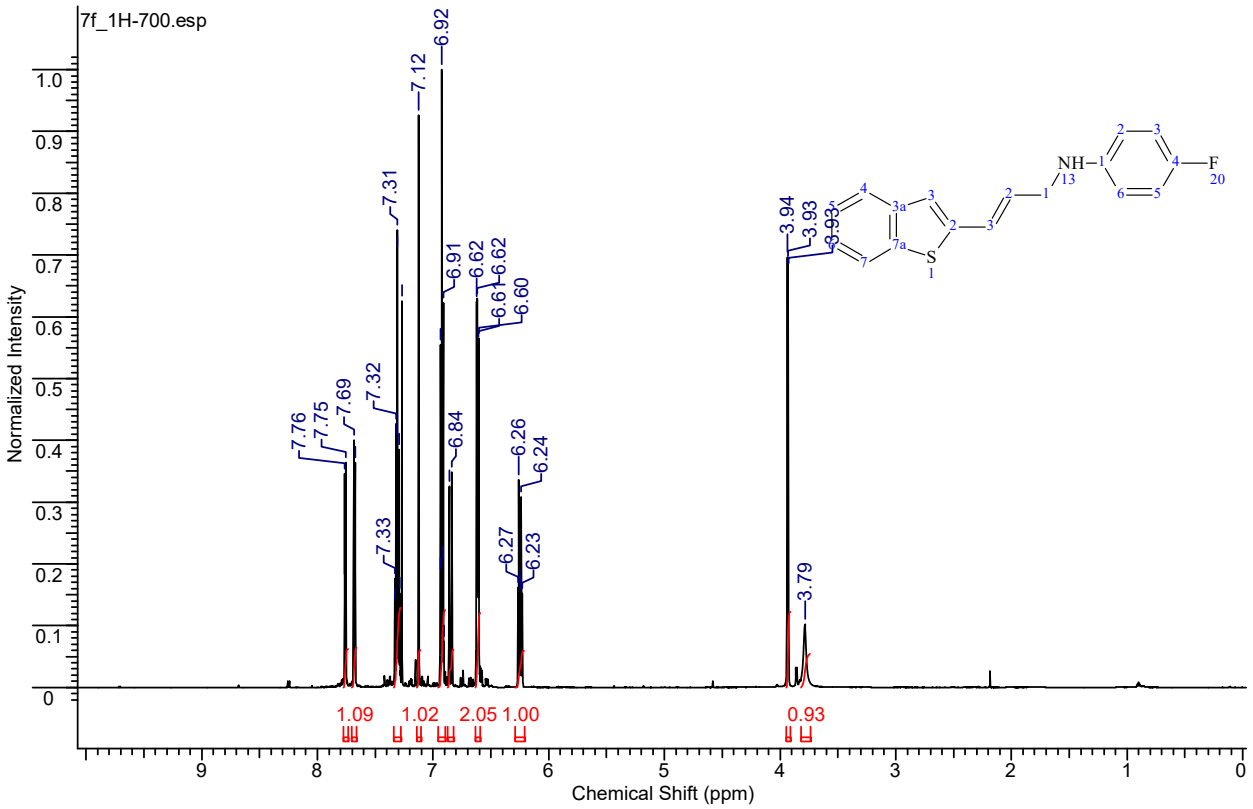


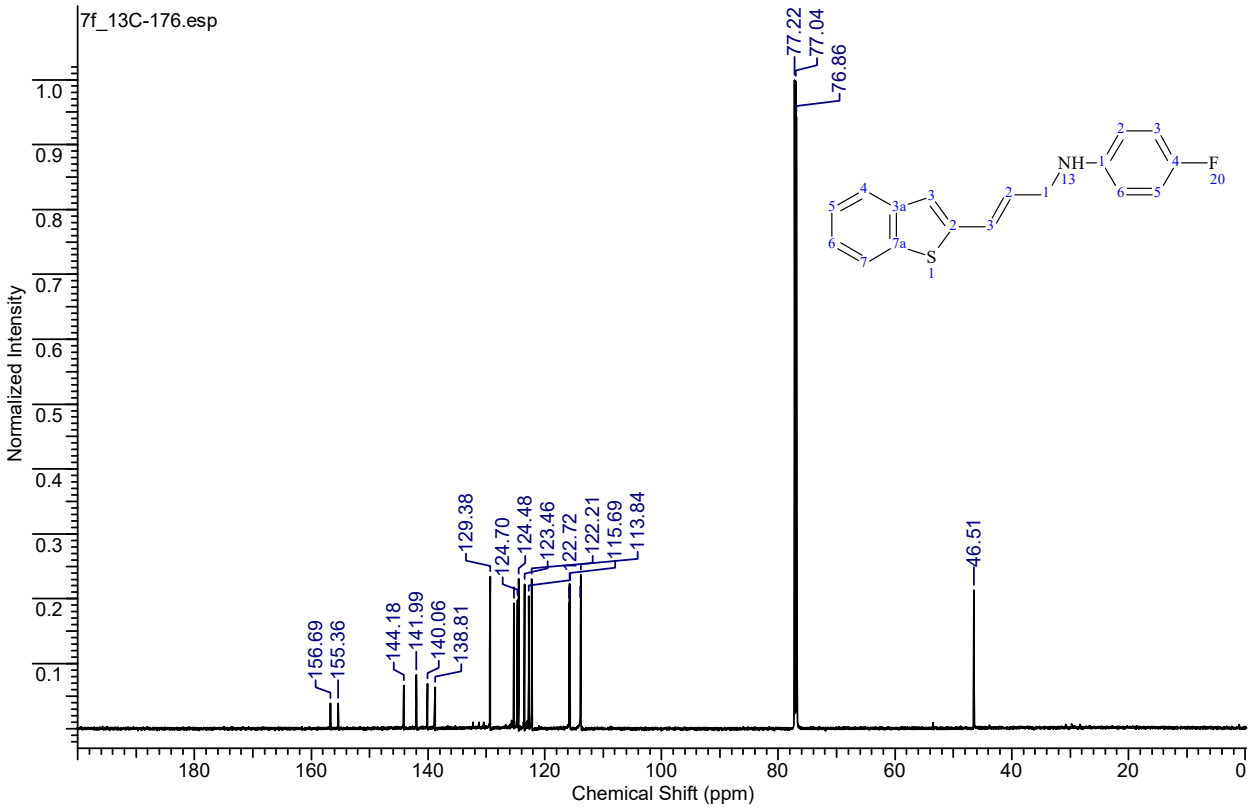
***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-methoxyaniline (7e).**

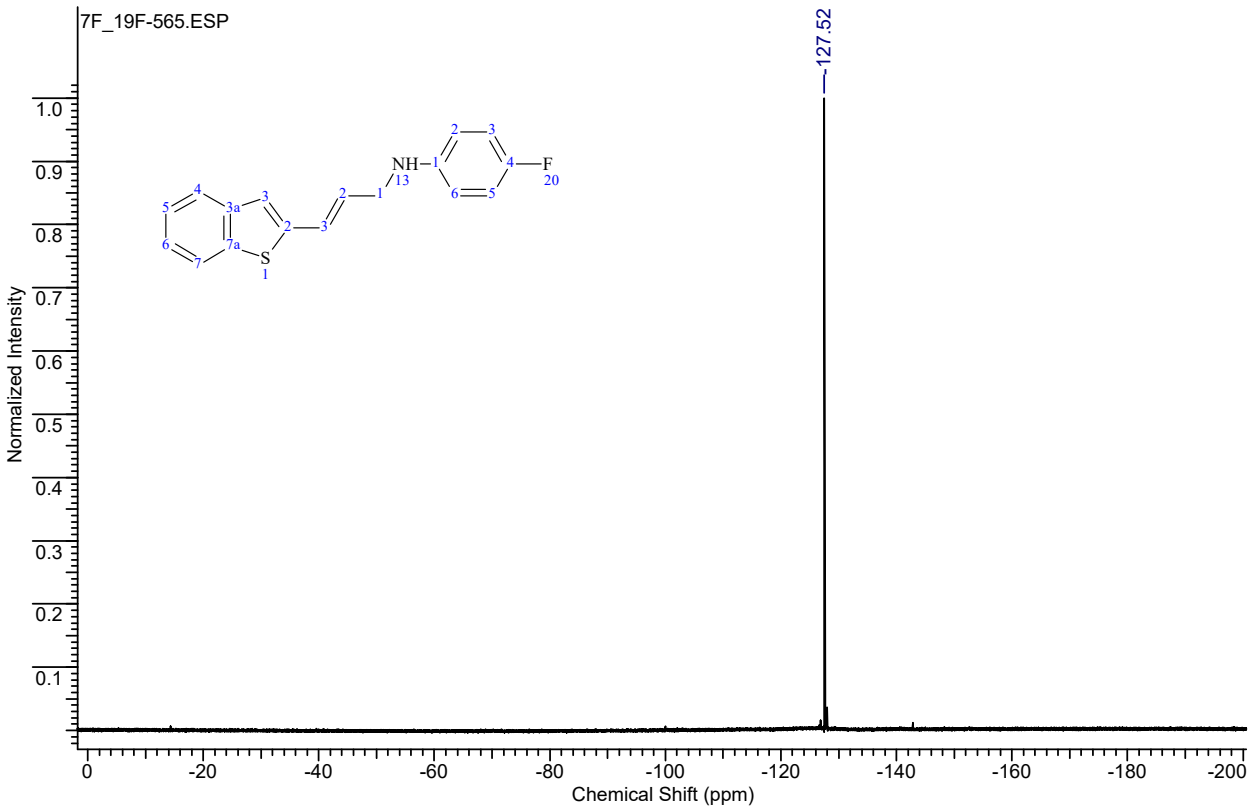




***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-fluoroaniline (7f).**



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Normalized Intensity
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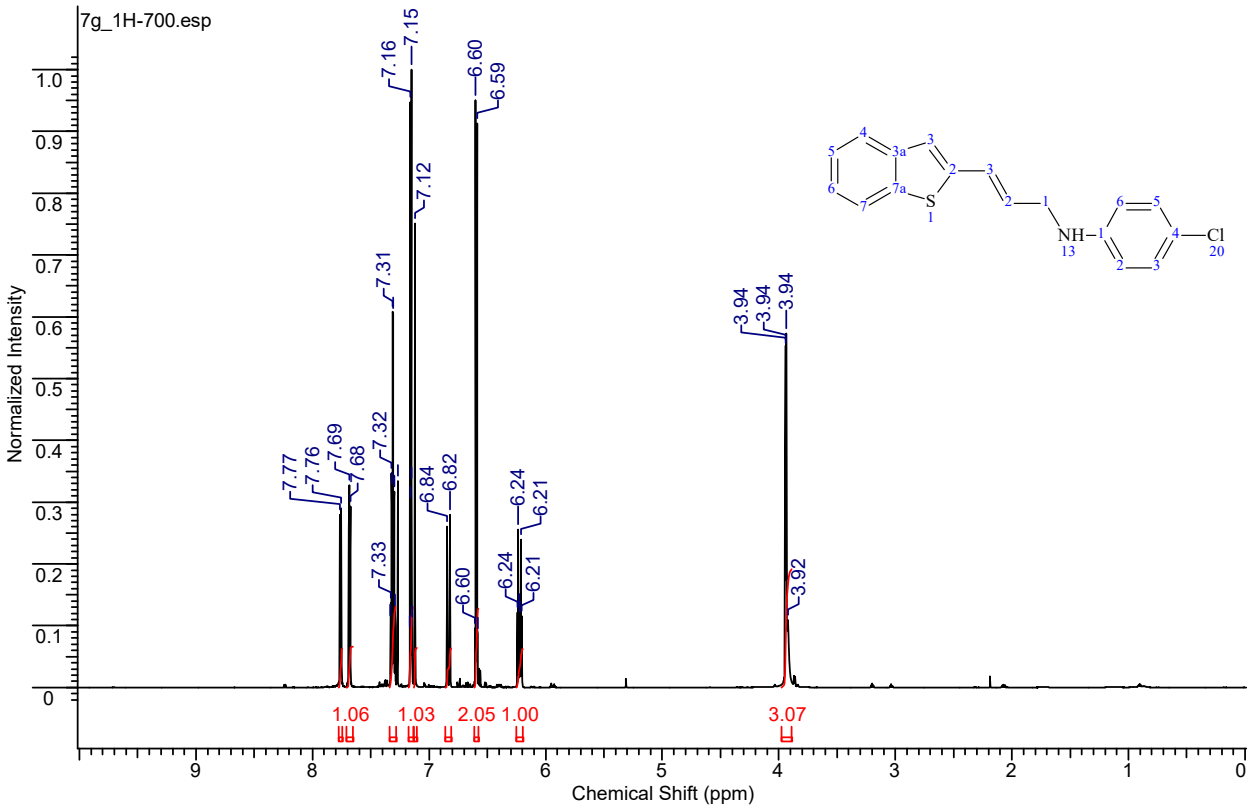
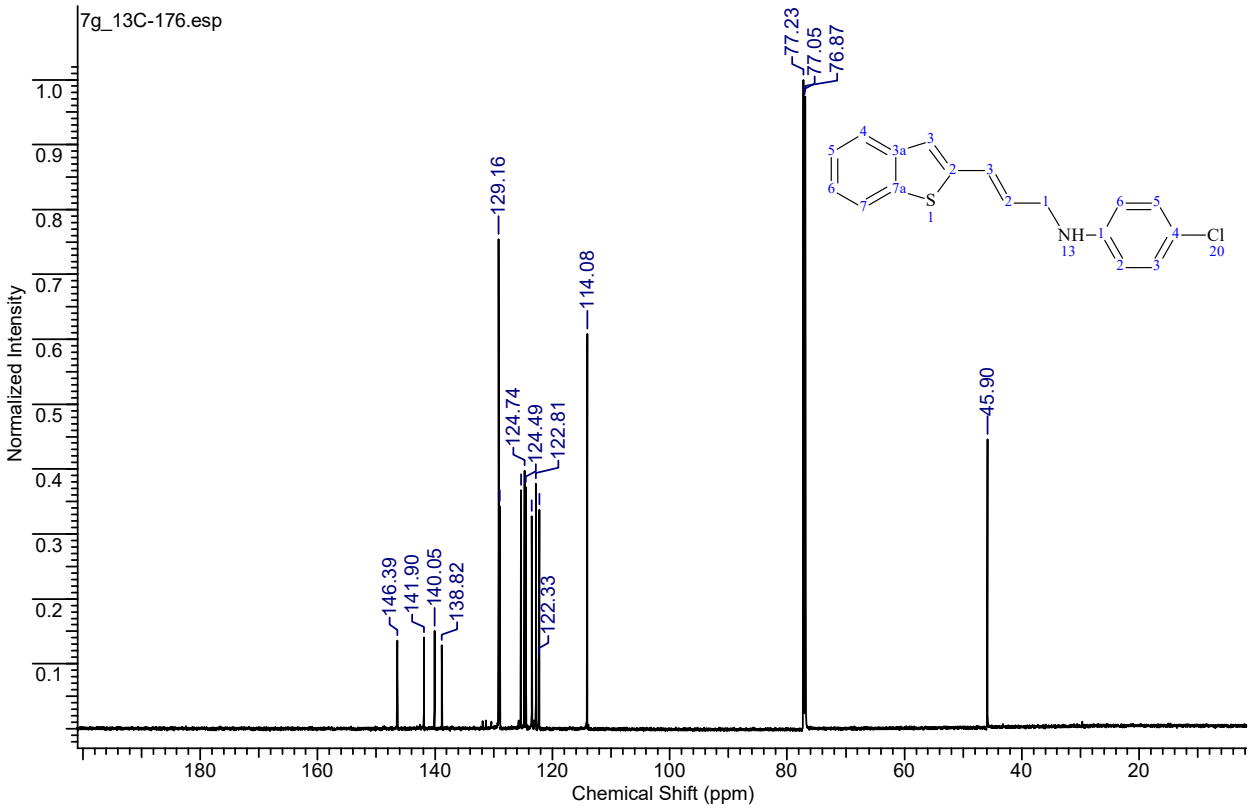
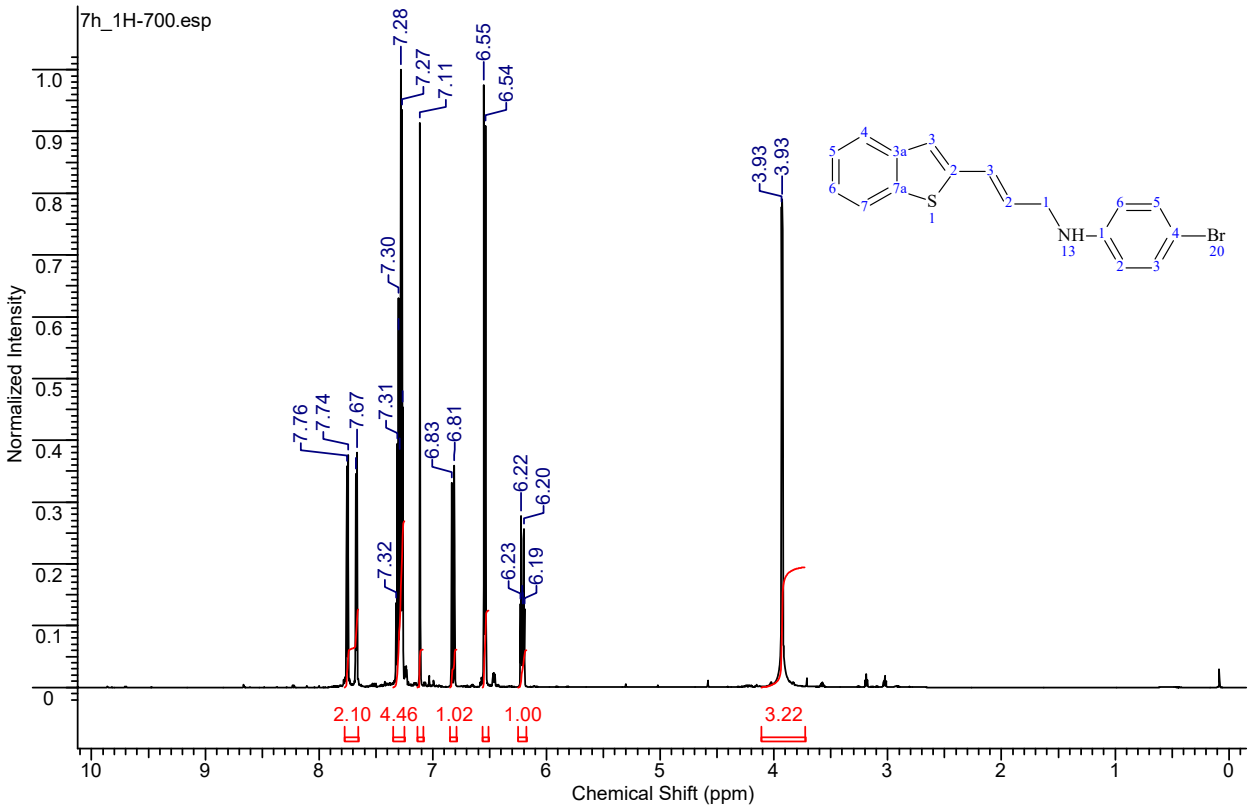
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
NH
F

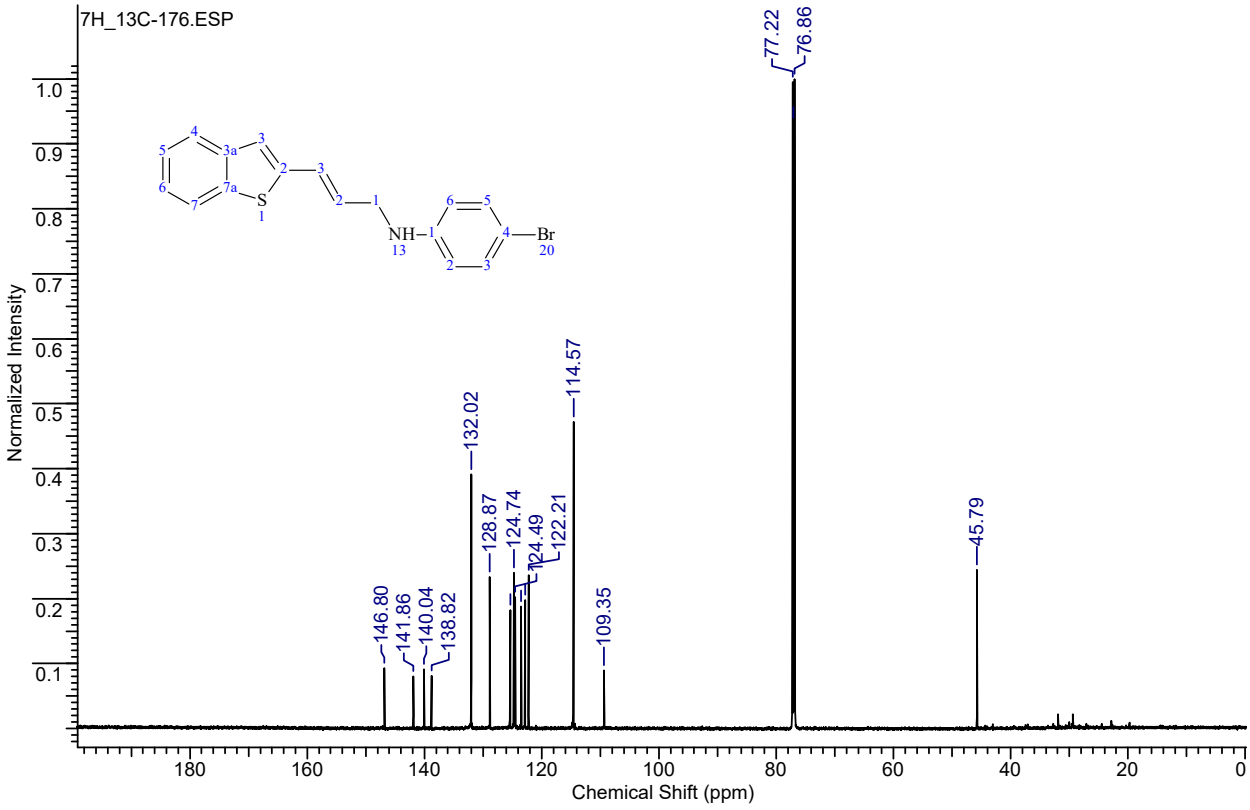
***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-chloroaniline (7g).**



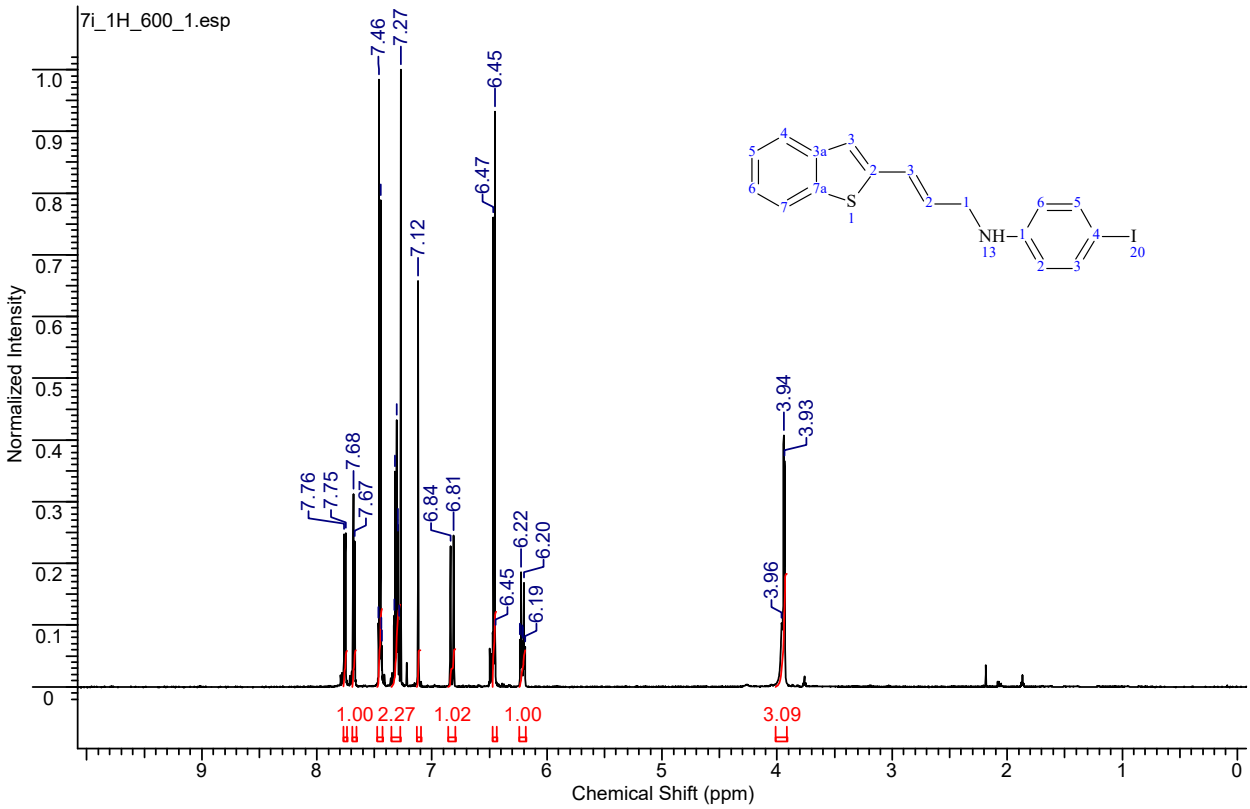


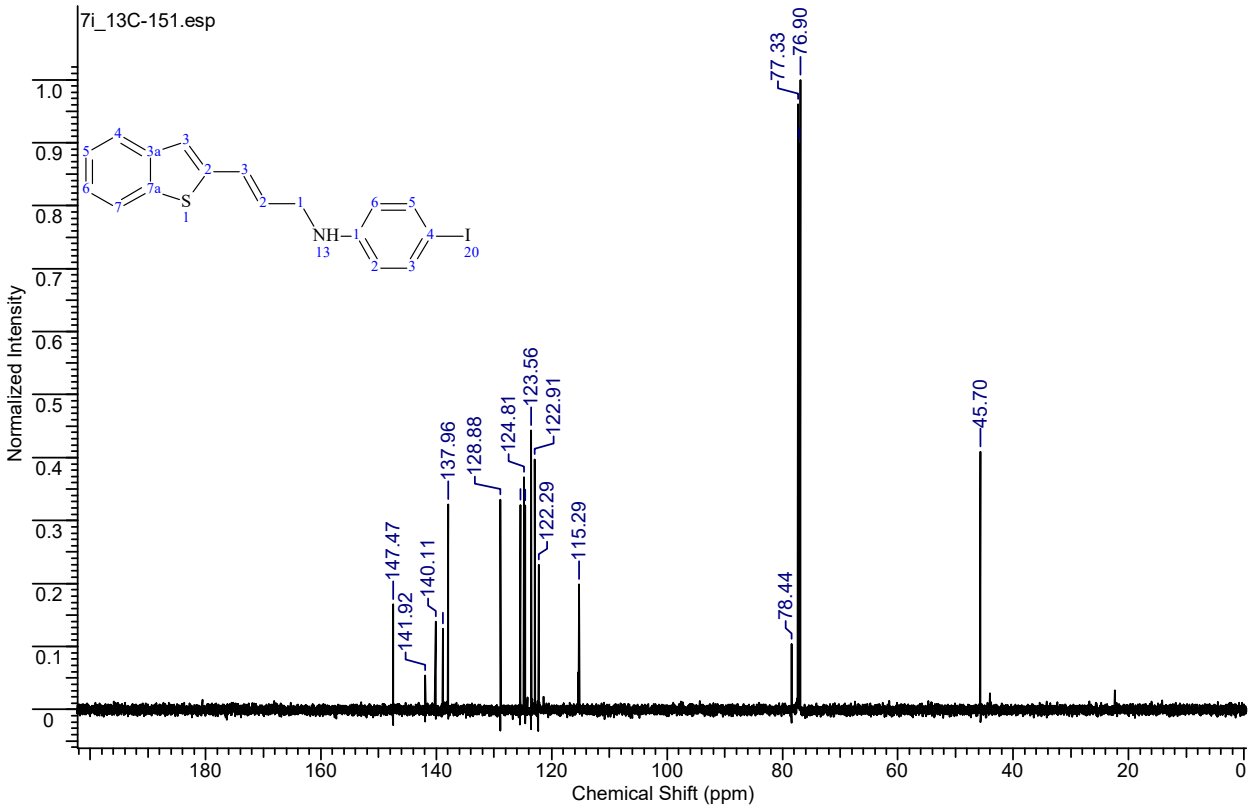
***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-bromoaniline (7h).**



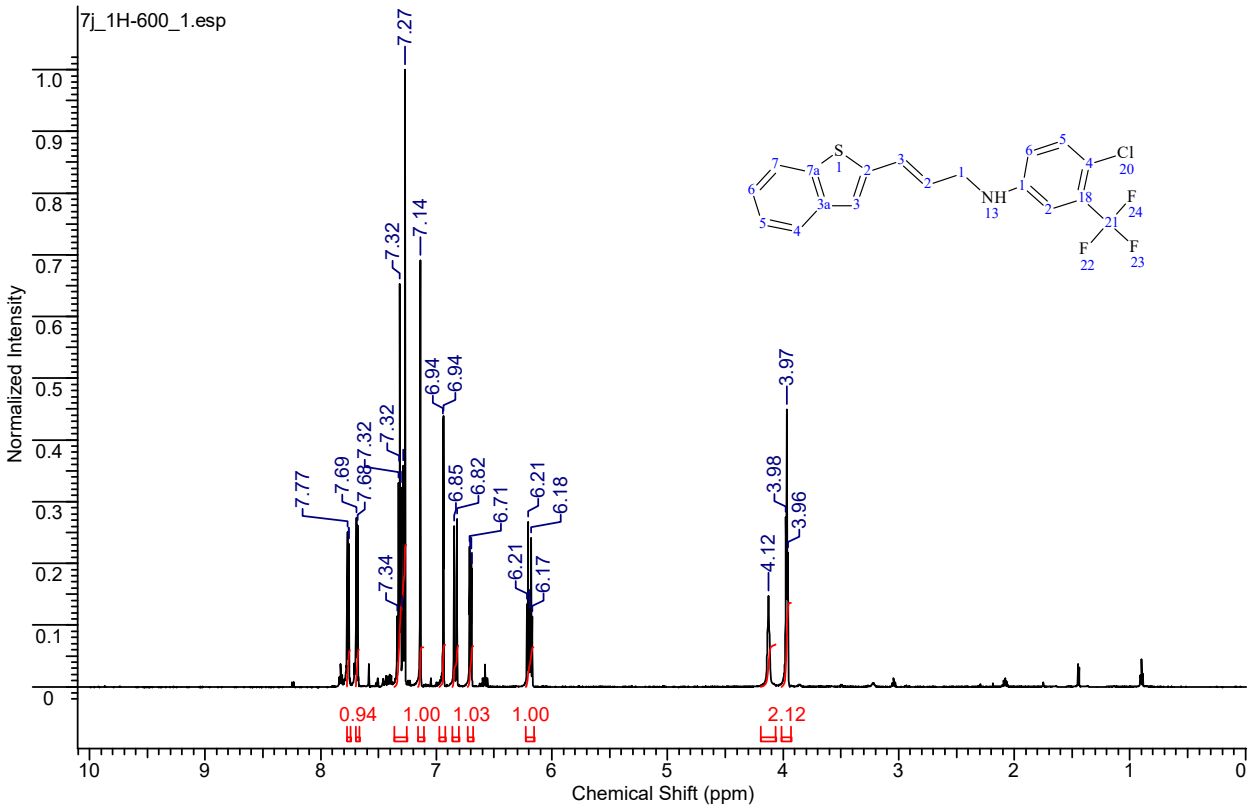


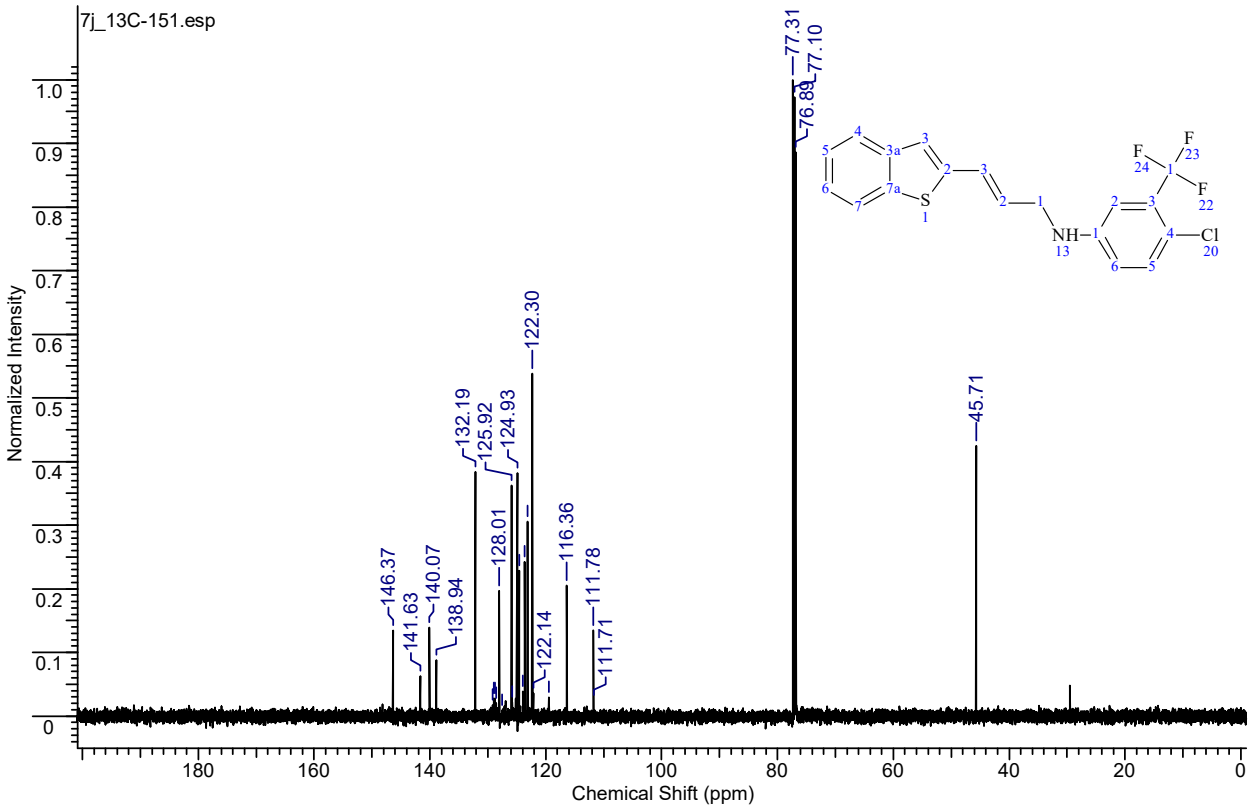
***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-iodoaniline (7i).**

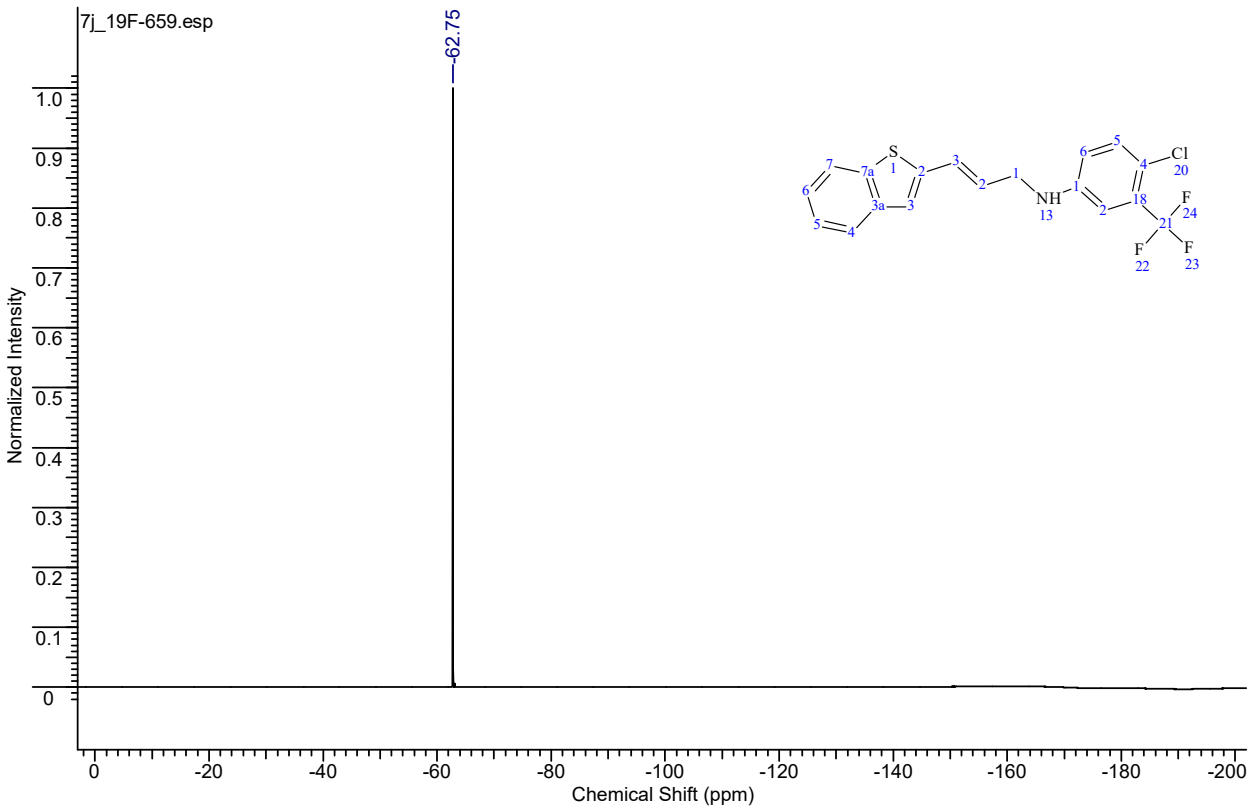




***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-chloro-3-(trifluoromethyl)aniline (7j).**



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-140
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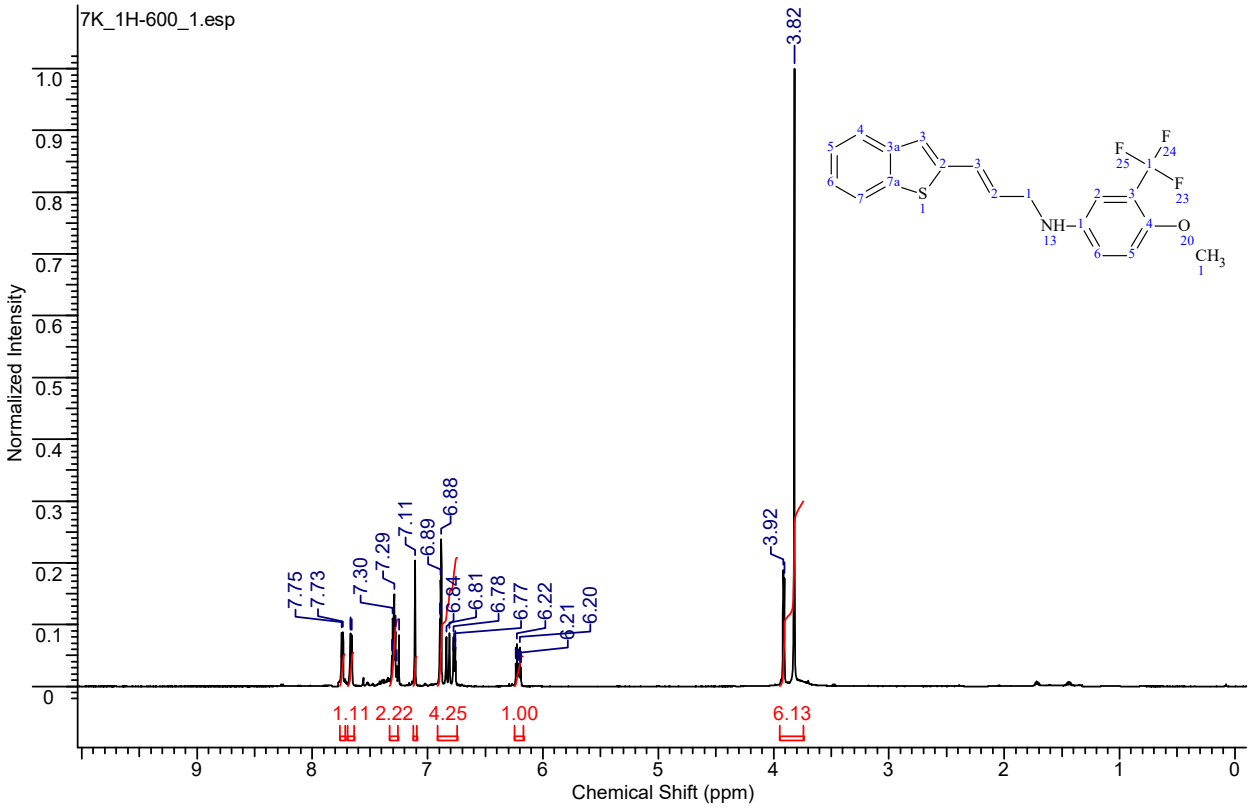
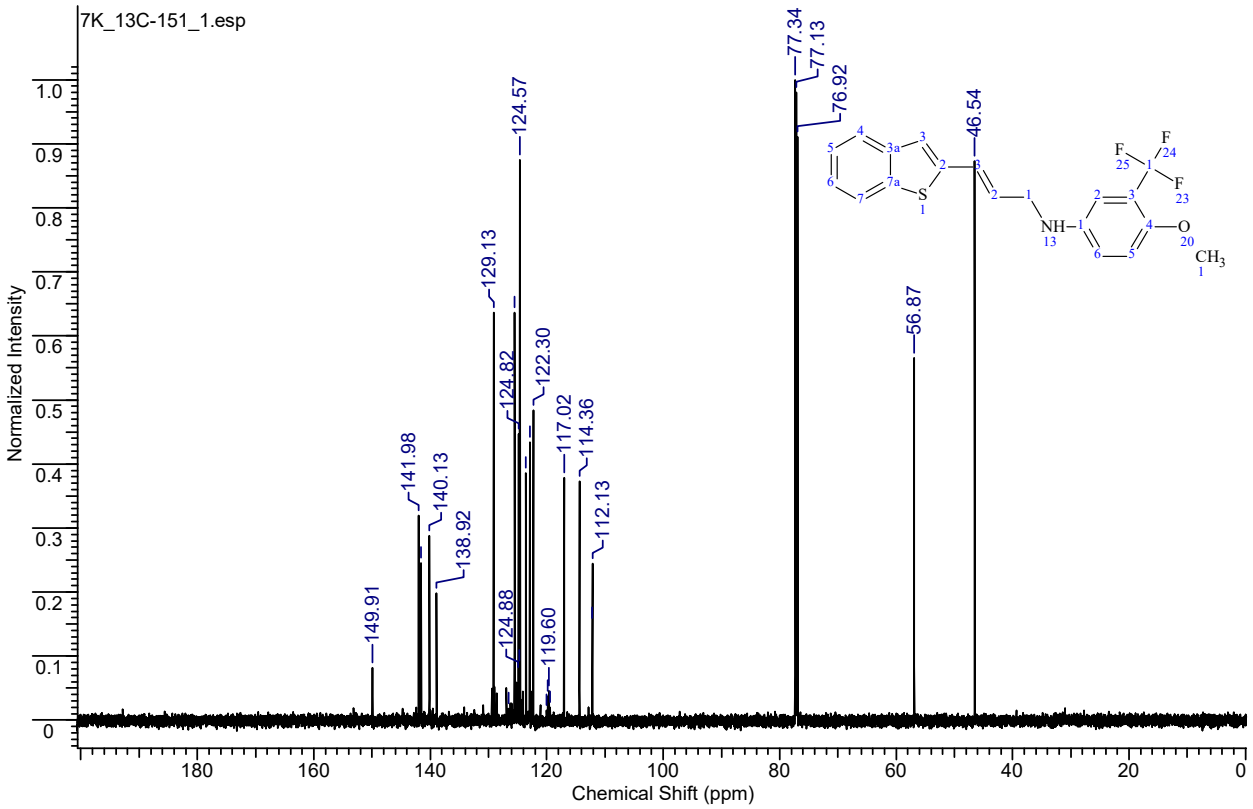
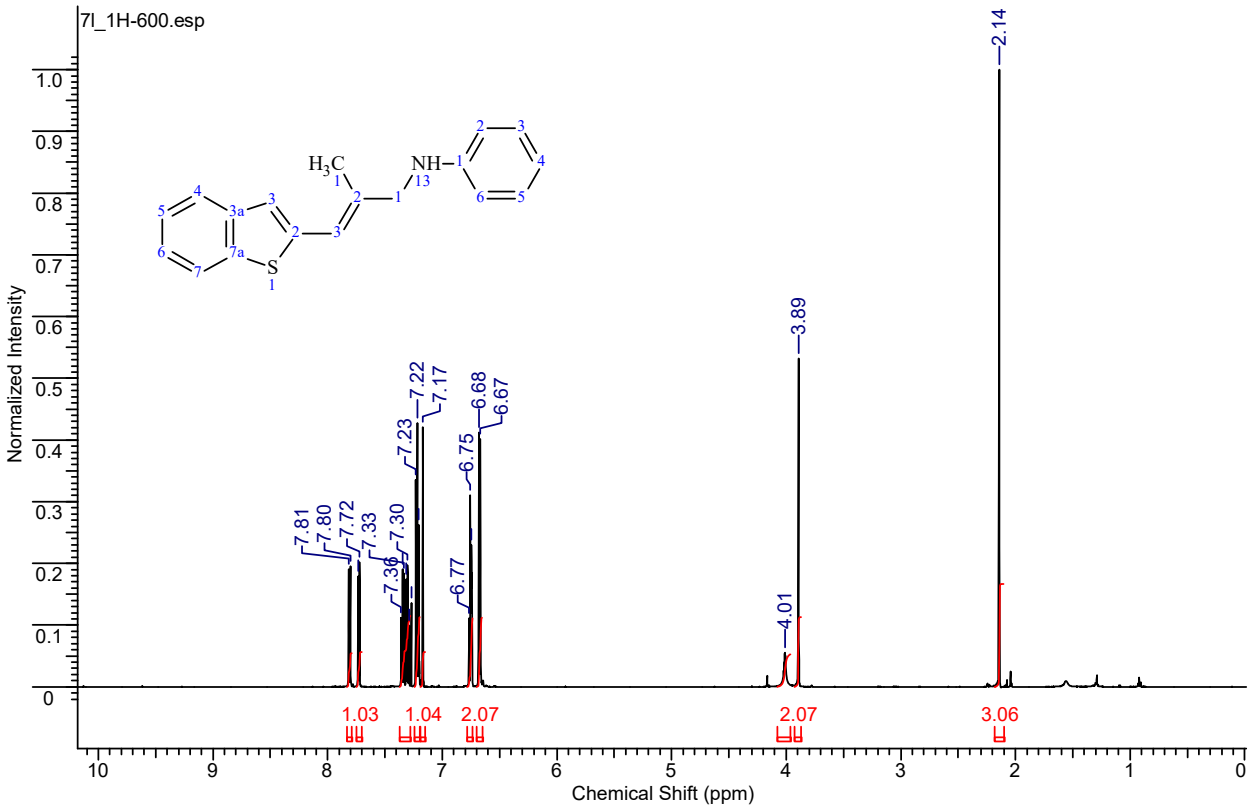
7a
6
5
4
3a
3
2
3
2
1
NH
13
1
6
5
4
Cl
20
2
18
21
F
24
F
22
F
23

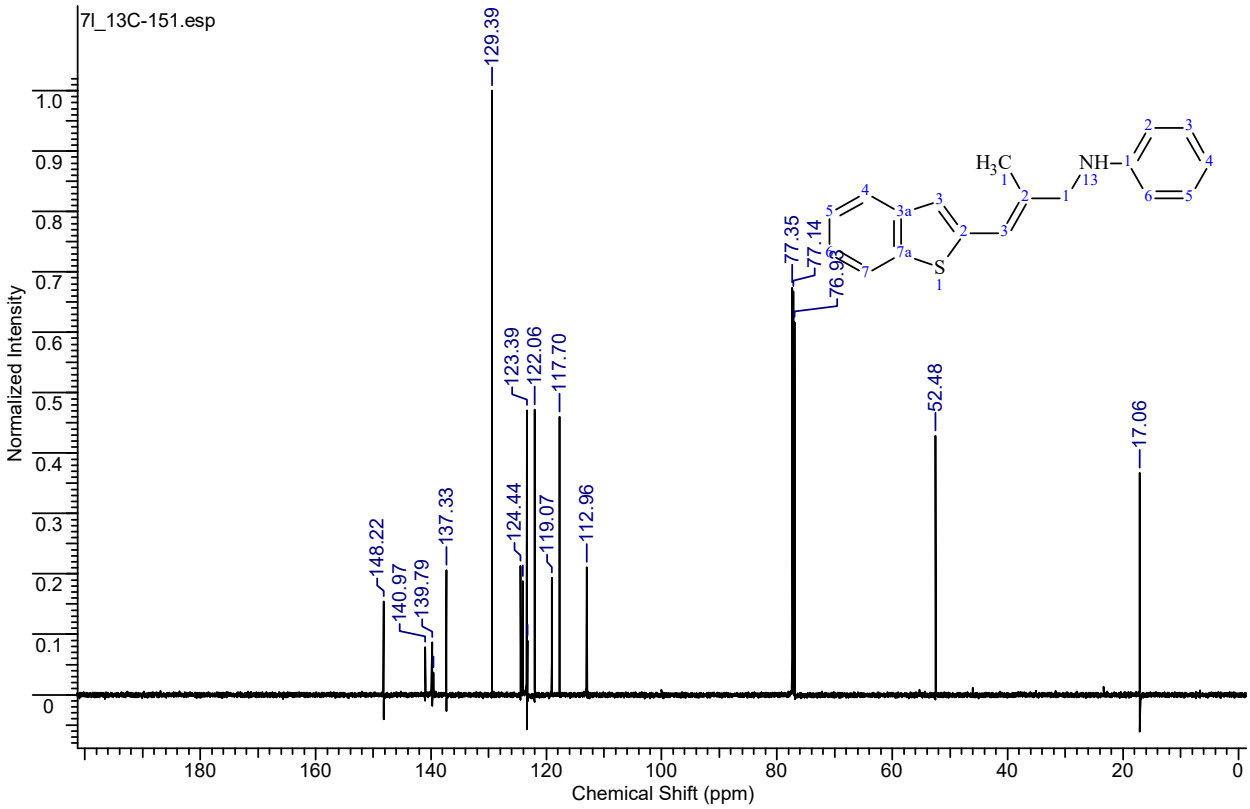
***(E)-N*-(3-(Benzo[*b*]thiophen-2-yl)allyl)-4-methoxy-3-(trifluoromethyl)aniline (7k).**



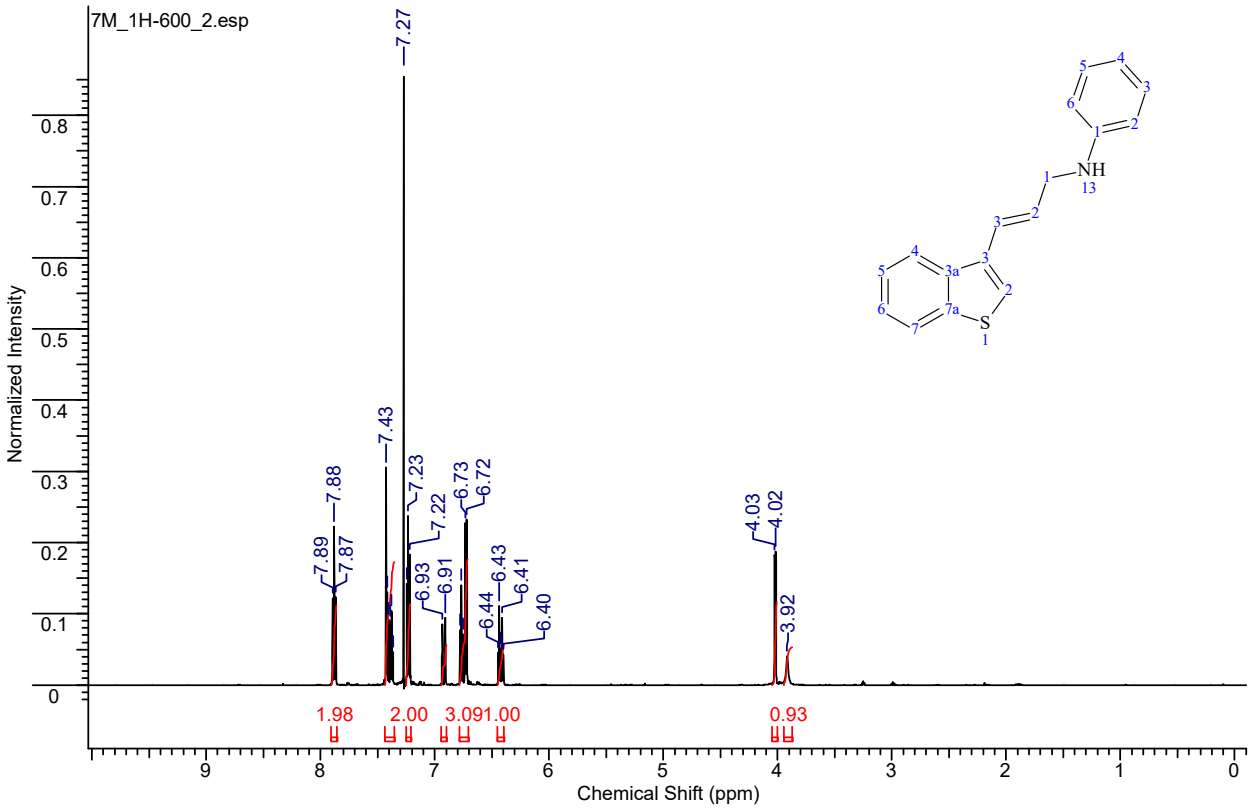


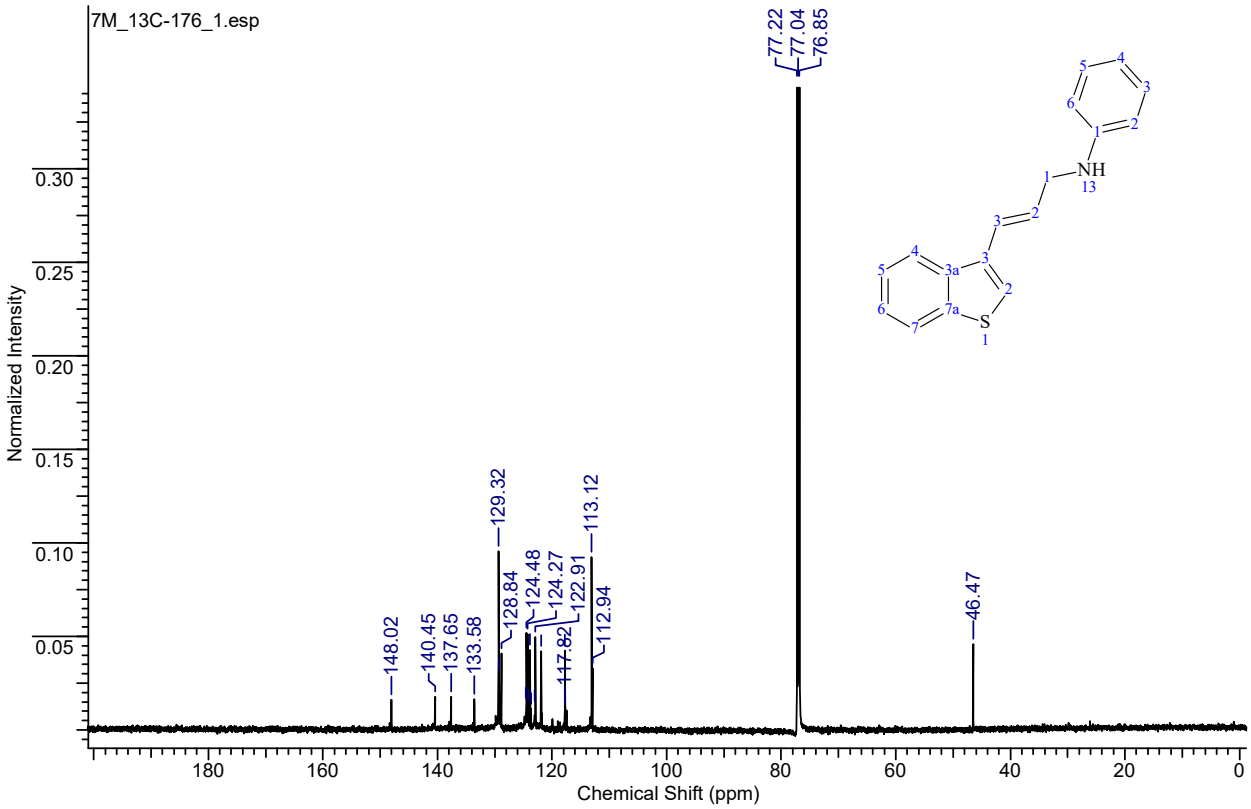
***(E)*-*N*-(3-(Benzo[*b*]thiophen-2-yl)-2-methylallyl)aniline (7l).**



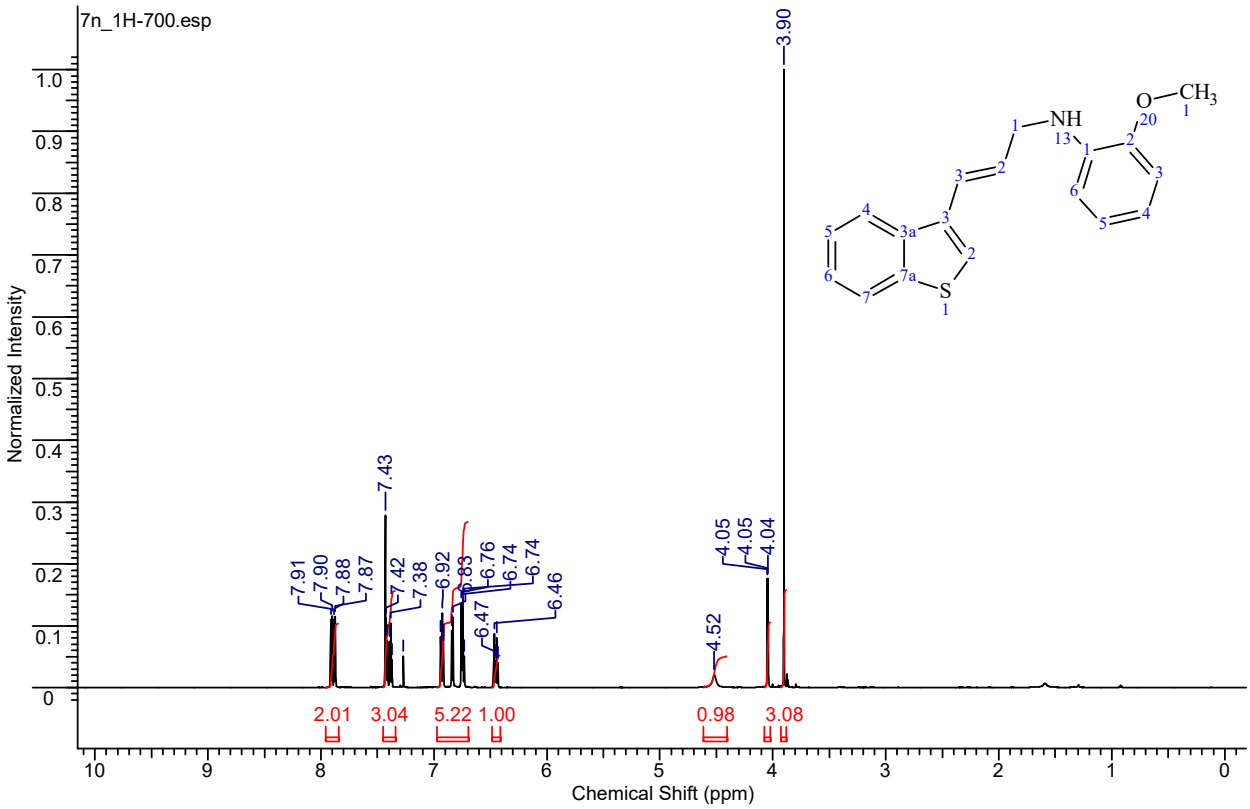


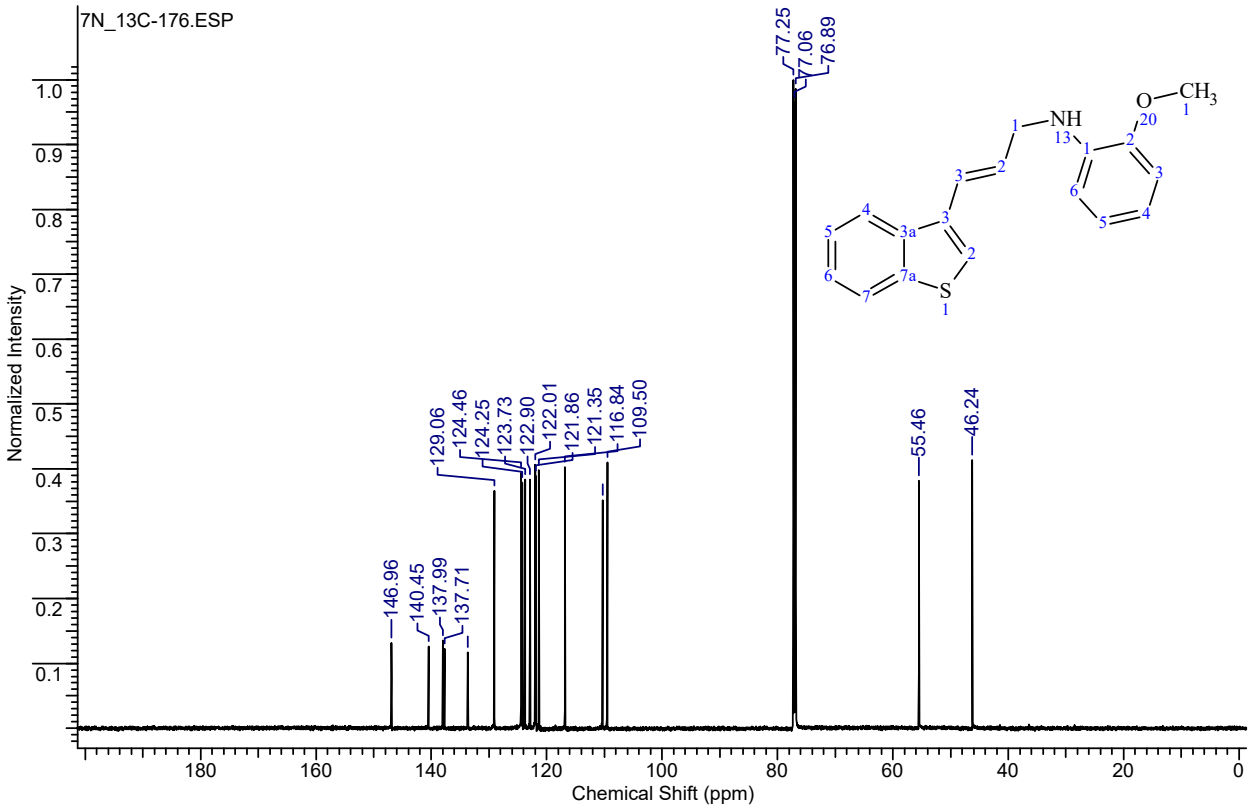
***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)aniline (7m).**



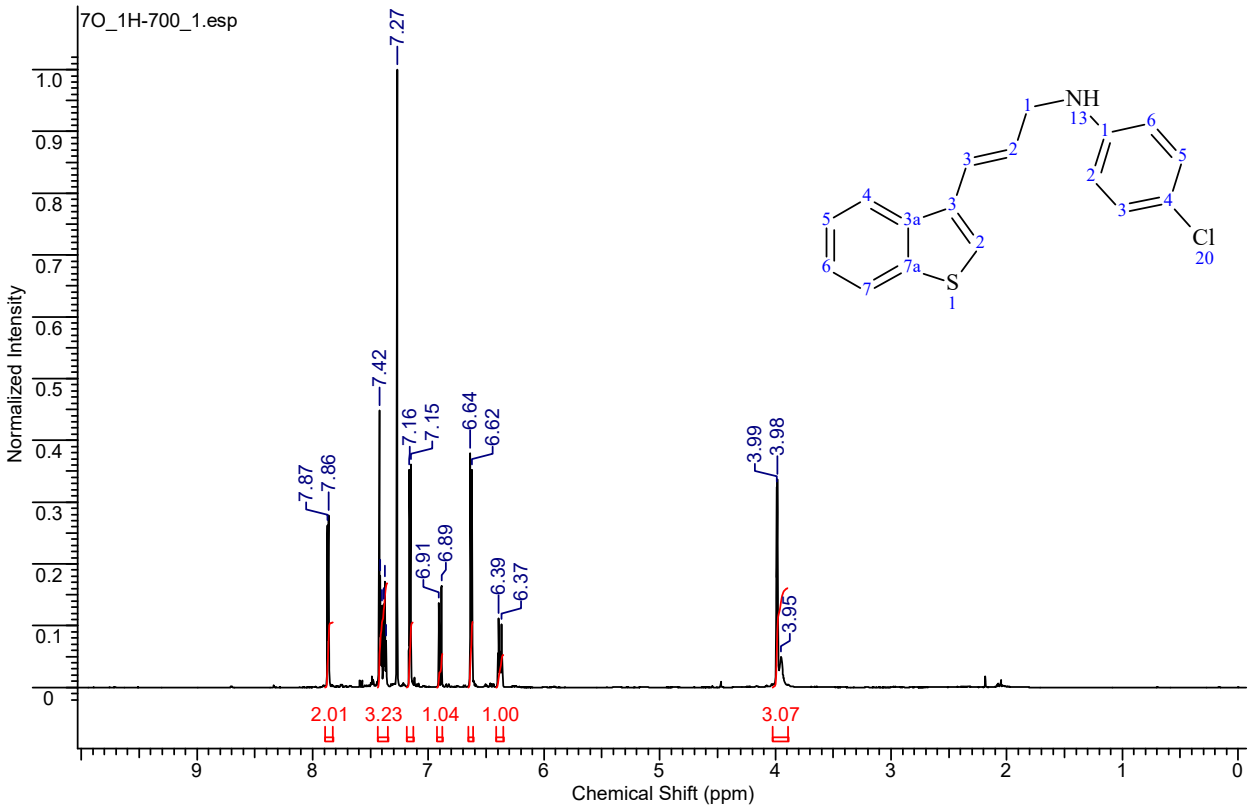


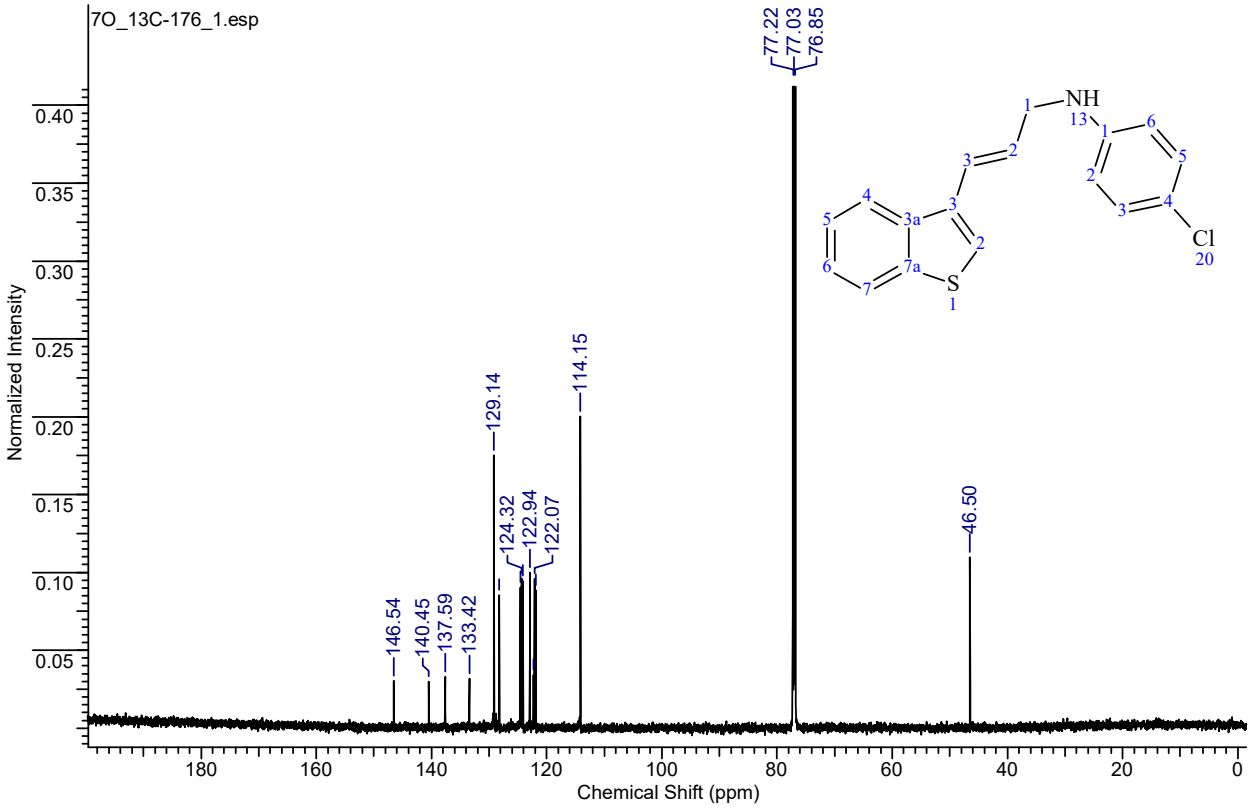
***(E)*-*N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-2-methoxyaniline (7n).**



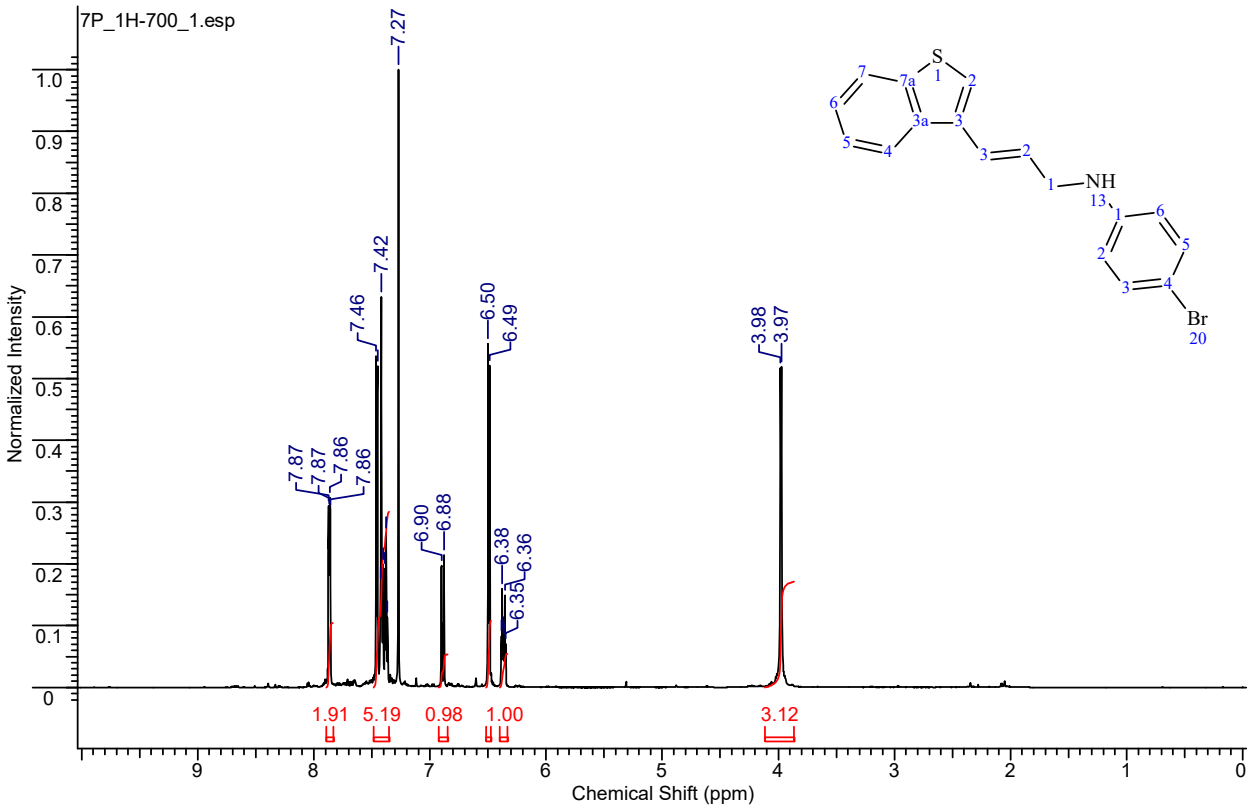


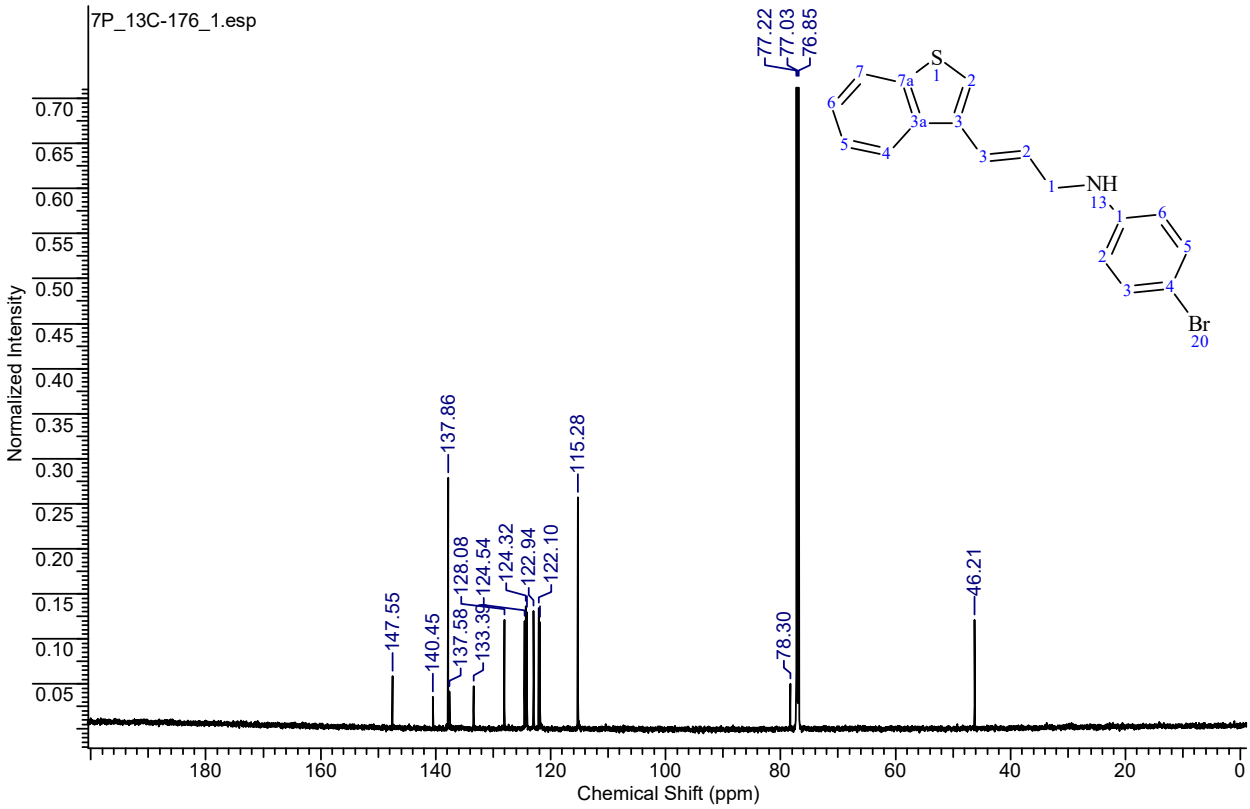
***(E)*-*N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-chloroaniline (7o).**



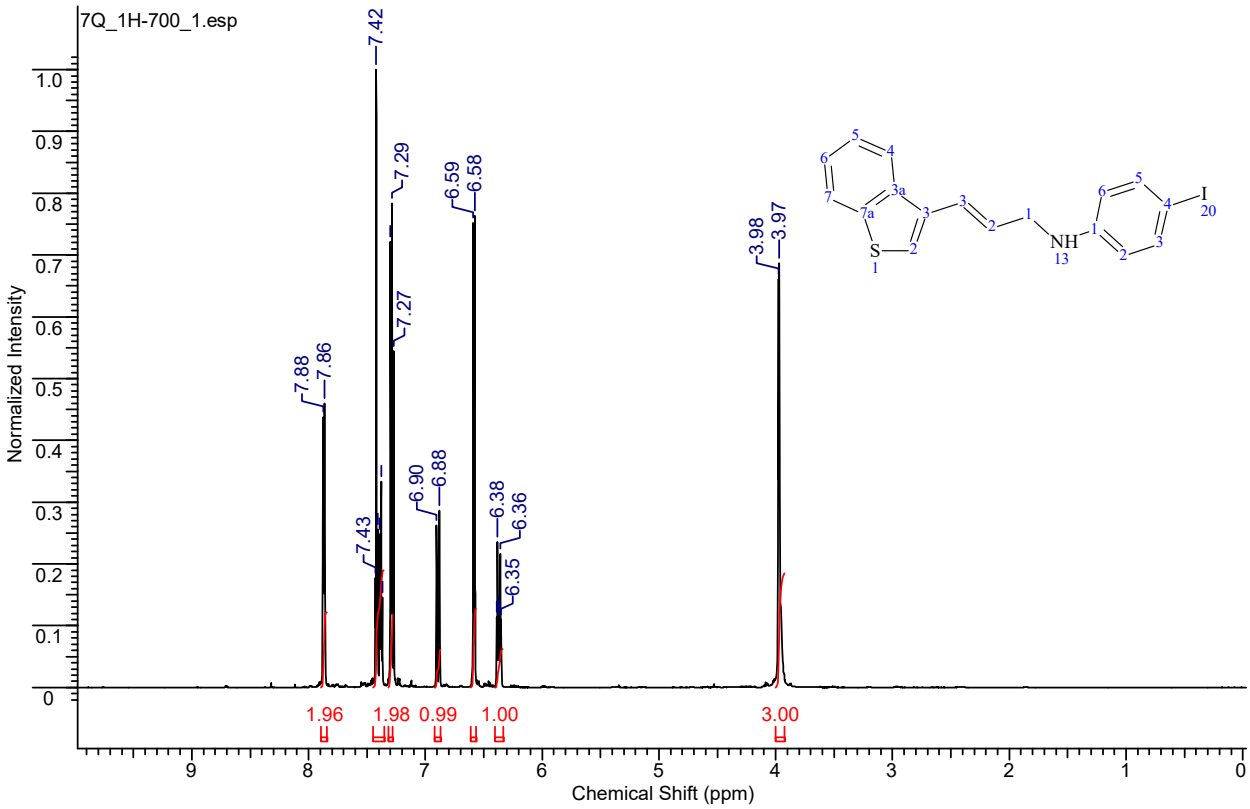


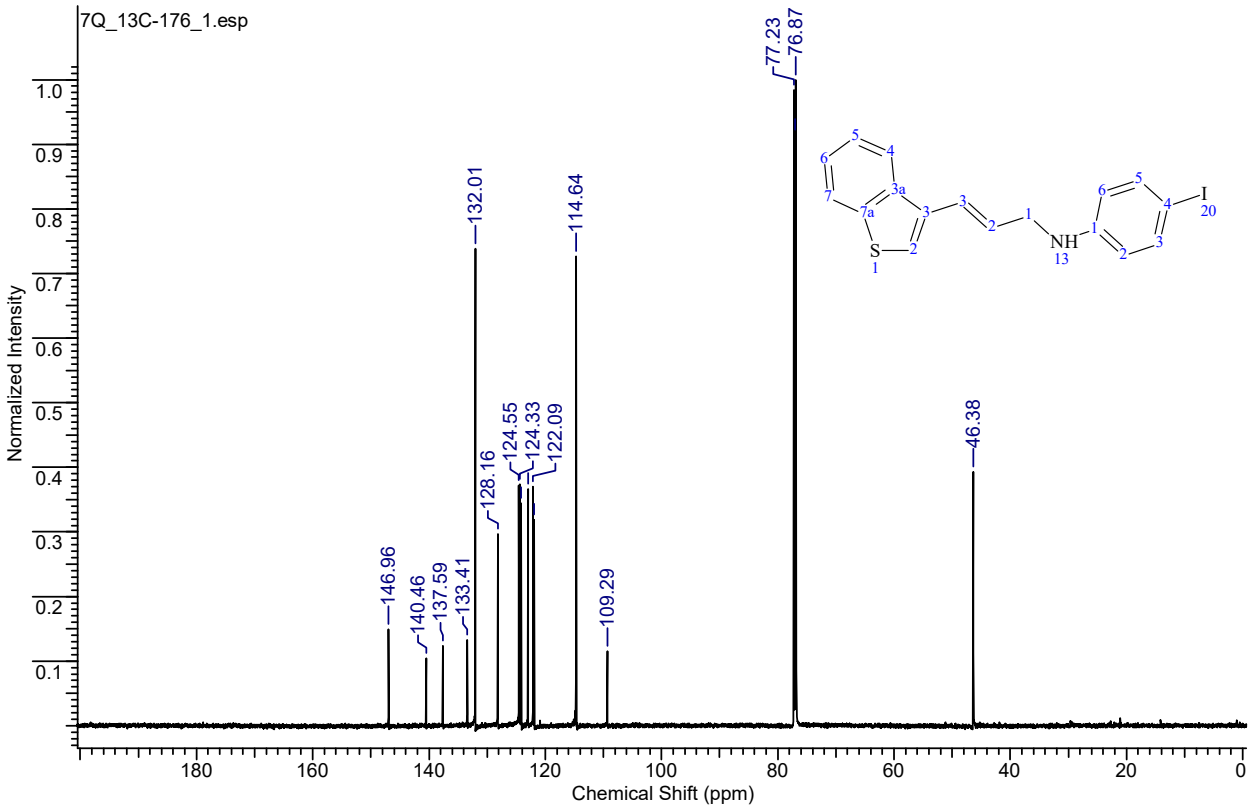
***(E)*-*N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-bromoaniline (7p).**



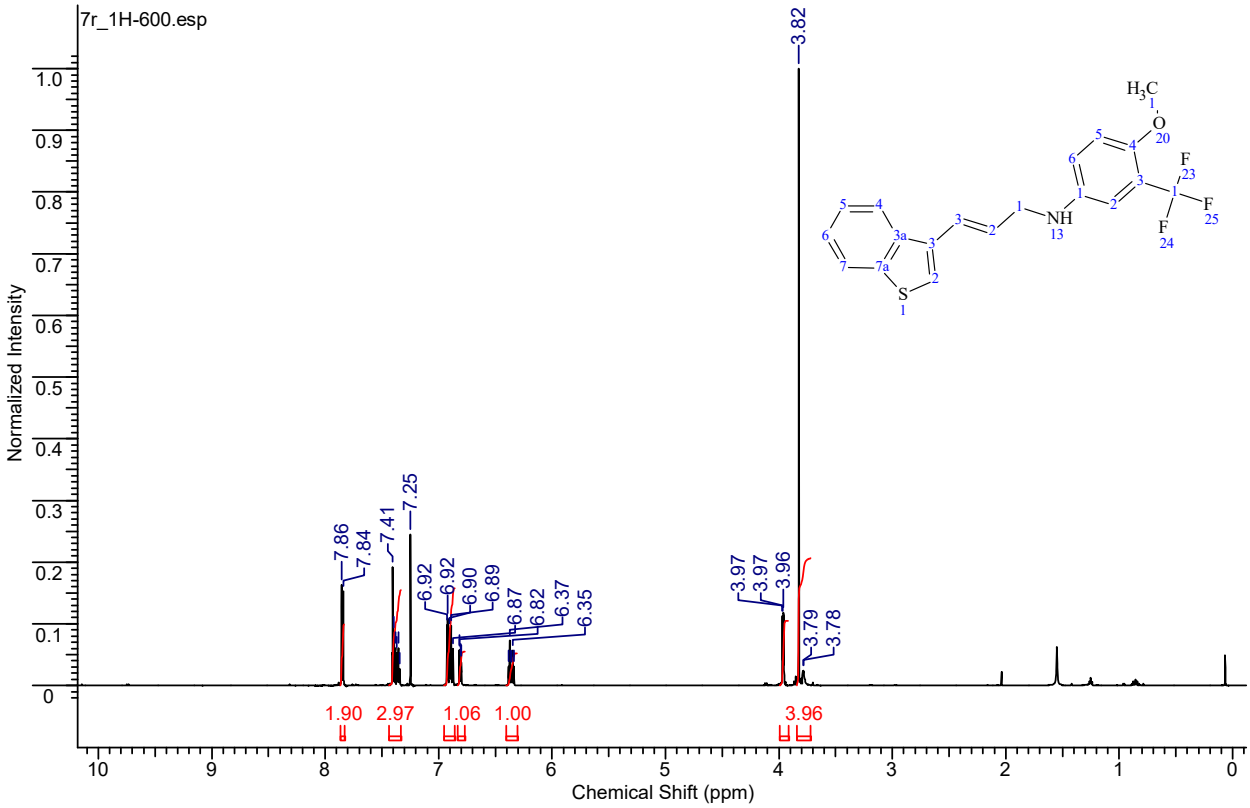


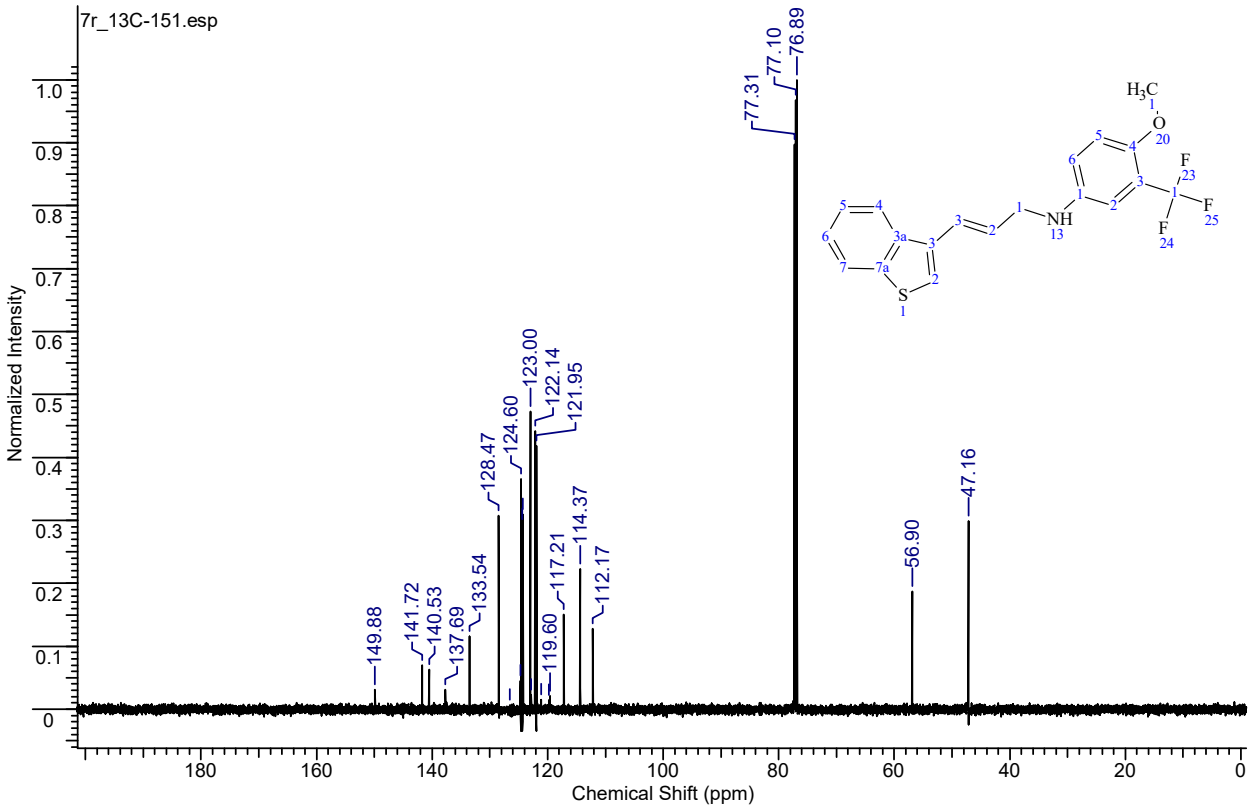
***(E)*-*N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-idoaniline (7q).**

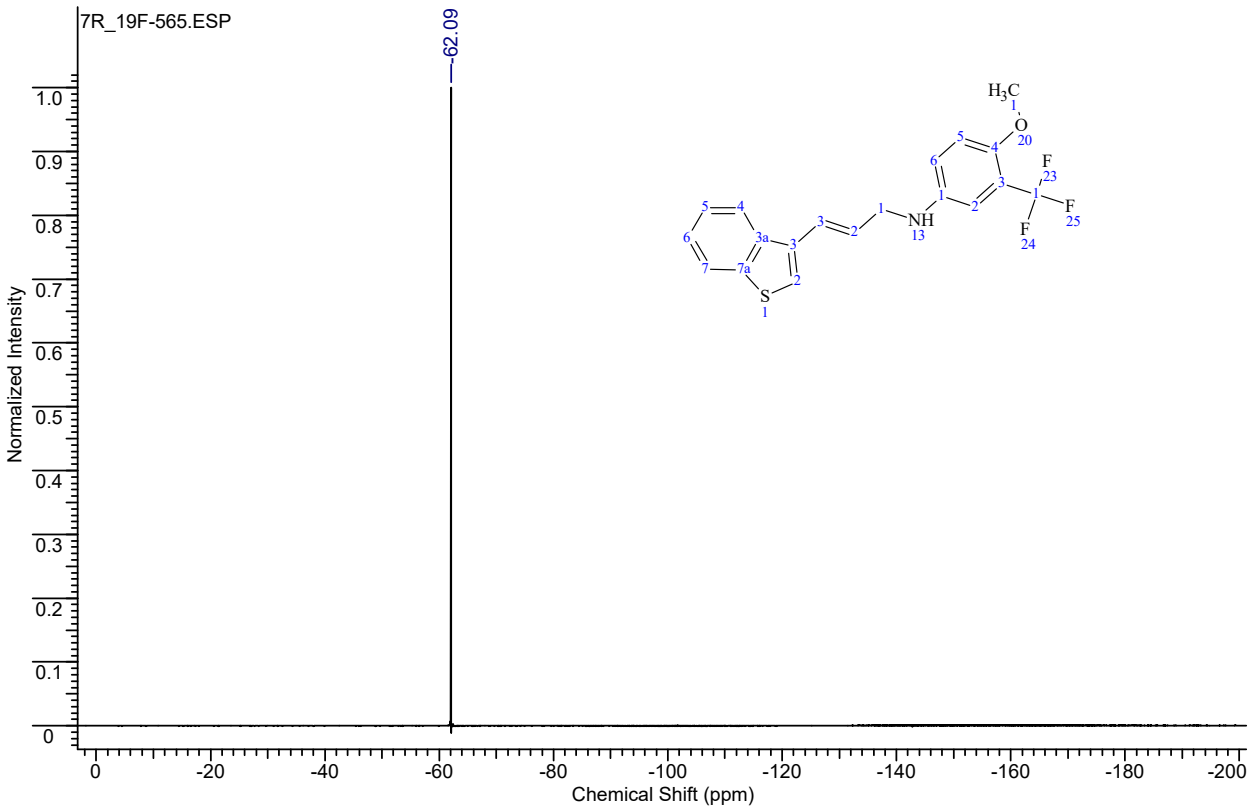




***(E)-N*-(3-(Benzo[*b*]thiophen-3-yl)allyl)-4-methoxy-3-(trifluoromethyl)aniline (7r).**



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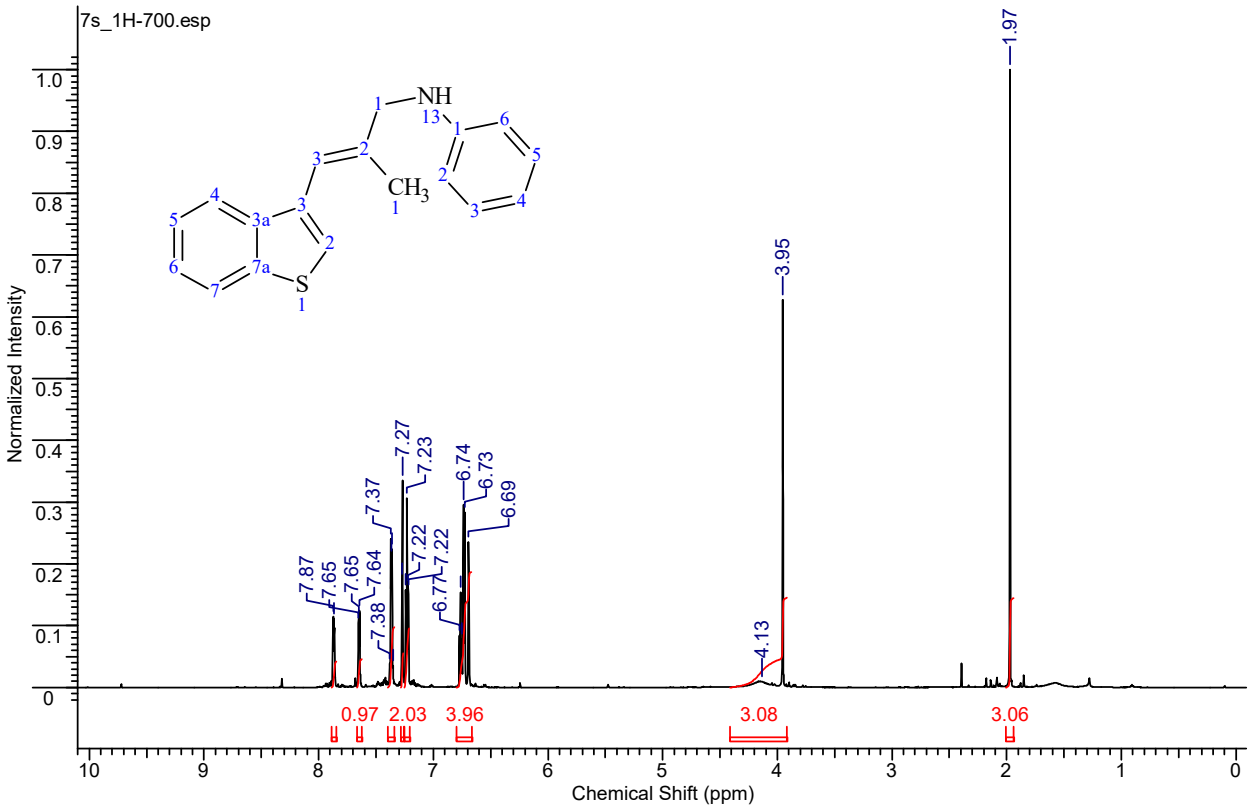
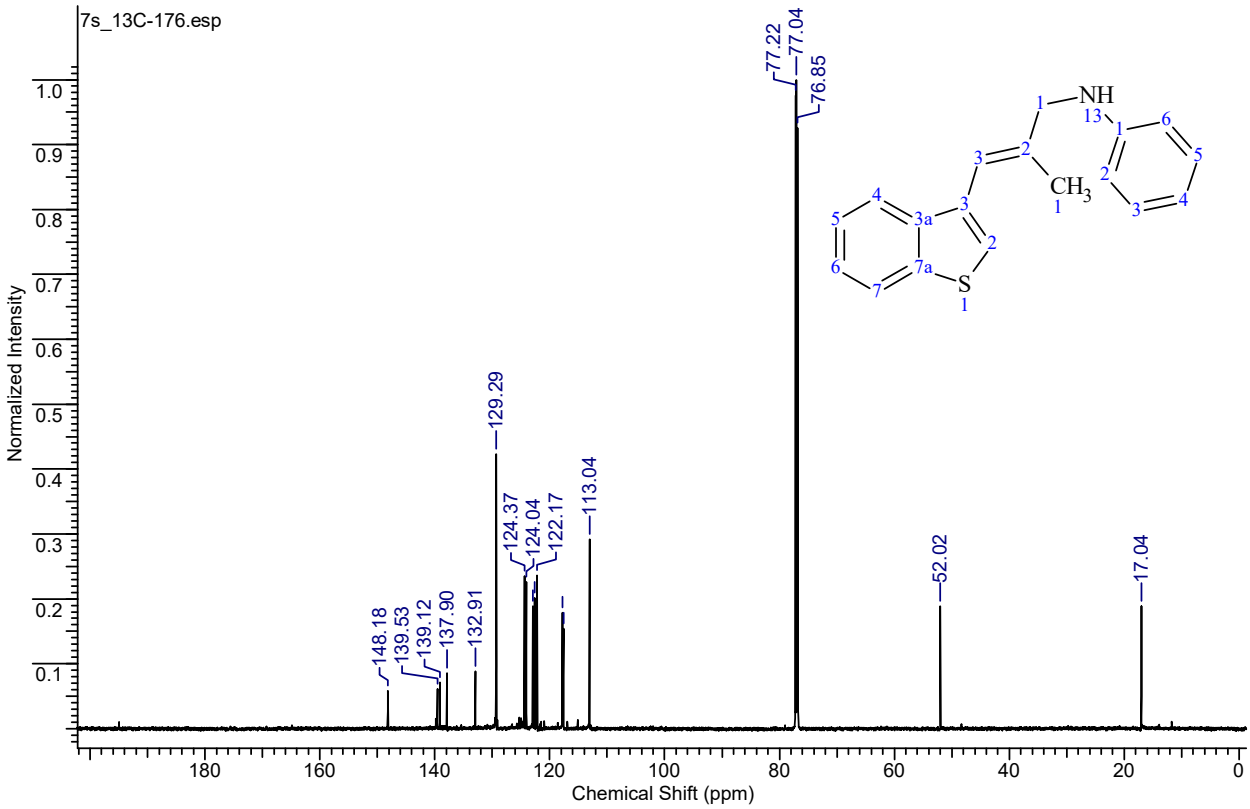
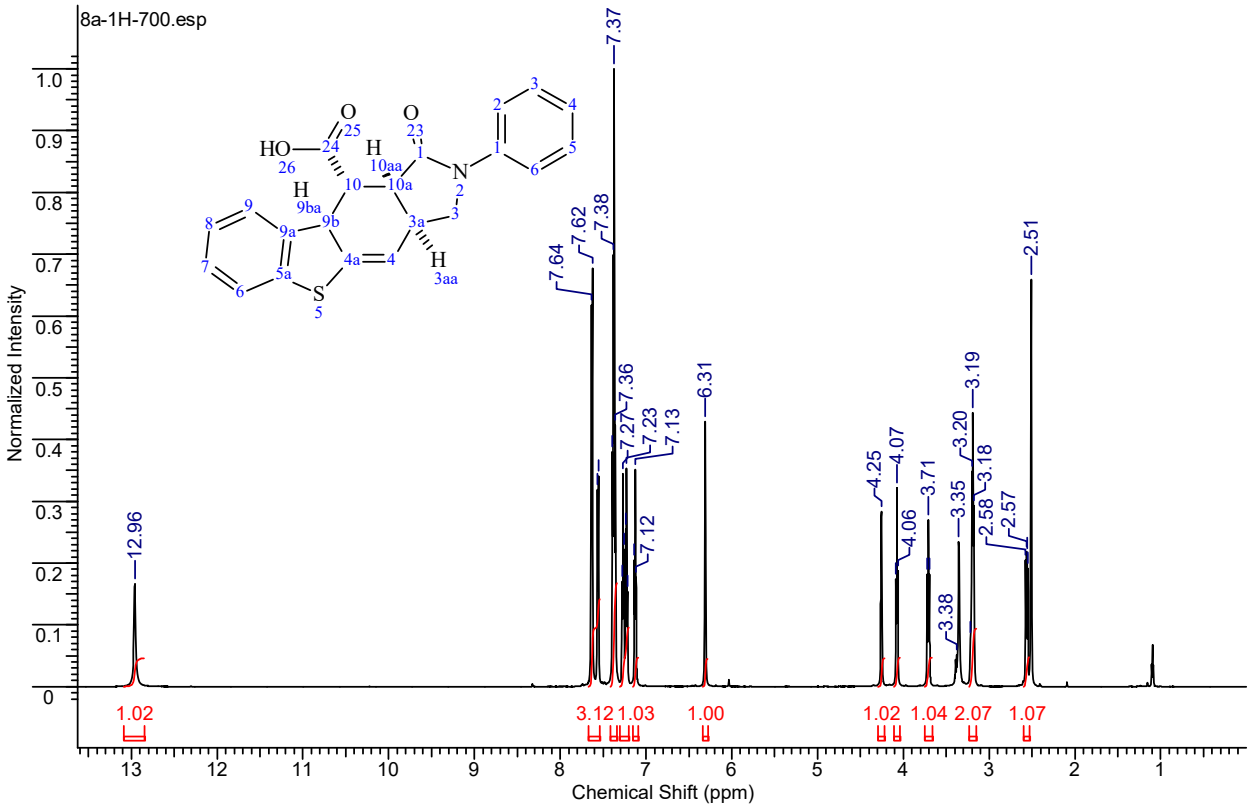
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
H3C
O
NH
F
S

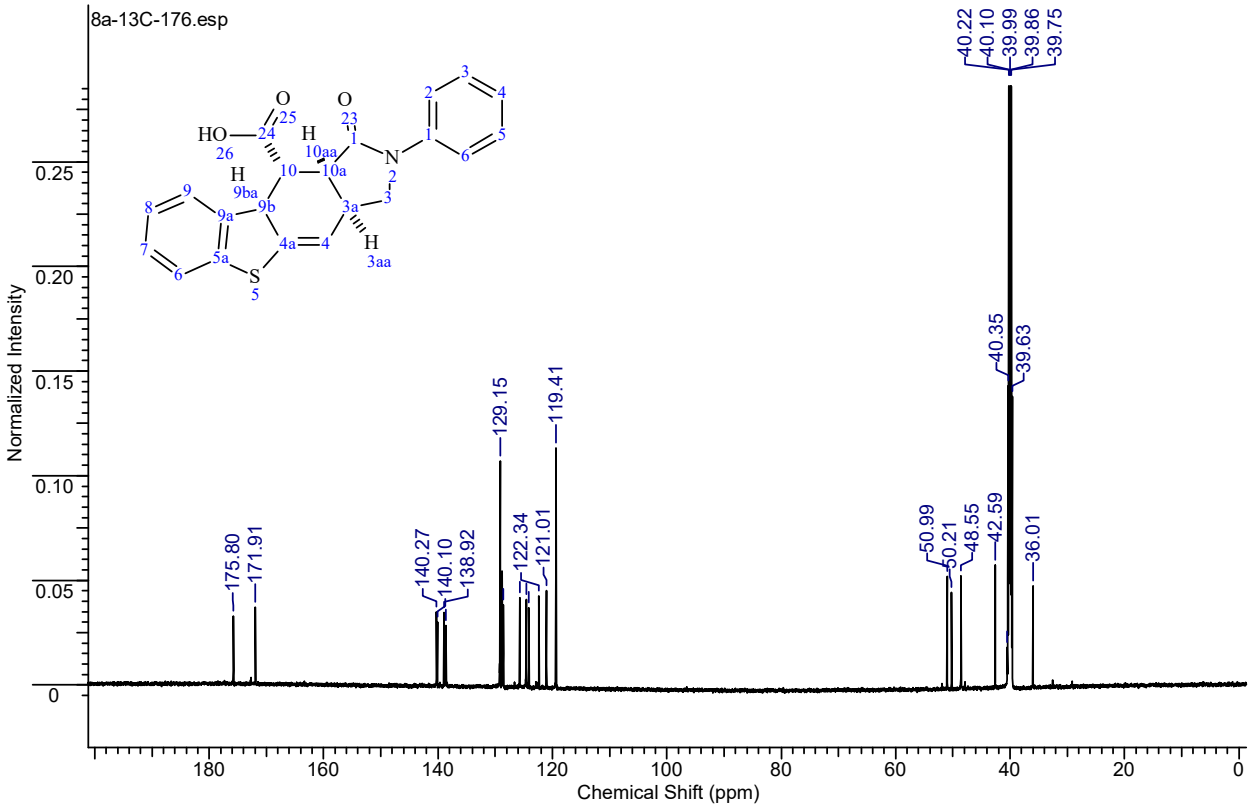
***(E)*-*N*-(3-(Benzo[*b*]thiophen-3-yl)-2-methylallyl)aniline (7s).**



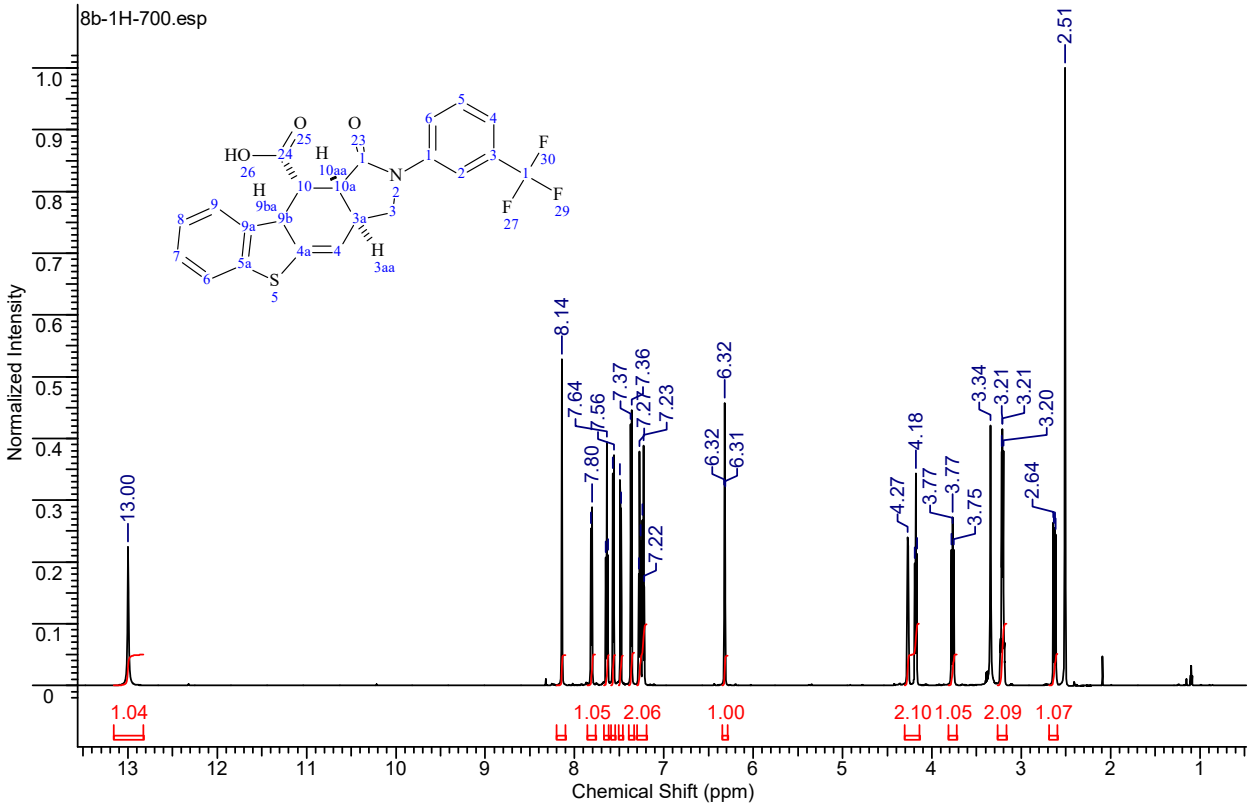


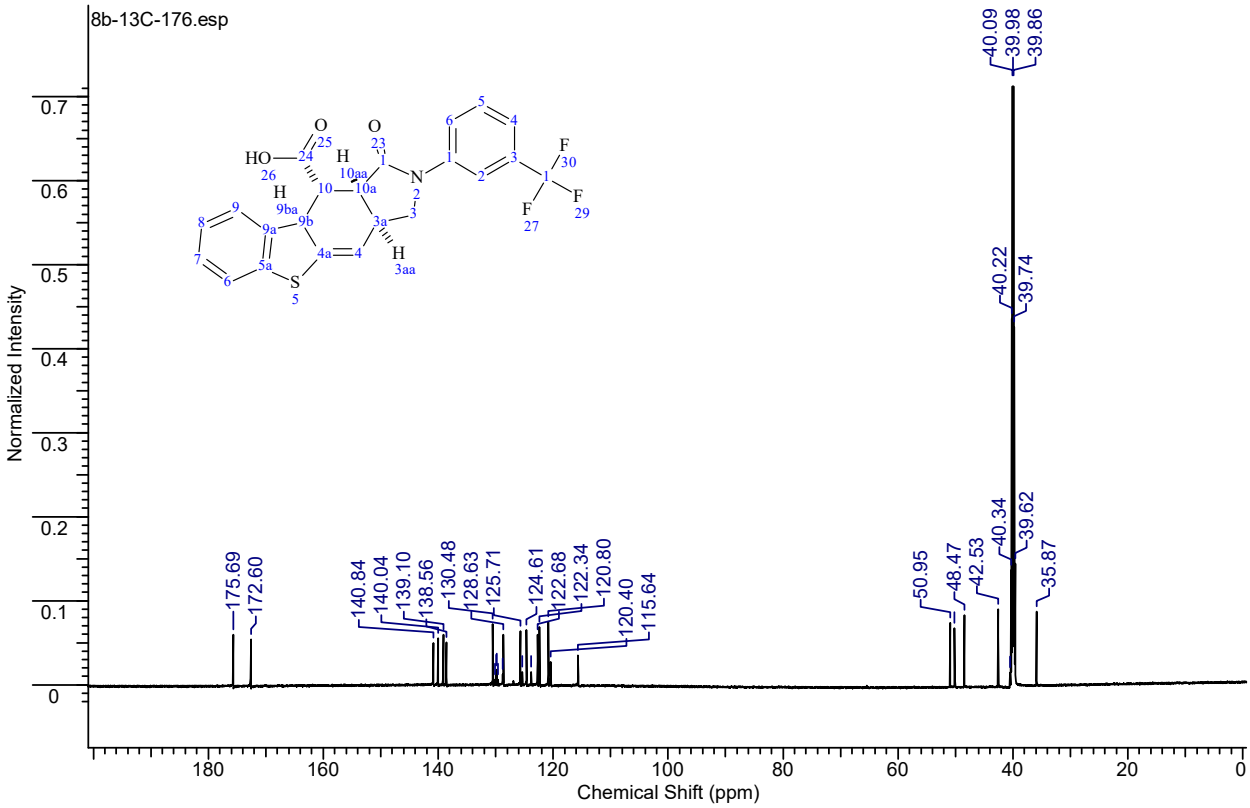
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-1-Oxo-2-phenyl-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8a).

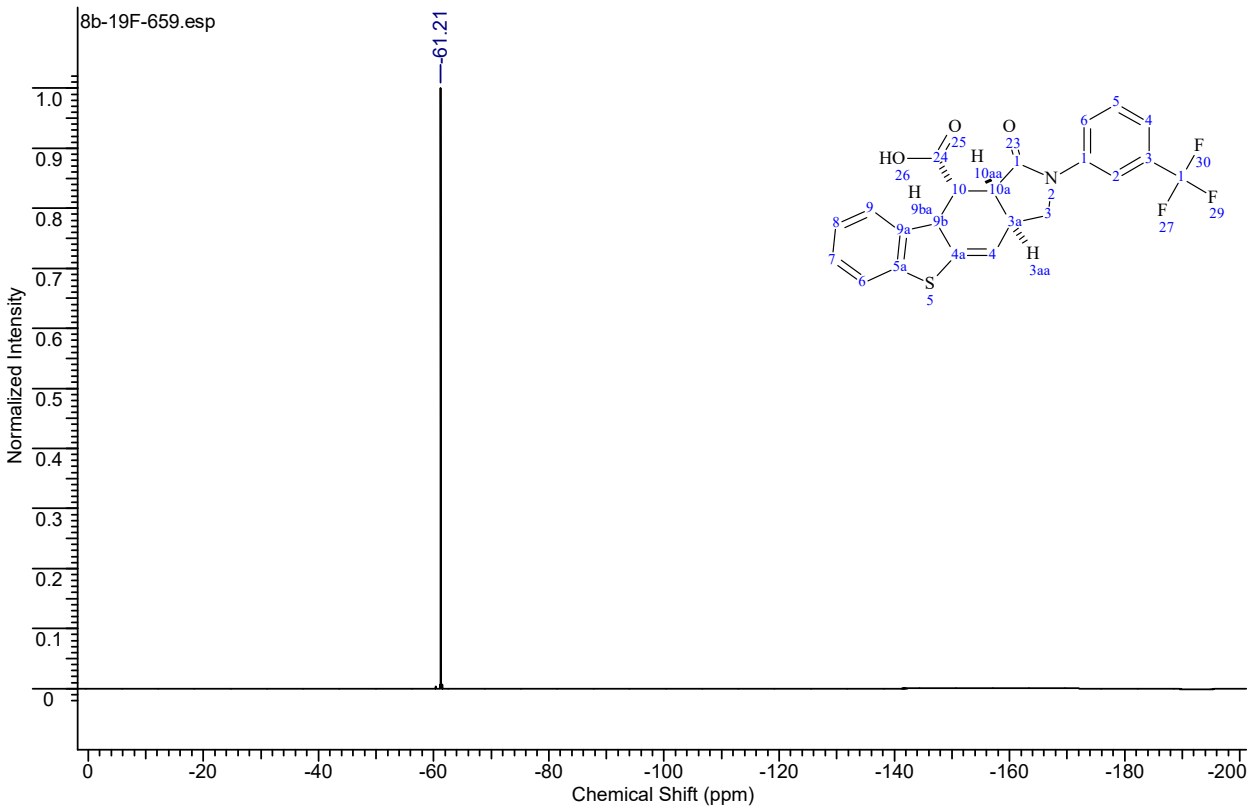




(3a*RS*,9b*RS*,10*RS*,10a*RS*)-1-Oxo-2-(3-(trifluoromethyl)phenyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8b).



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-20
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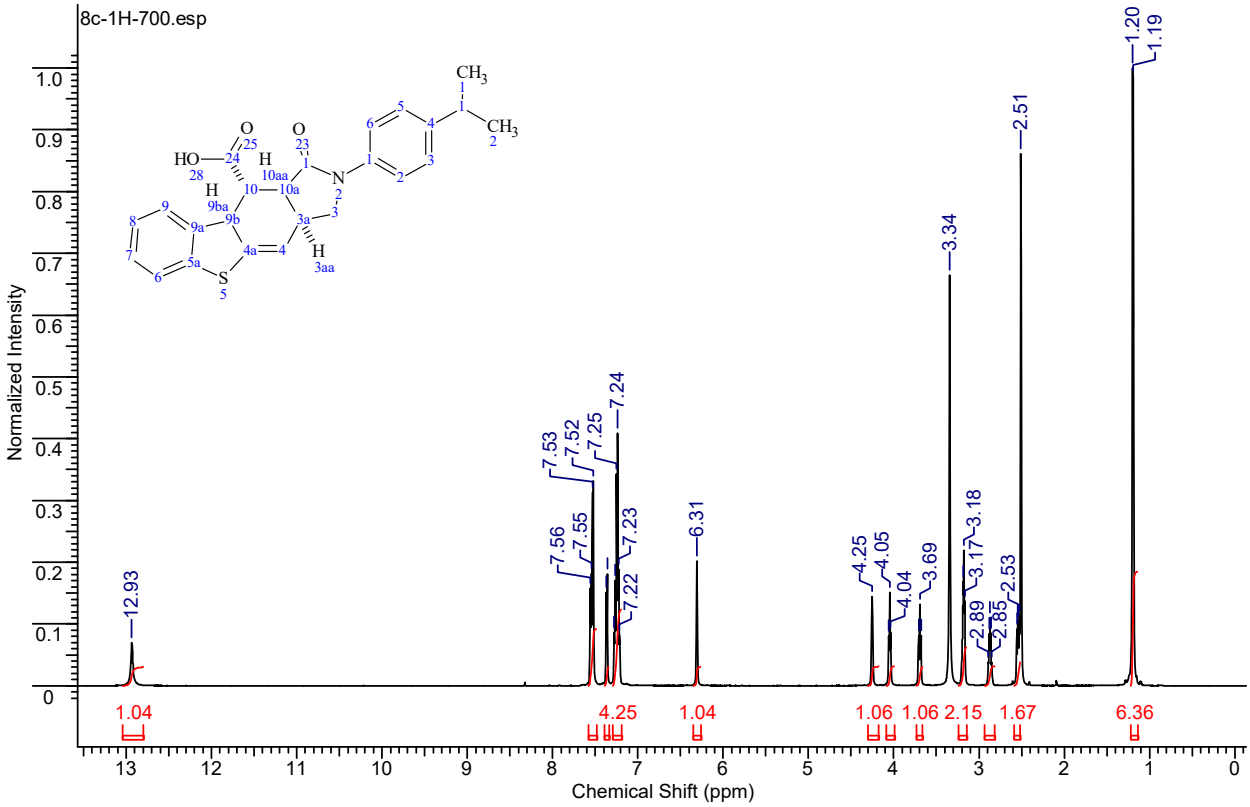
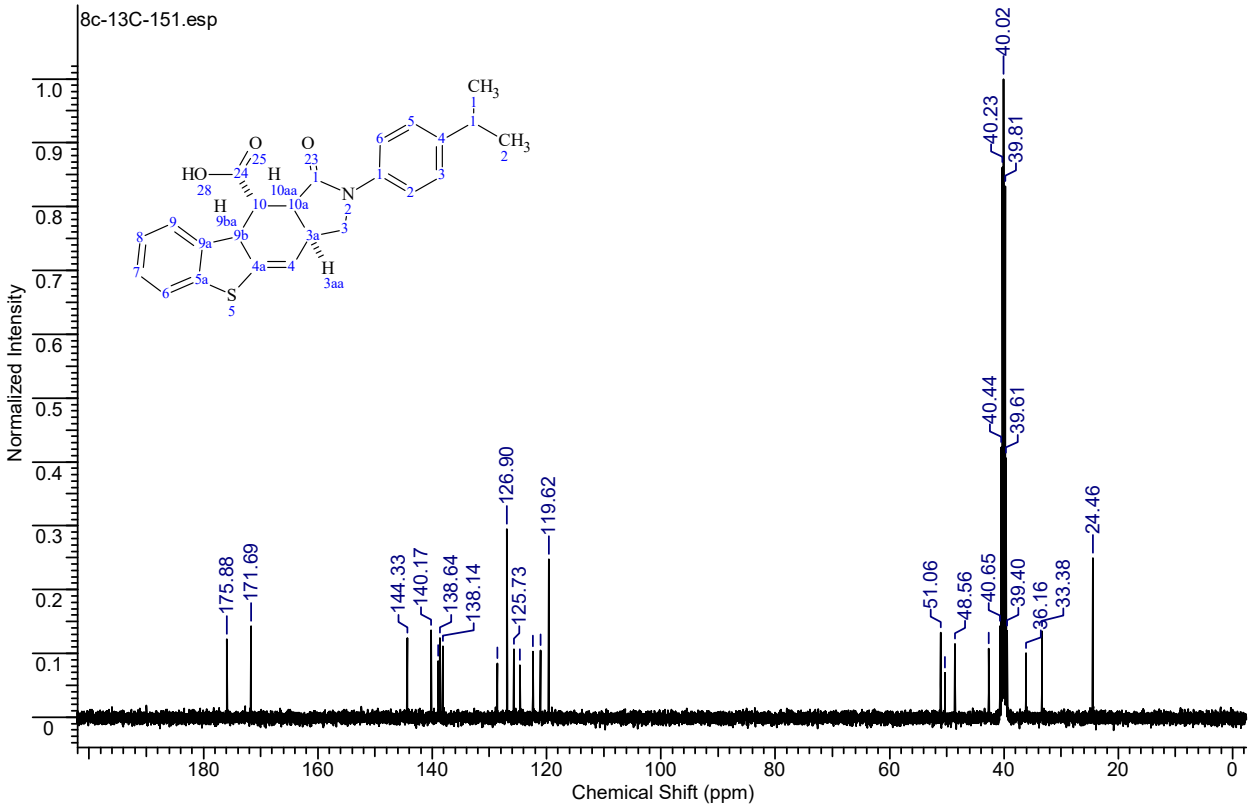
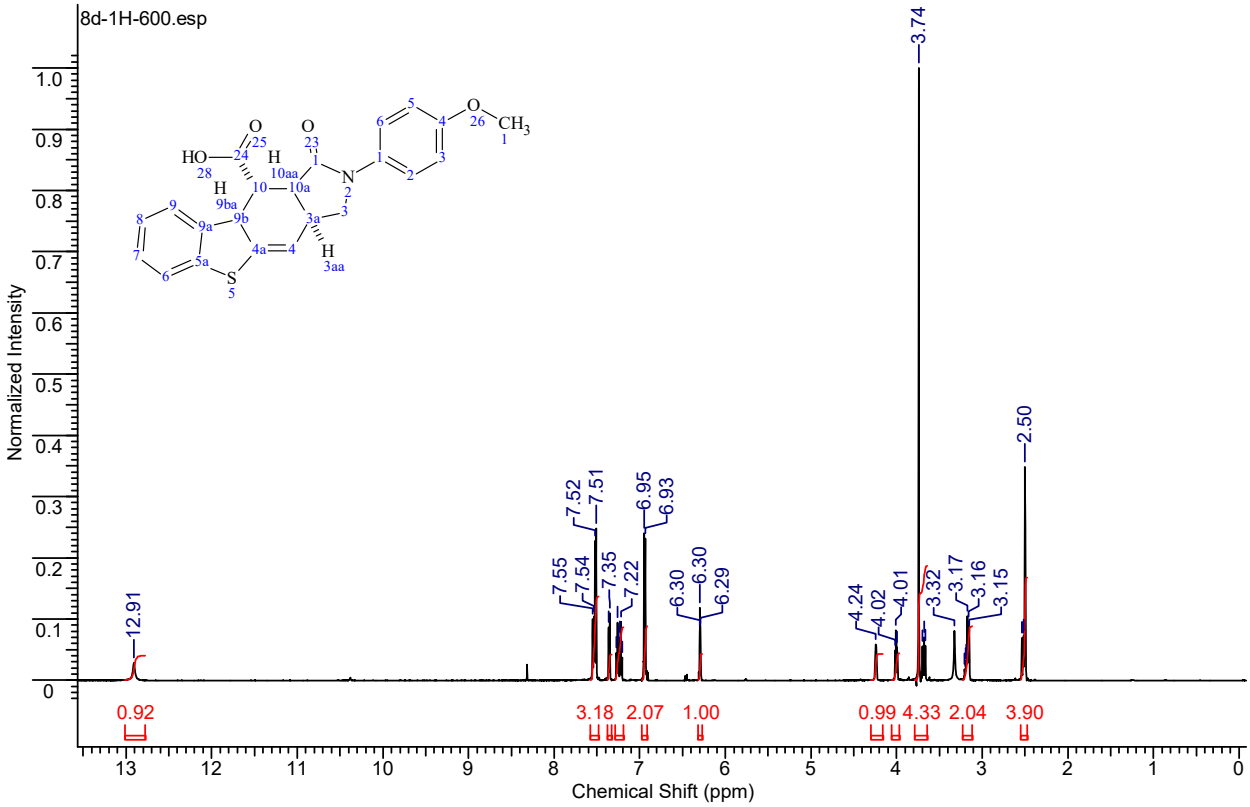
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
O
O
HO
H
N
F
F
F
S
H
H

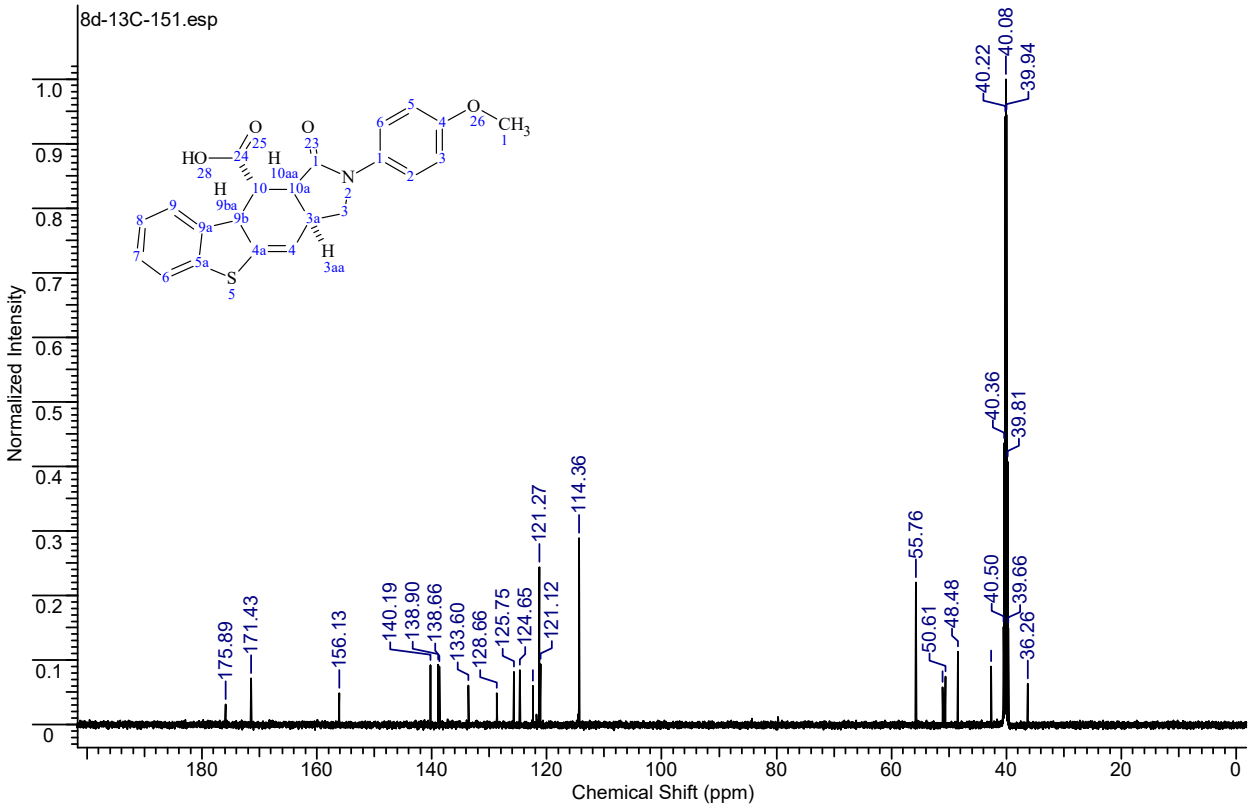
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Isopropylphenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8c).



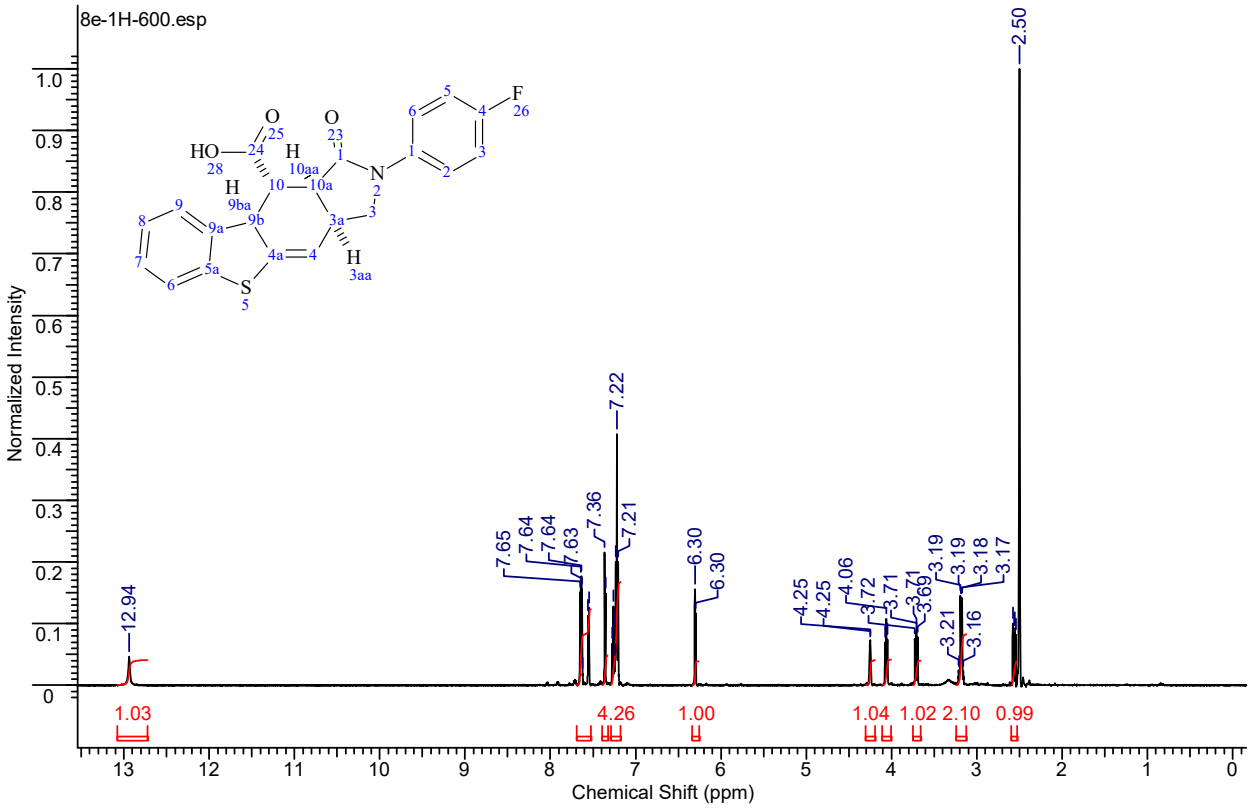


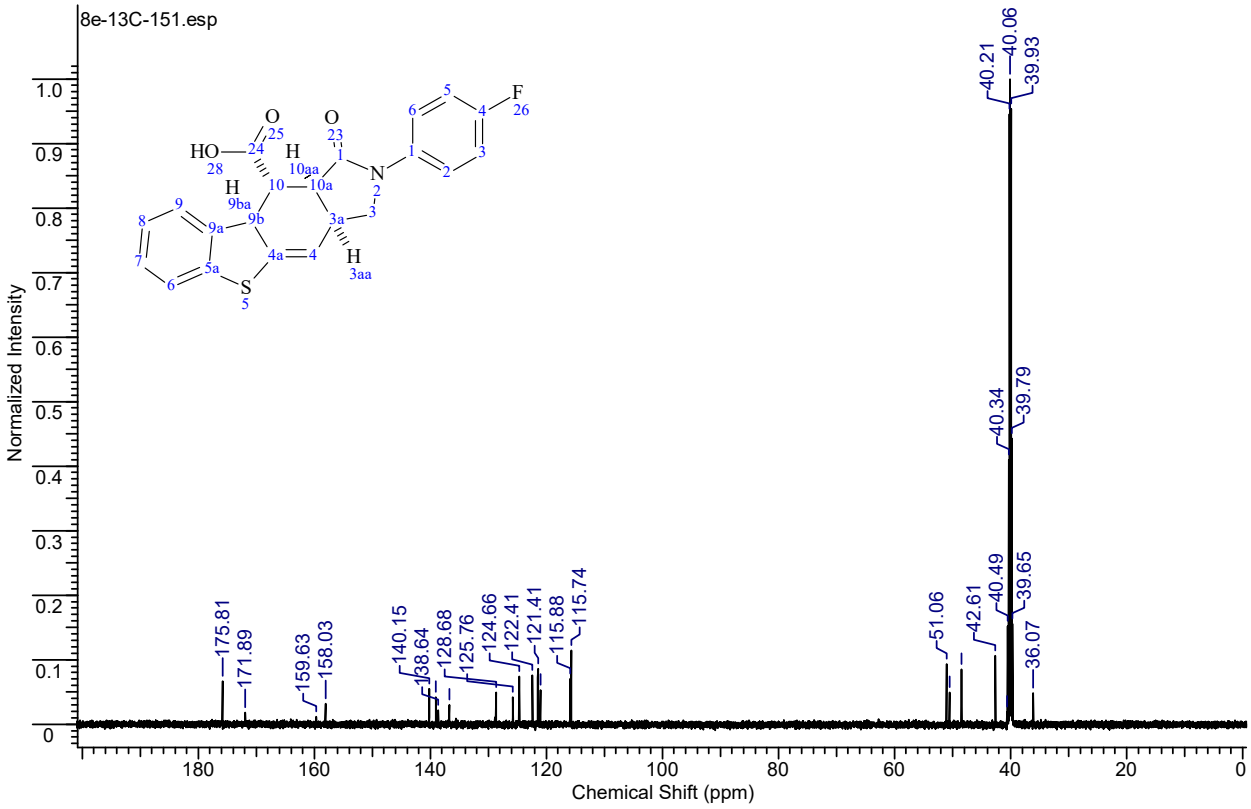
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8d).

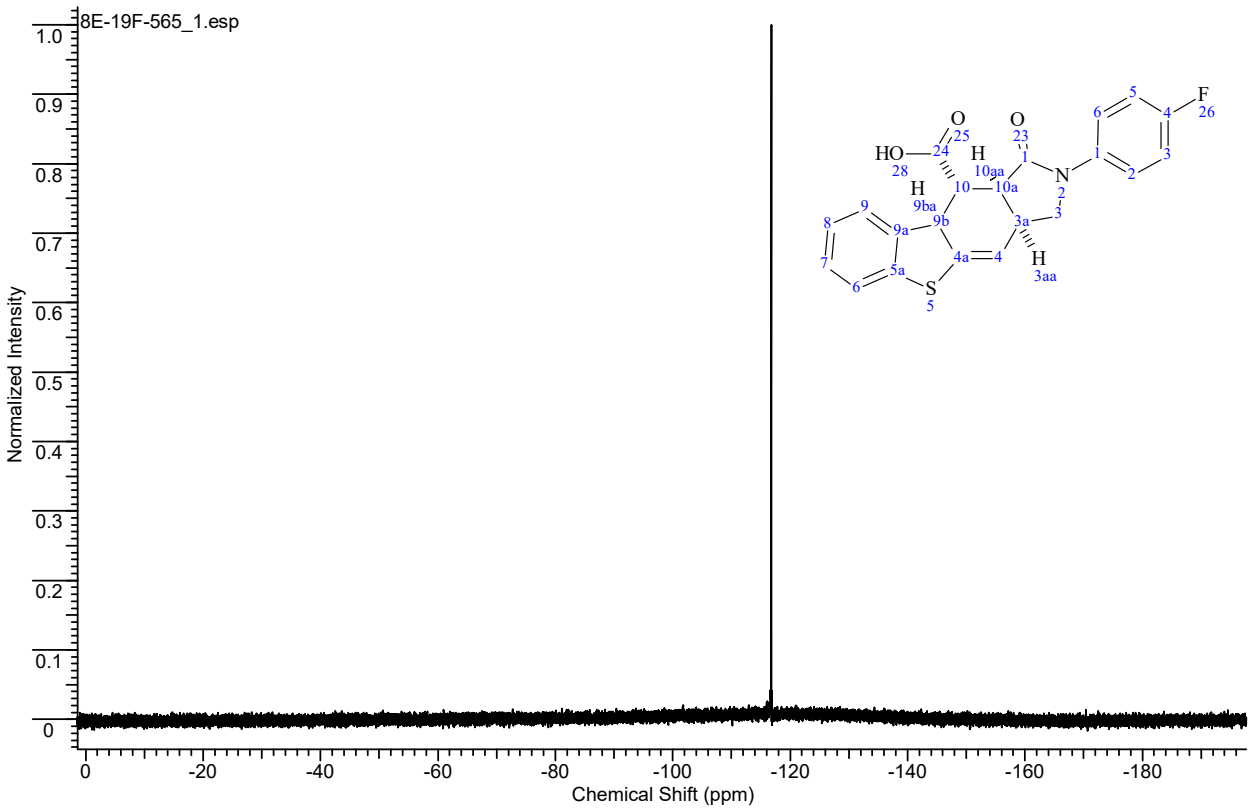




(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8e).



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0.4
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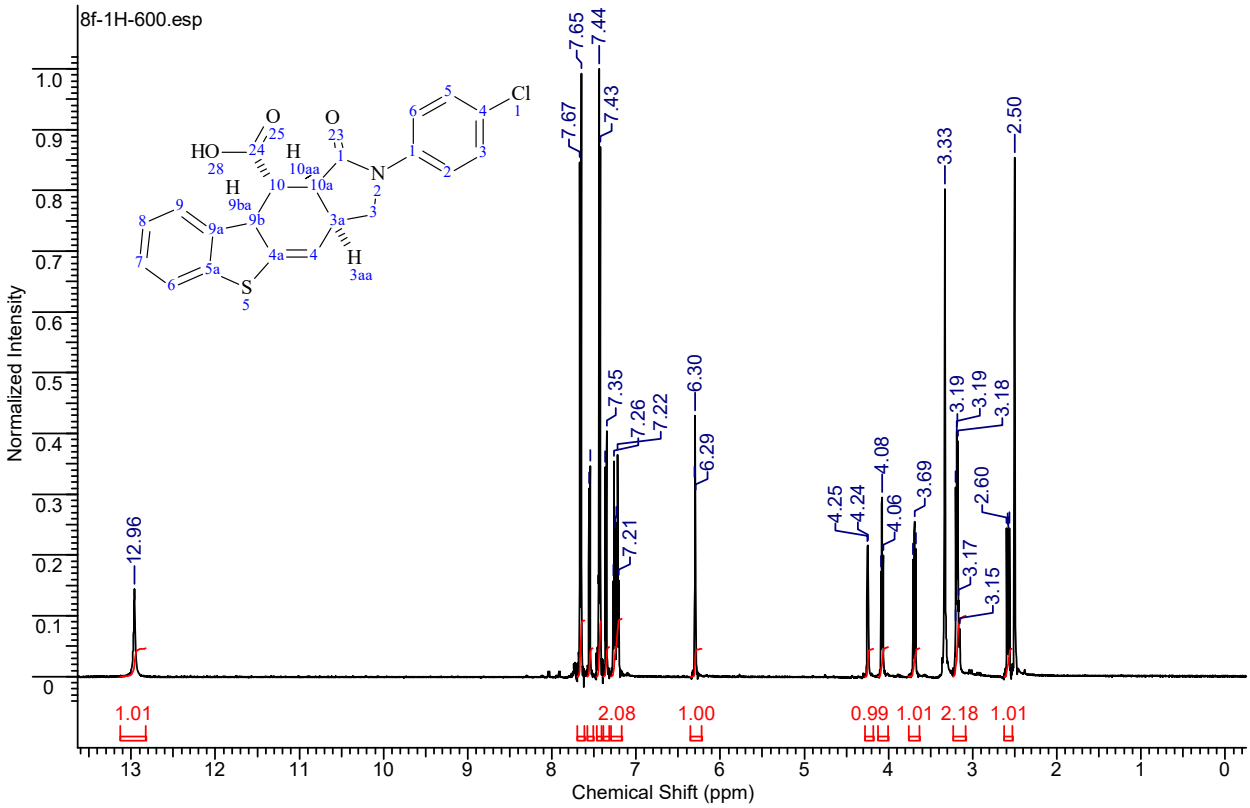
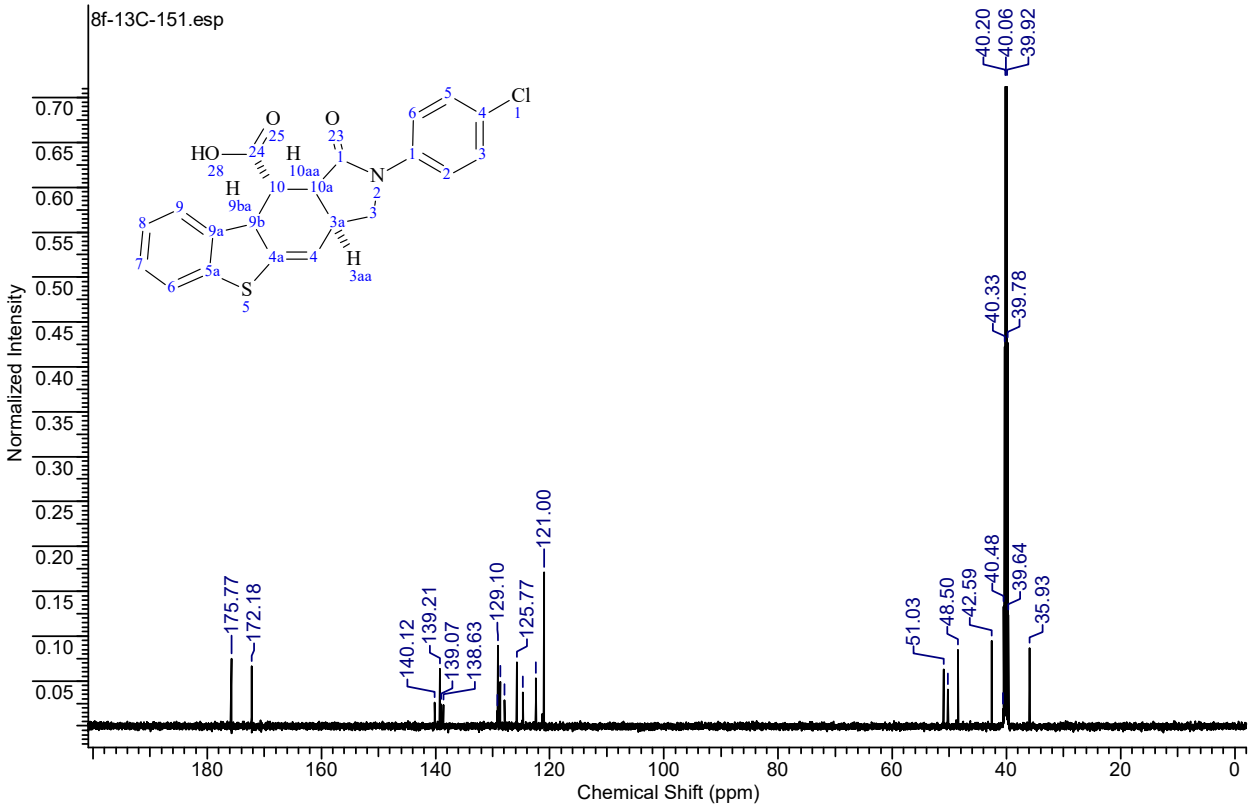
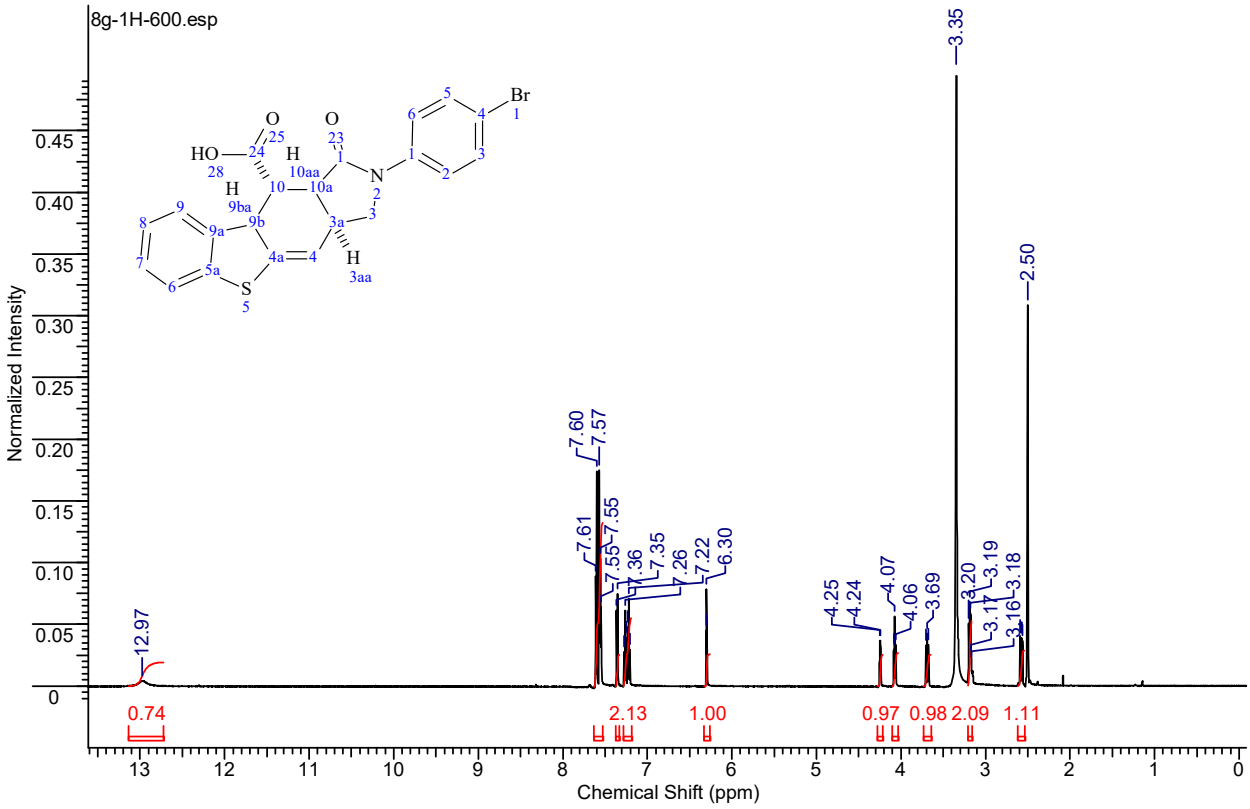
-20
-40
-60
-80
-100
-120
-140
-160
-180
Chemical Shift (ppm)
HO
O
O
H
H
N
F
S

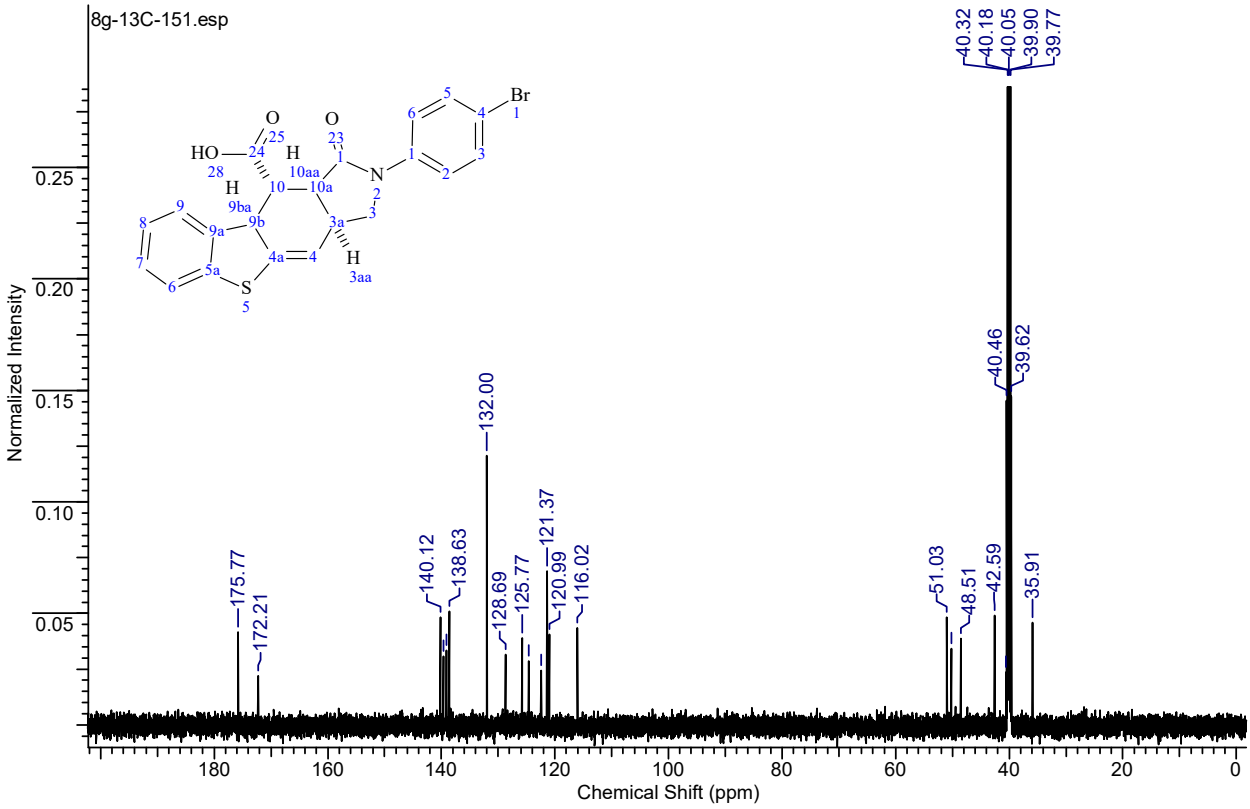
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Chlorophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8f).



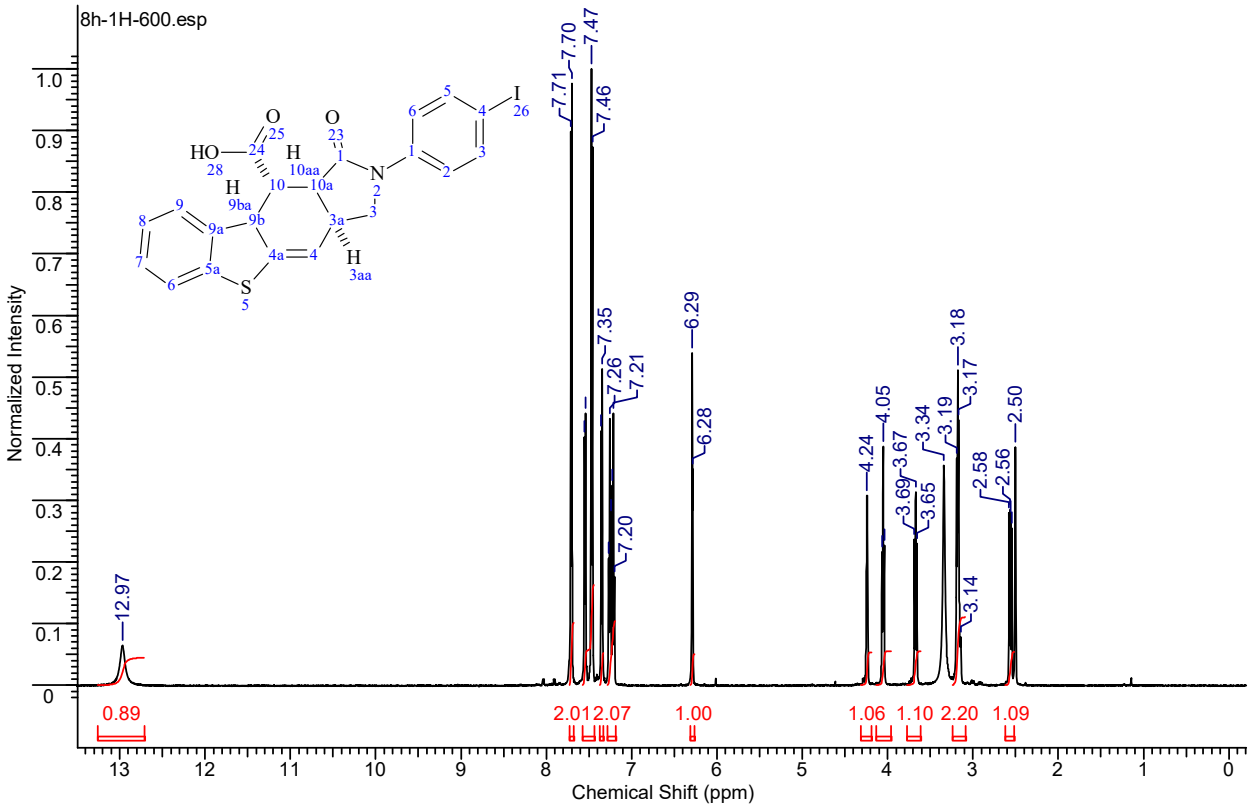


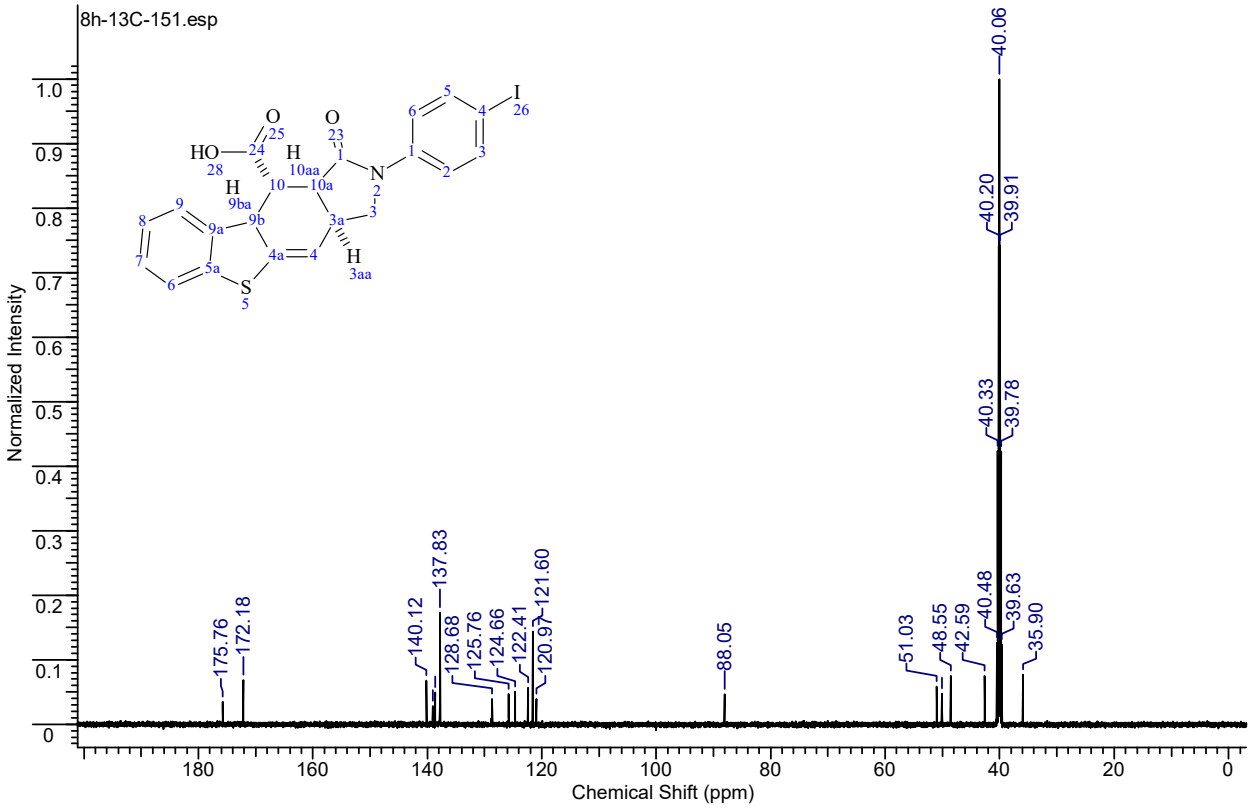
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8g).



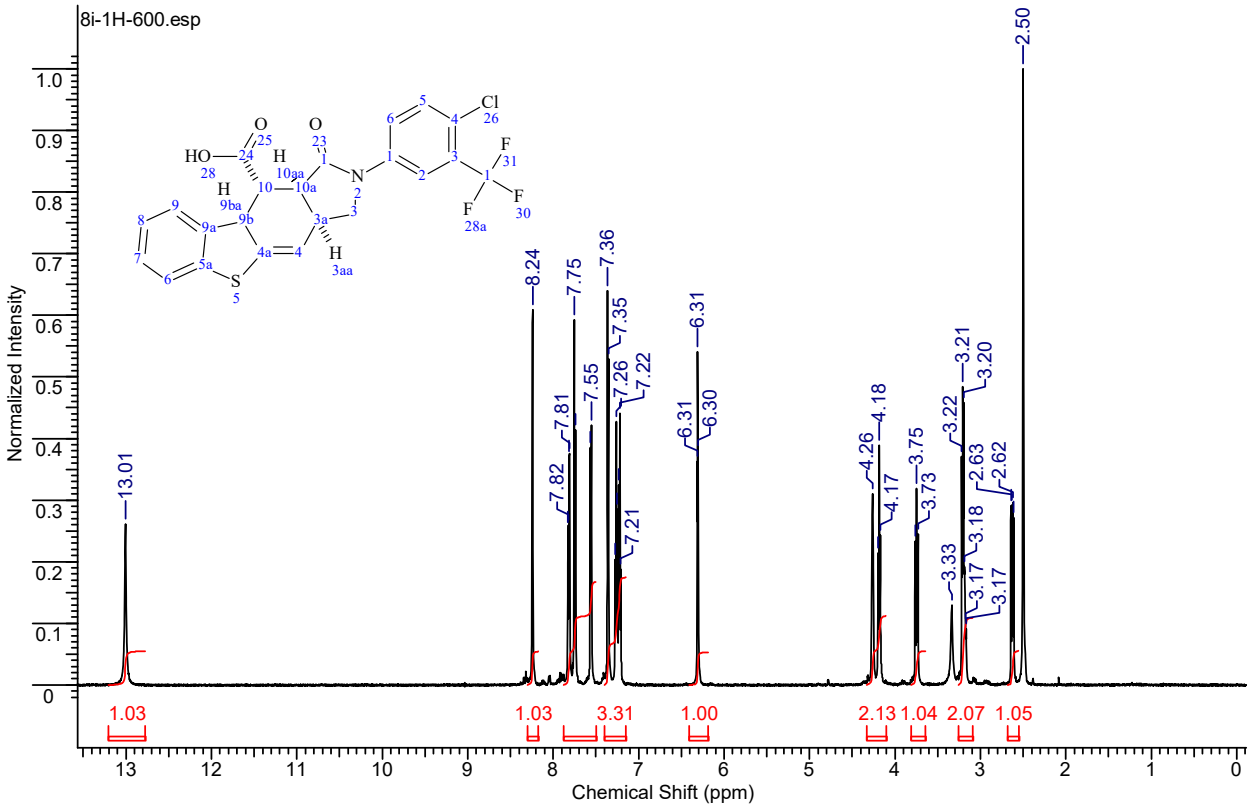


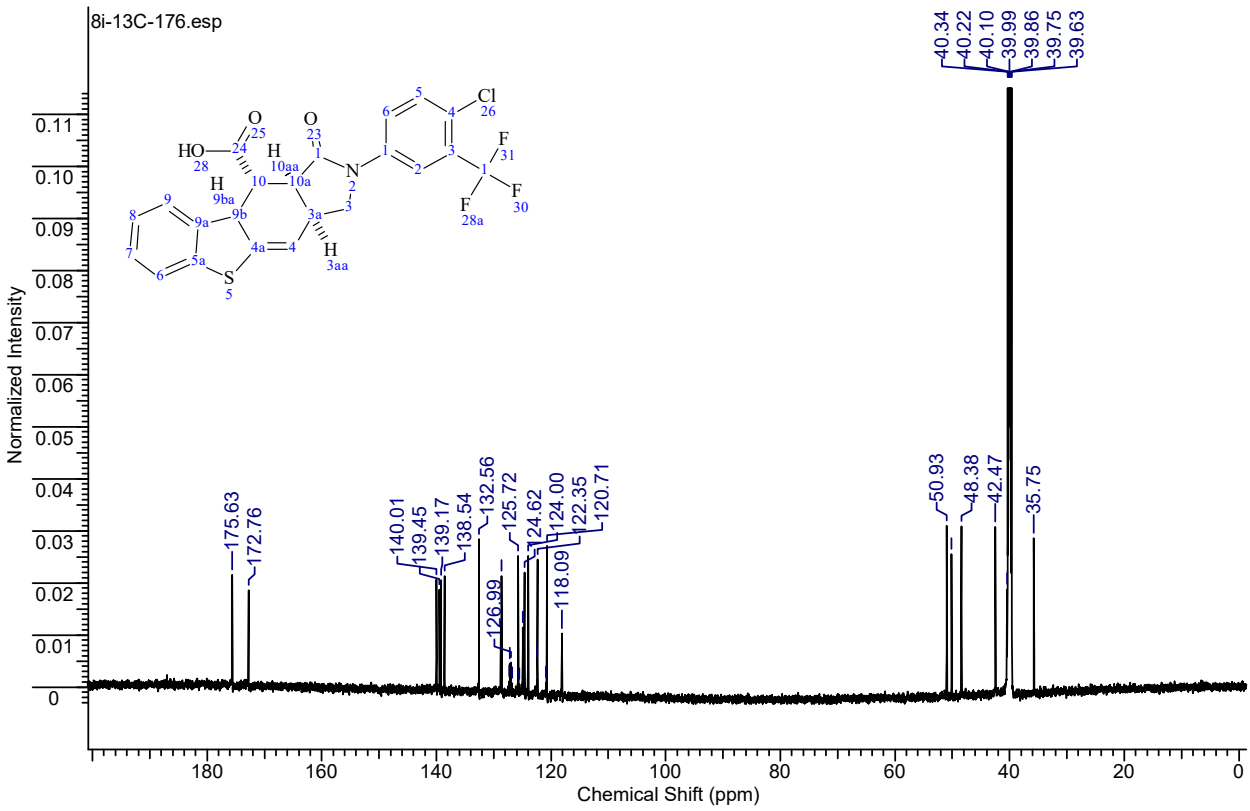
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Iodophenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8h).



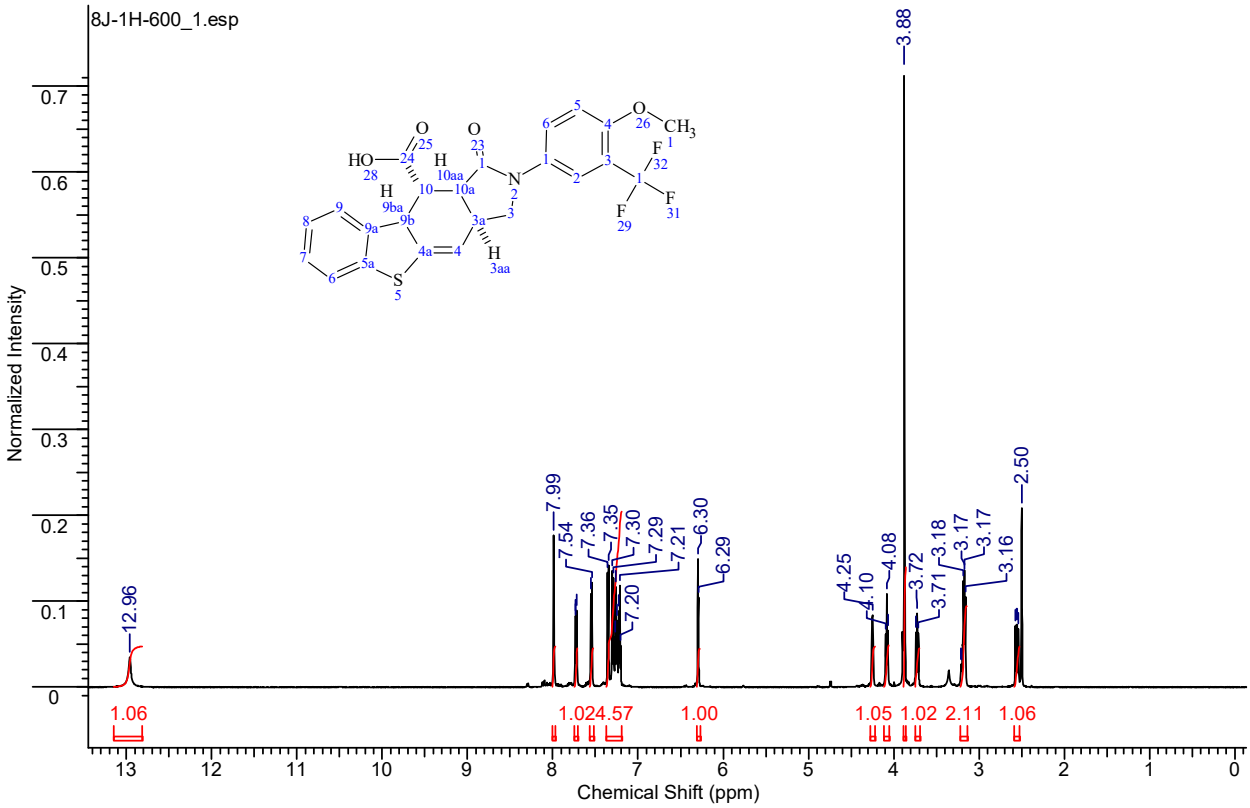


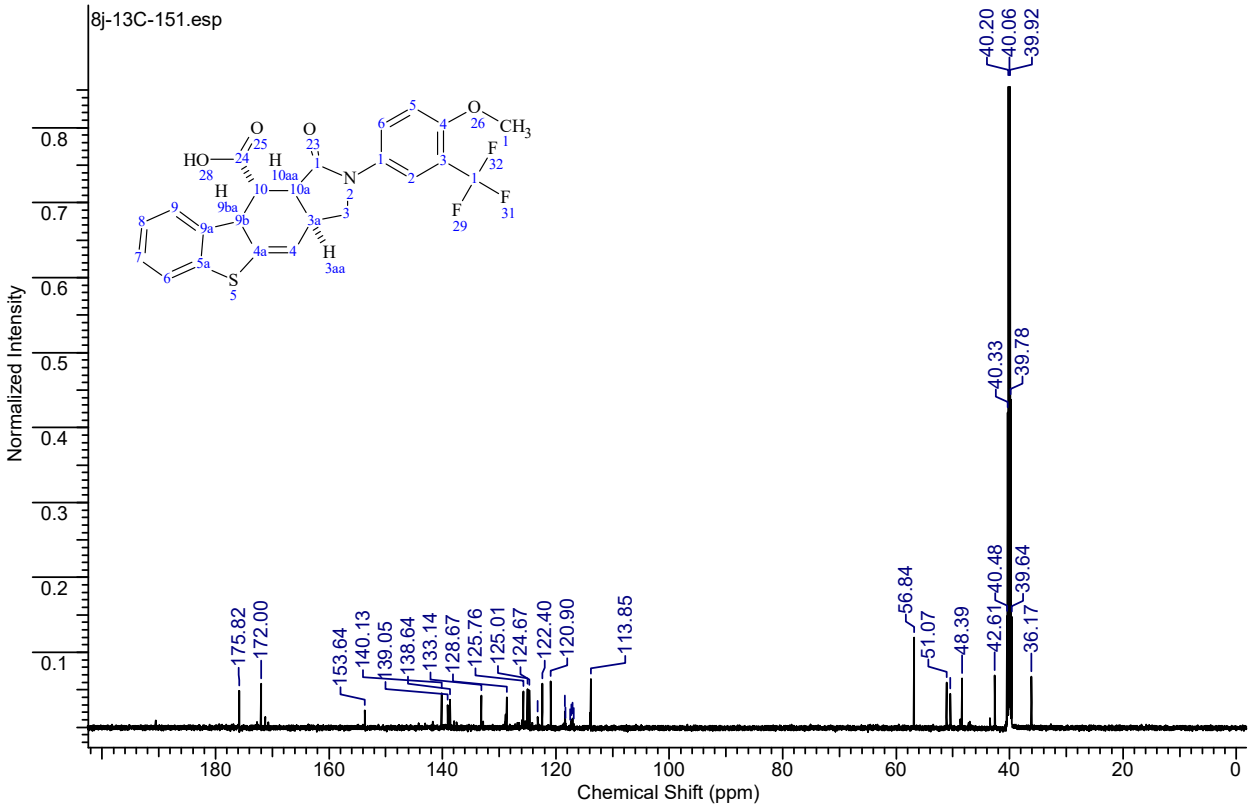
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Chloro-3-(trifluoromethyl)phenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8i).



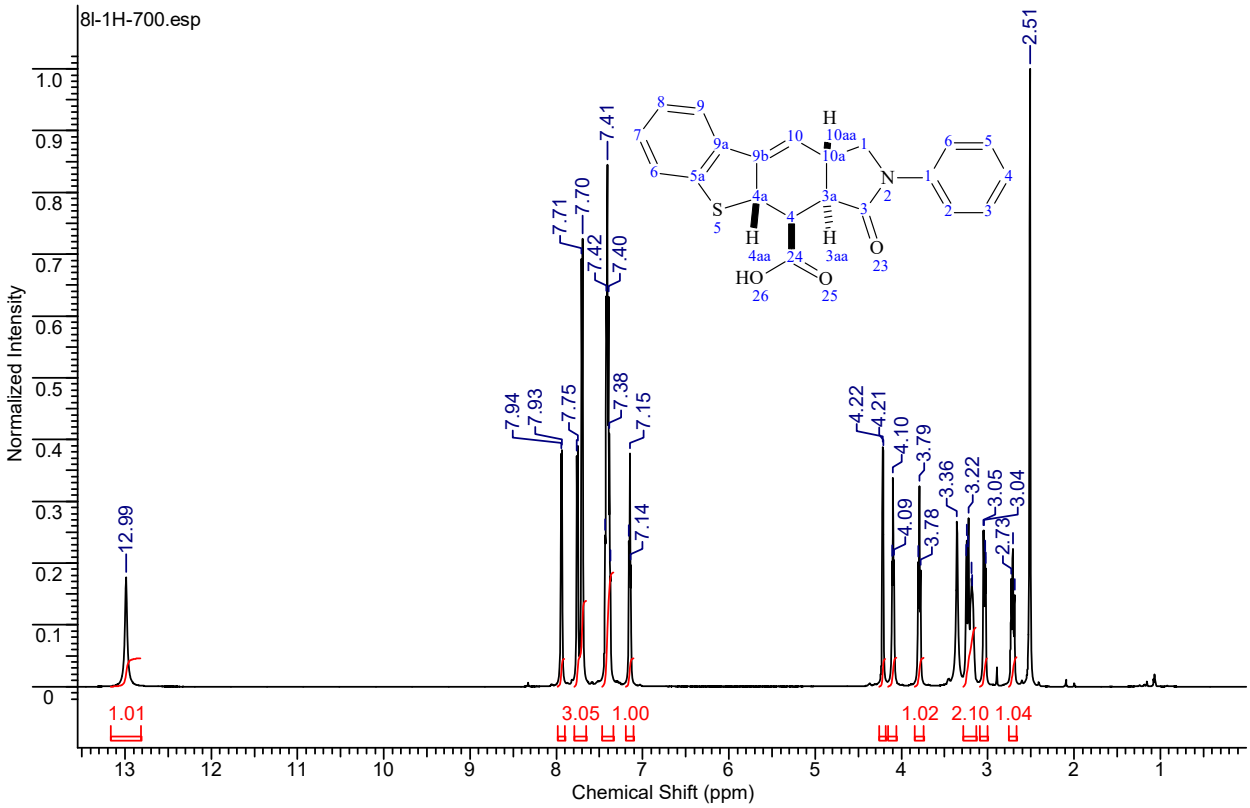


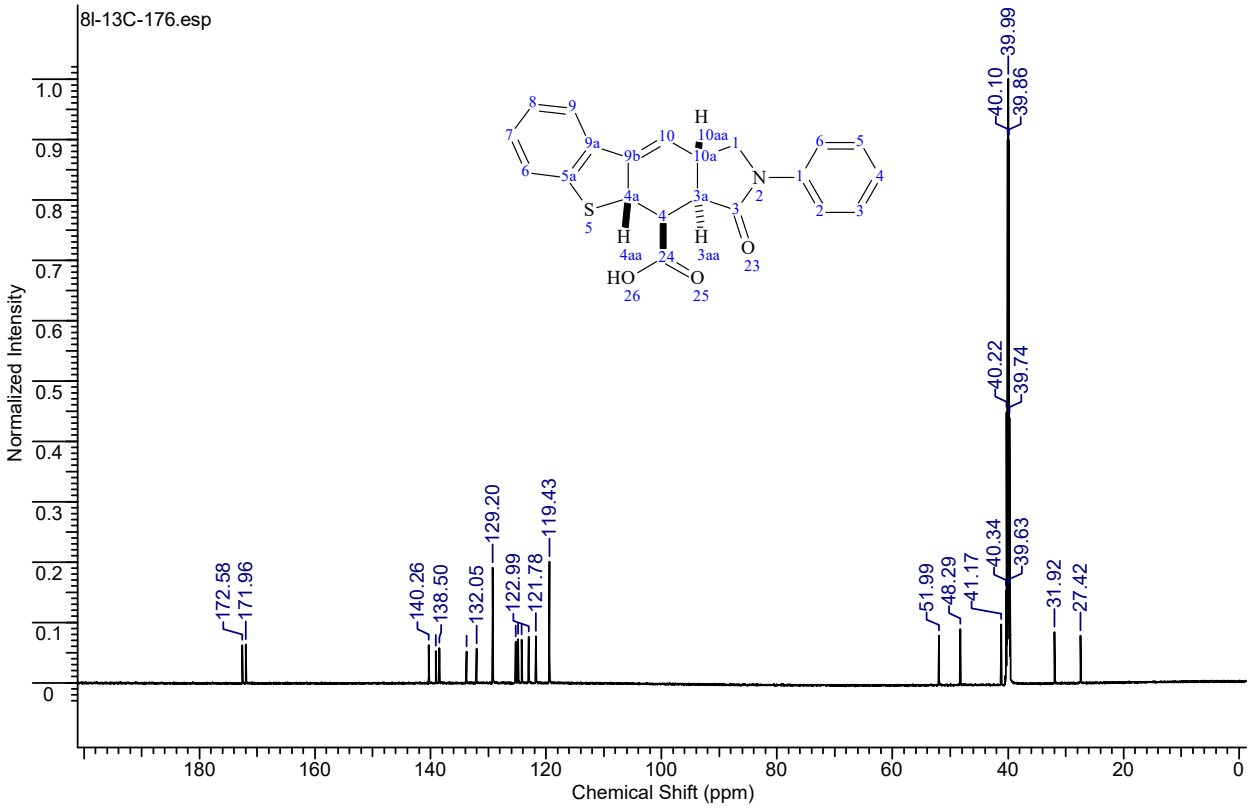
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-2-(4-Methoxy-3-(trifluoromethyl)phenyl)-1-oxo-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8j).



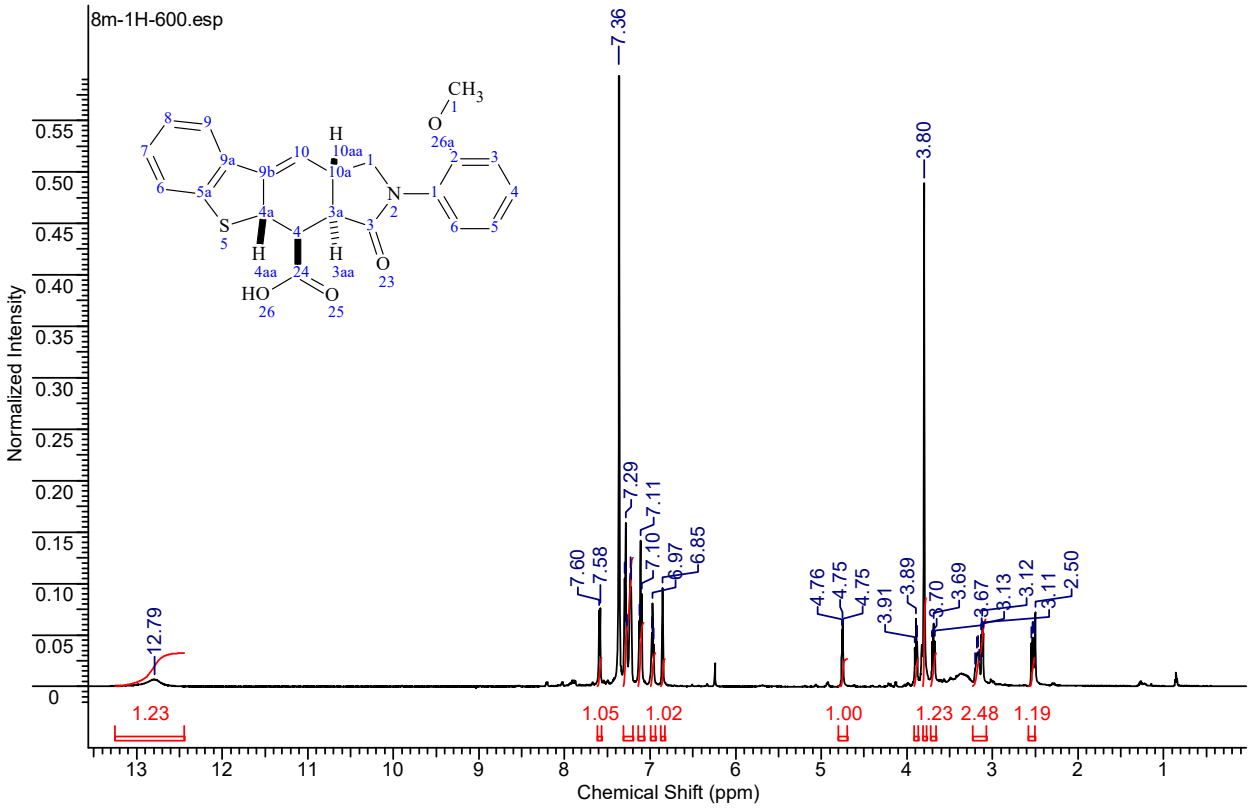


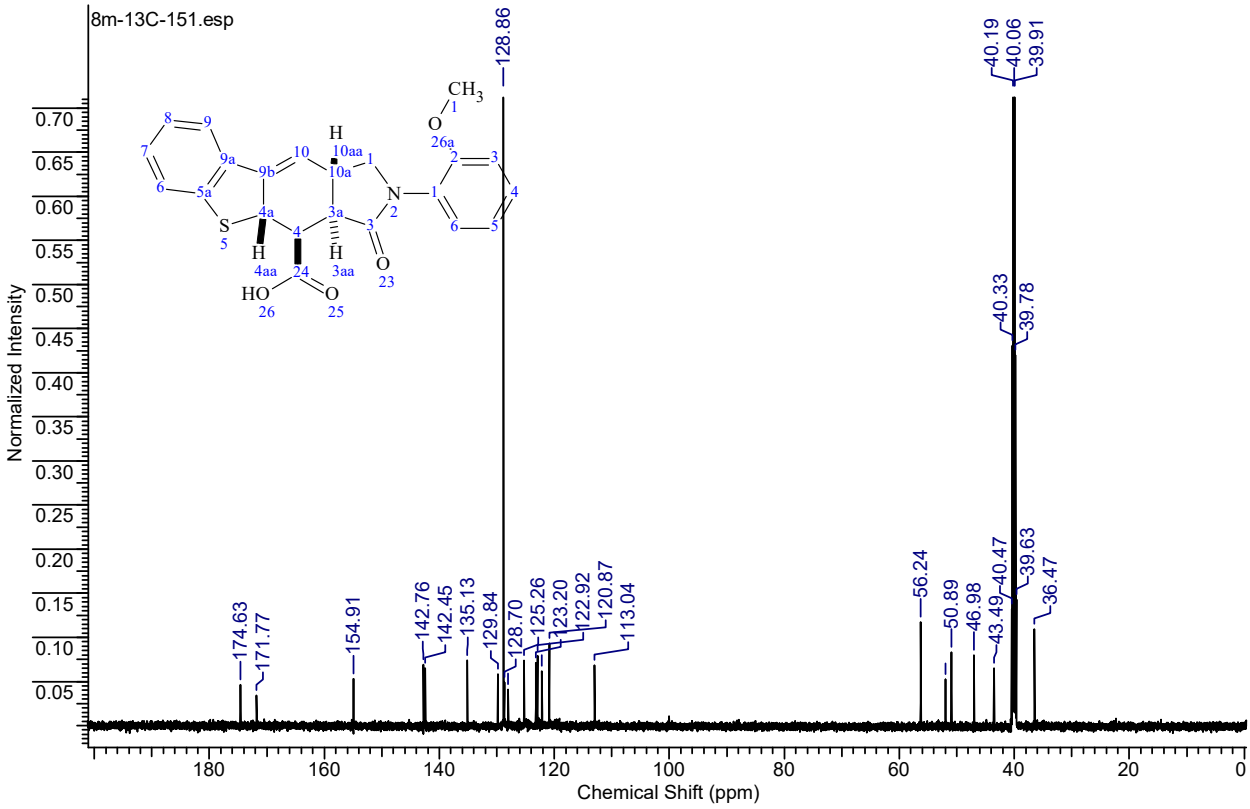
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-3-Oxo-2-phenyl-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8l).



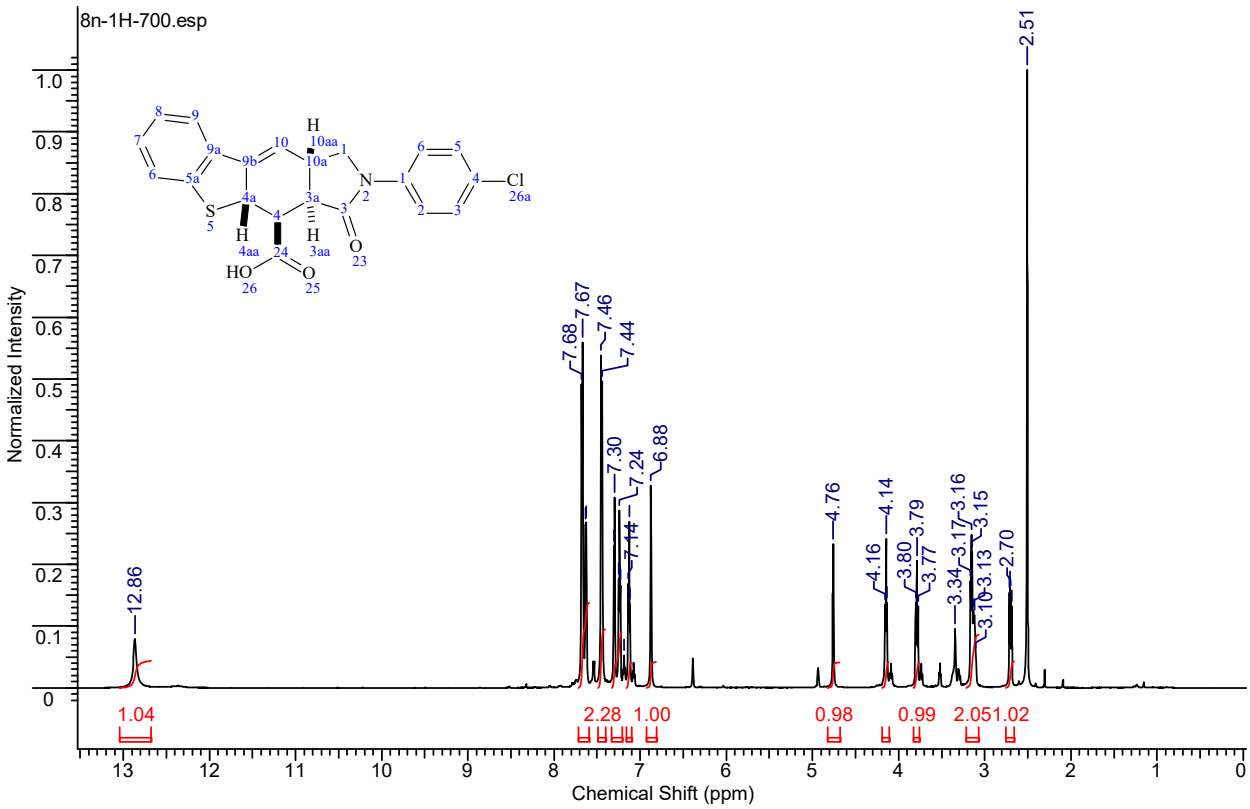


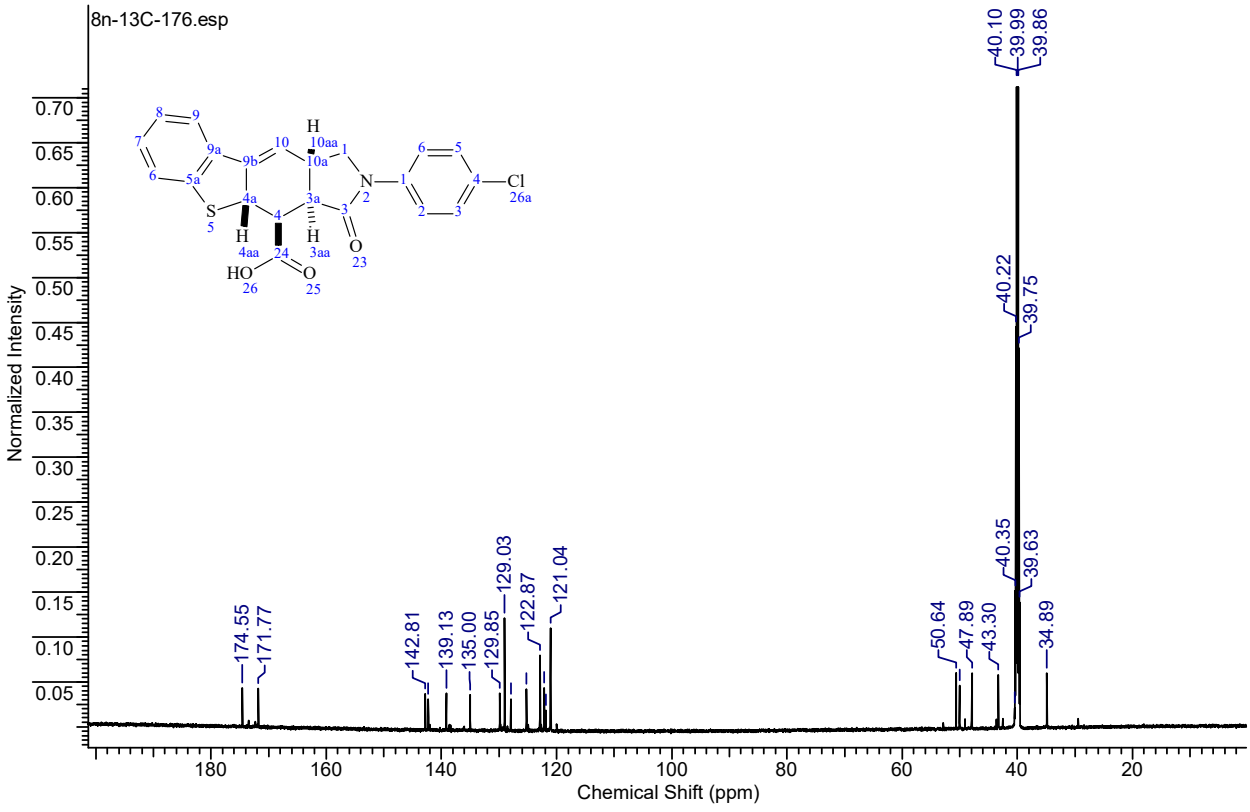
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(2-Methoxyphenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8m). *Contains an impurity of benzene*



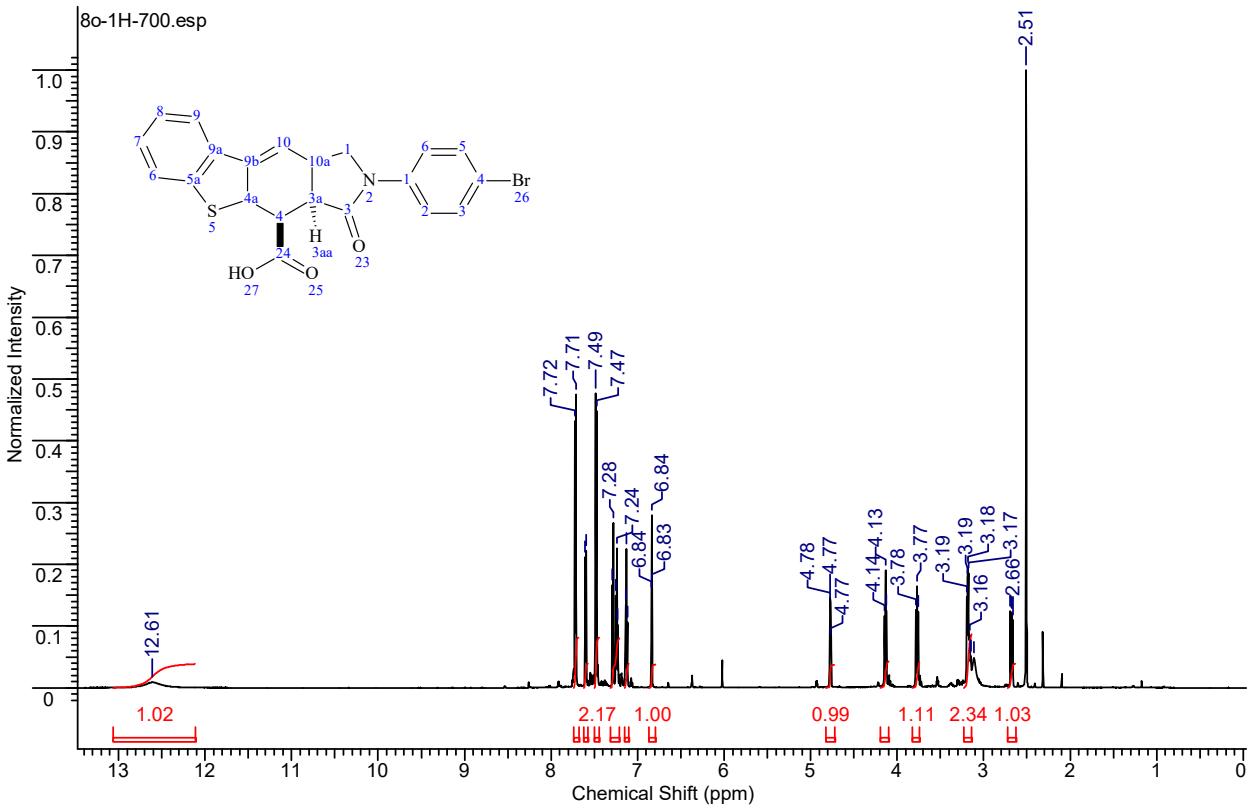


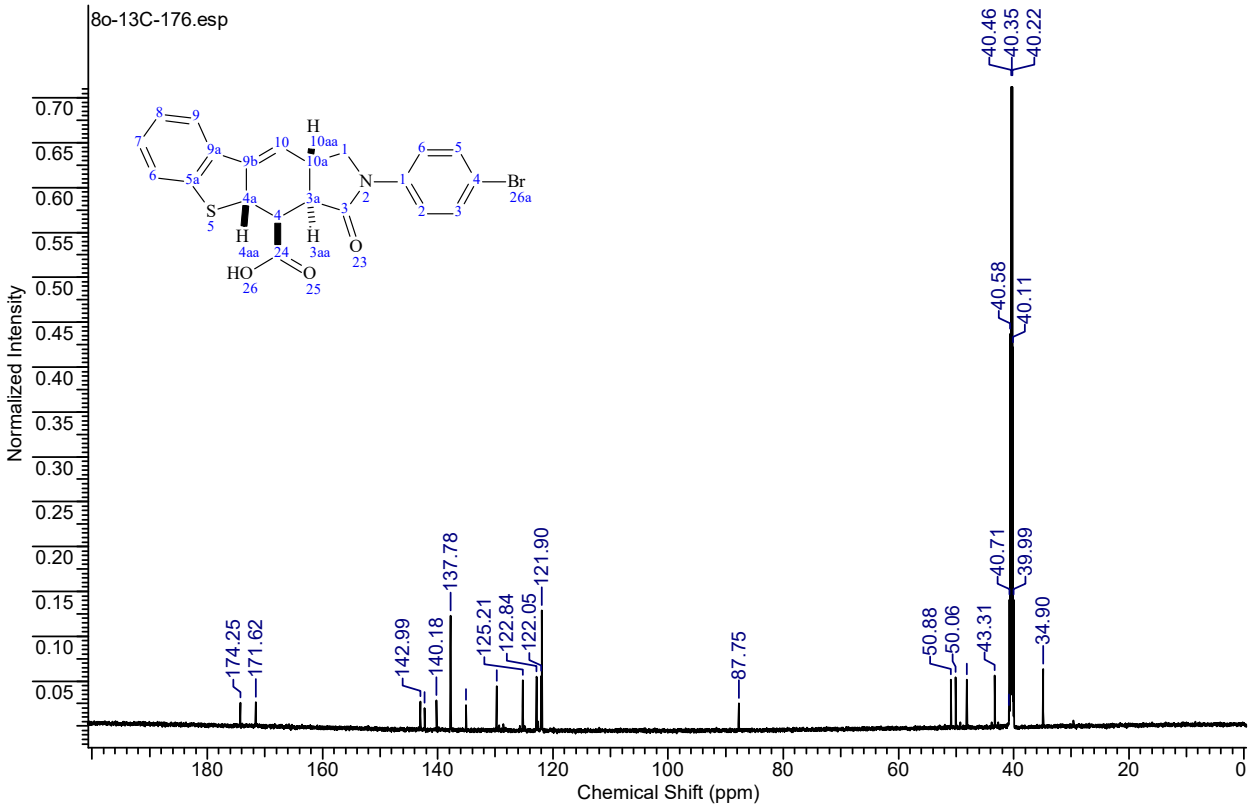
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Chlorophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8n). *Contains an impurity of endo-**8n** (~12%)*



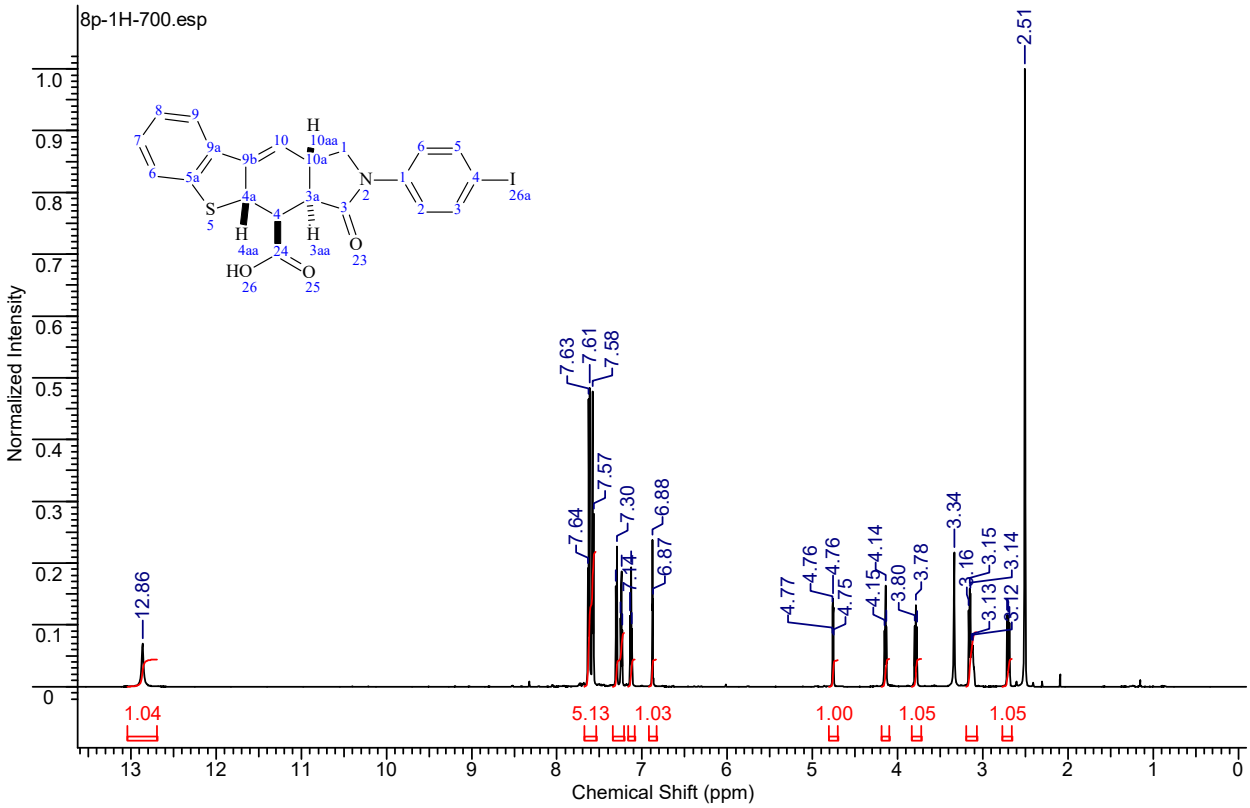


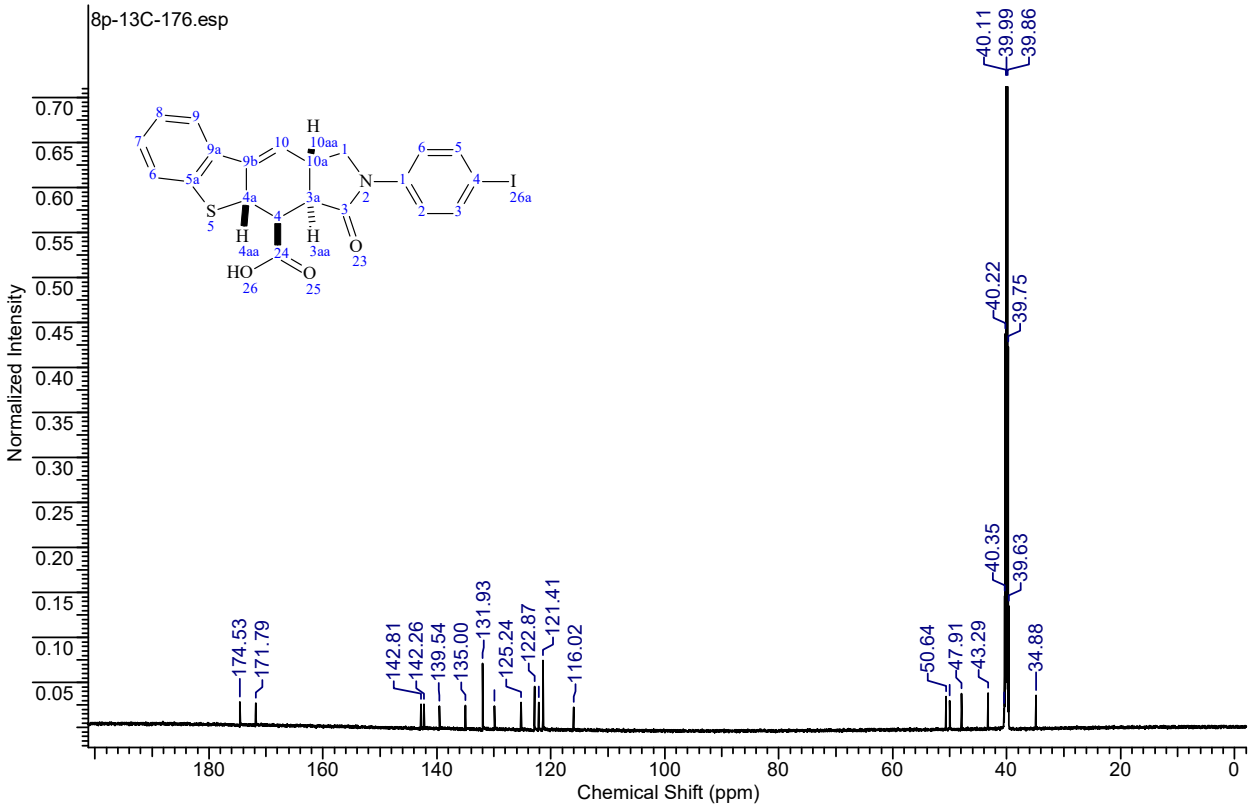
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Bromophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8o).). *Contains an impurity of endo-**8o** (~6%)*



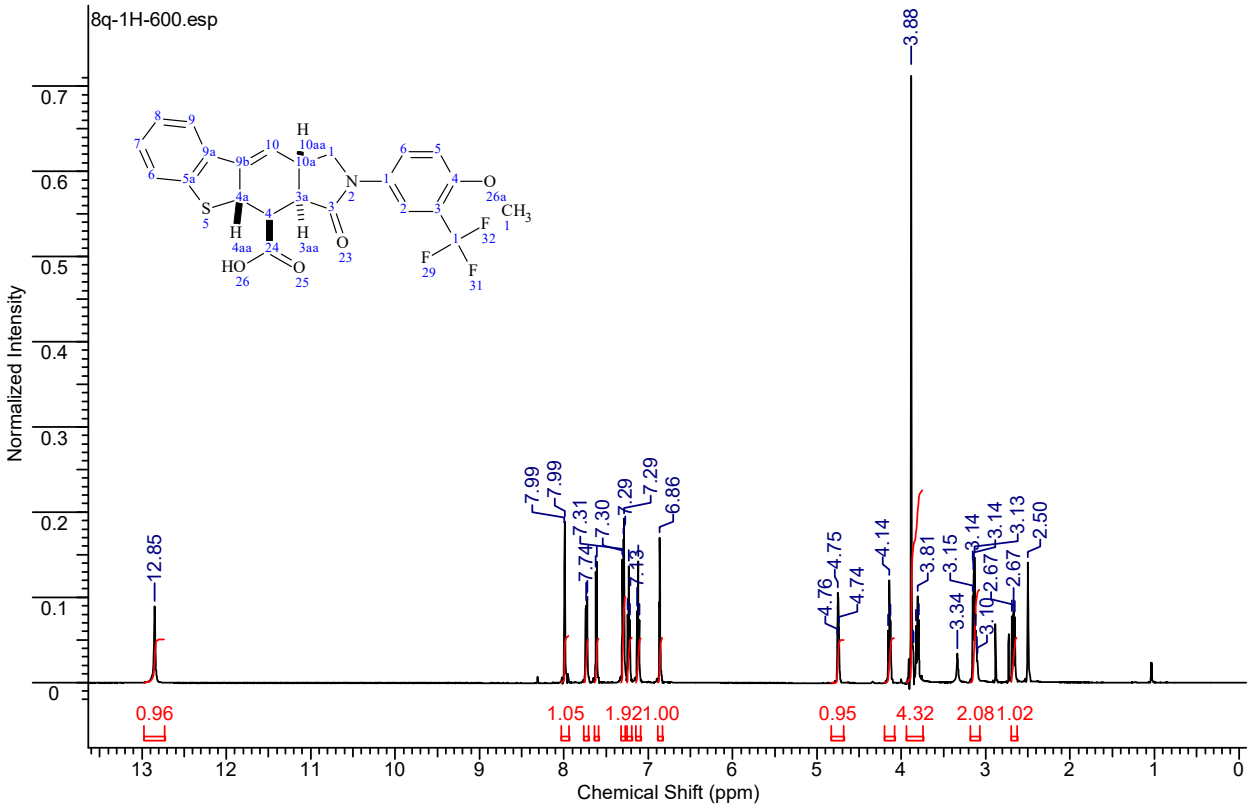


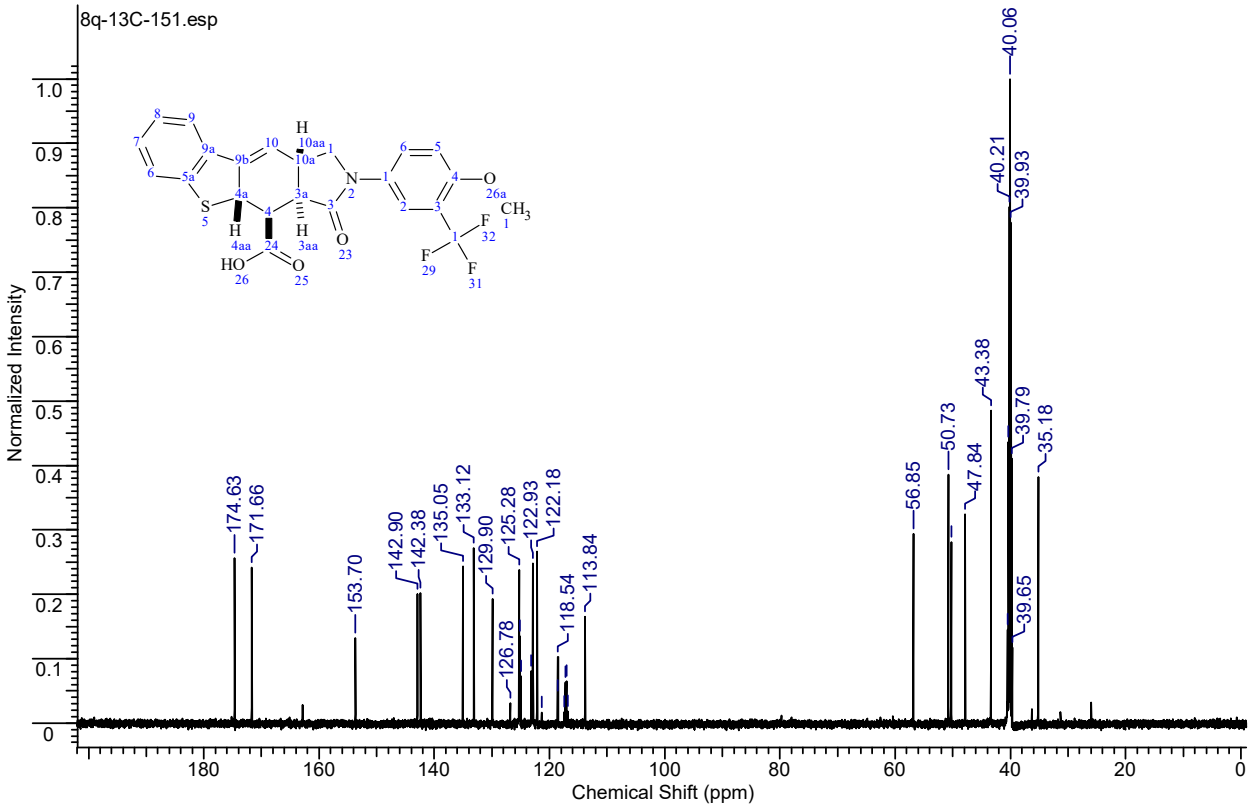
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Iodophenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8p).

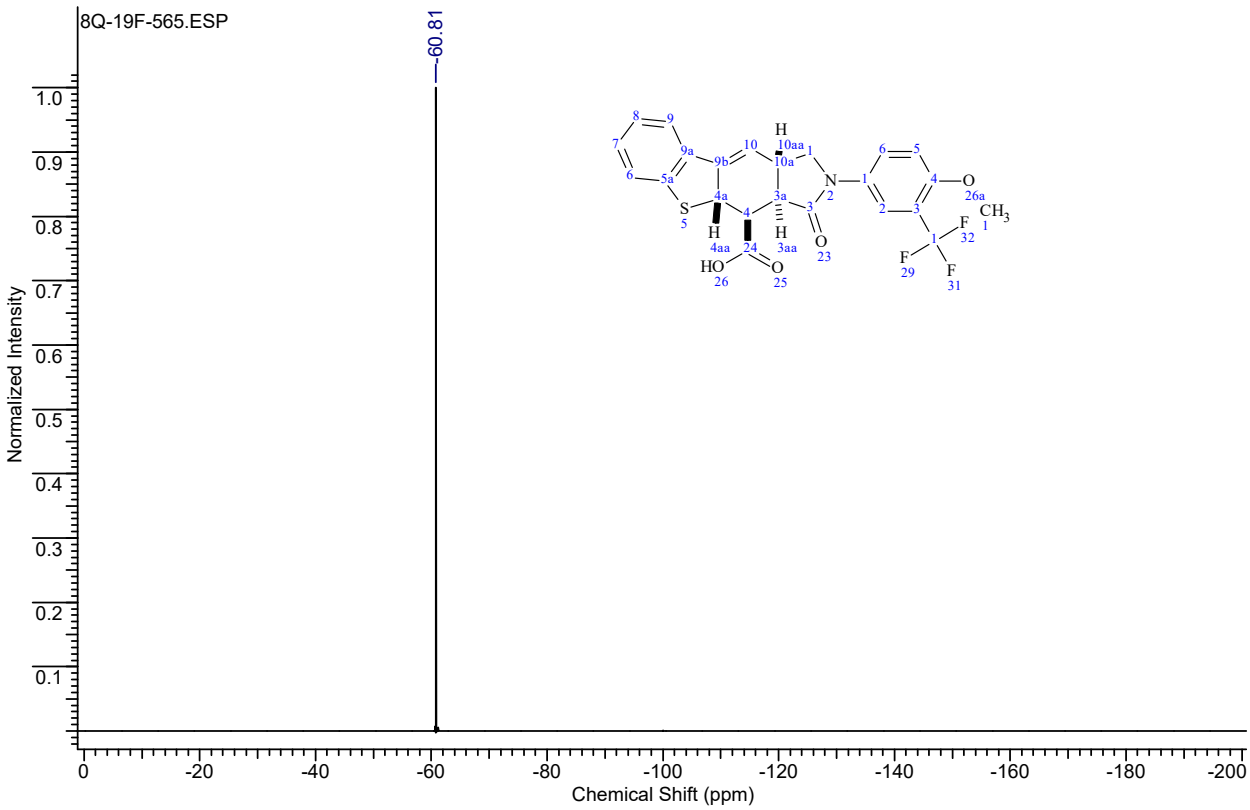




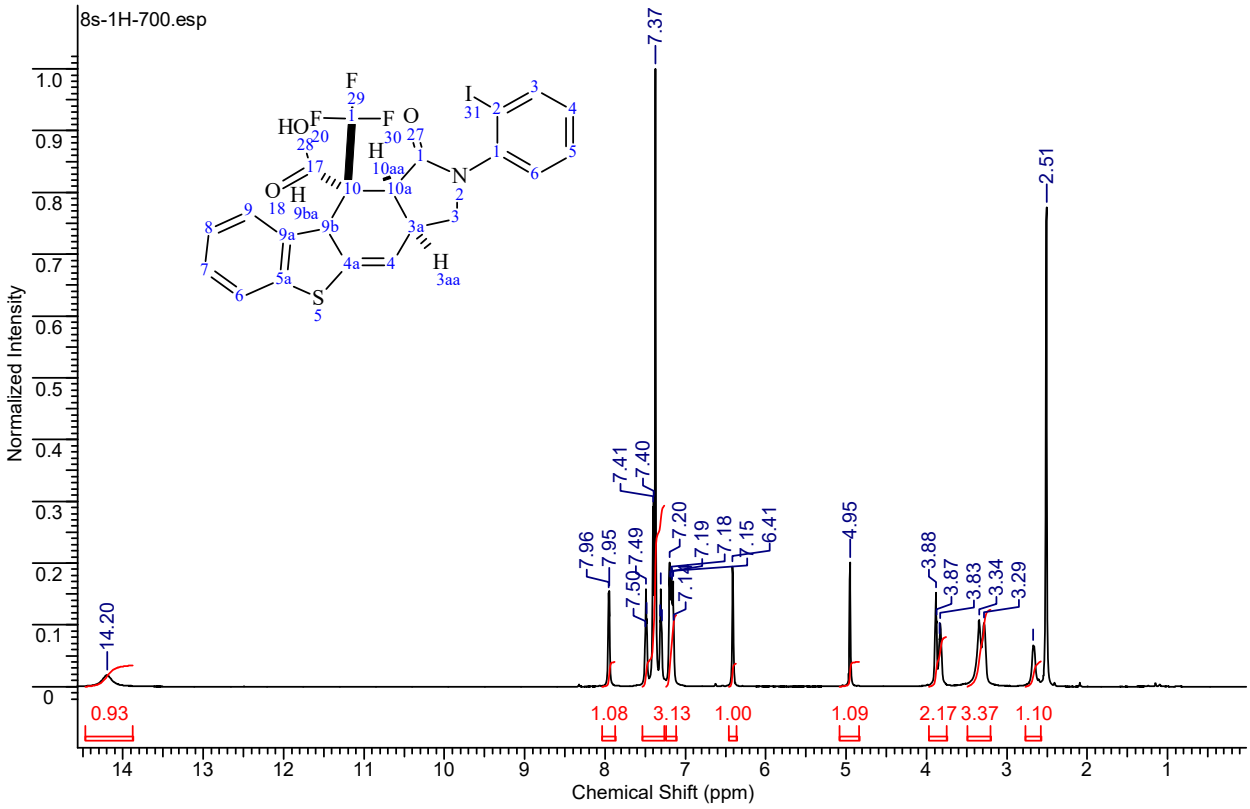
(3a*RS*,4*SR*,4a*SR*,10a*SR*)-2-(4-Methoxy-3-(trifluoromethyl)phenyl)-3-oxo-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8q).

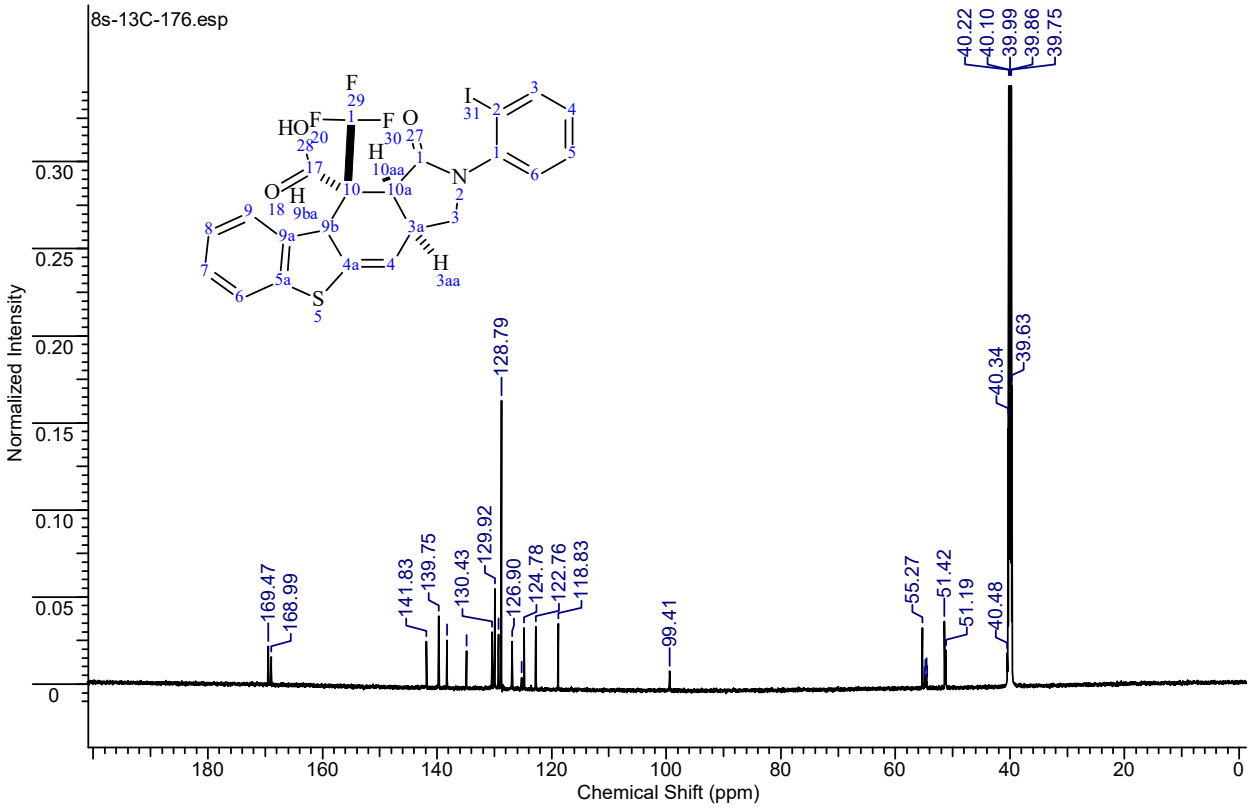


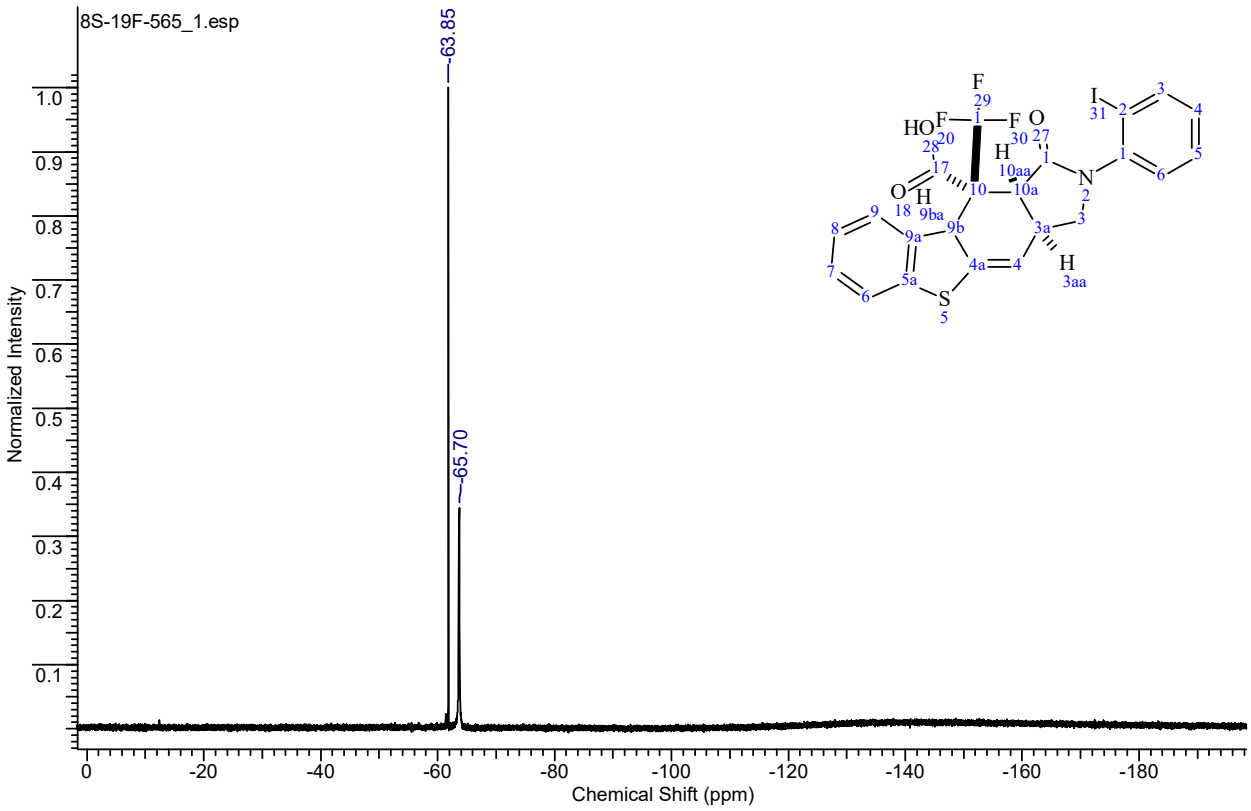



8Q-19F-565.ESP
-60.81
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)

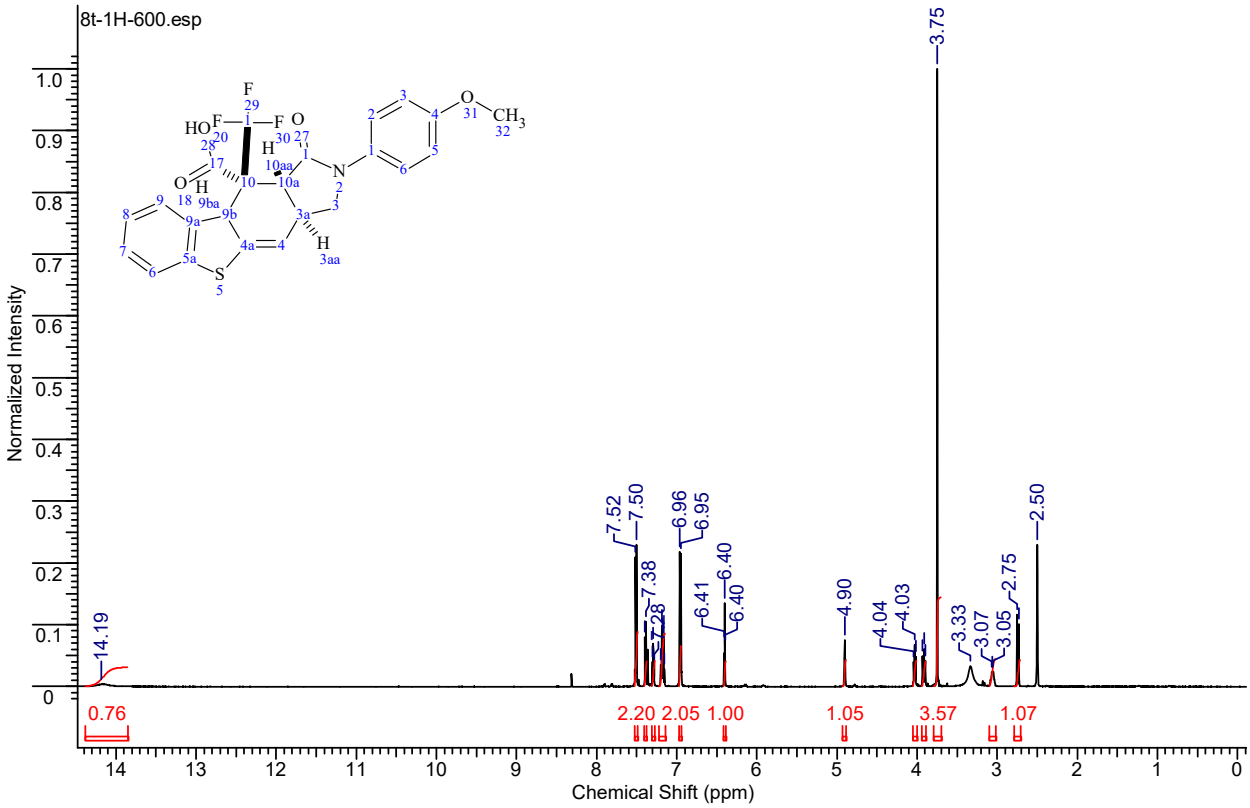
(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(2-Iodophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8s).

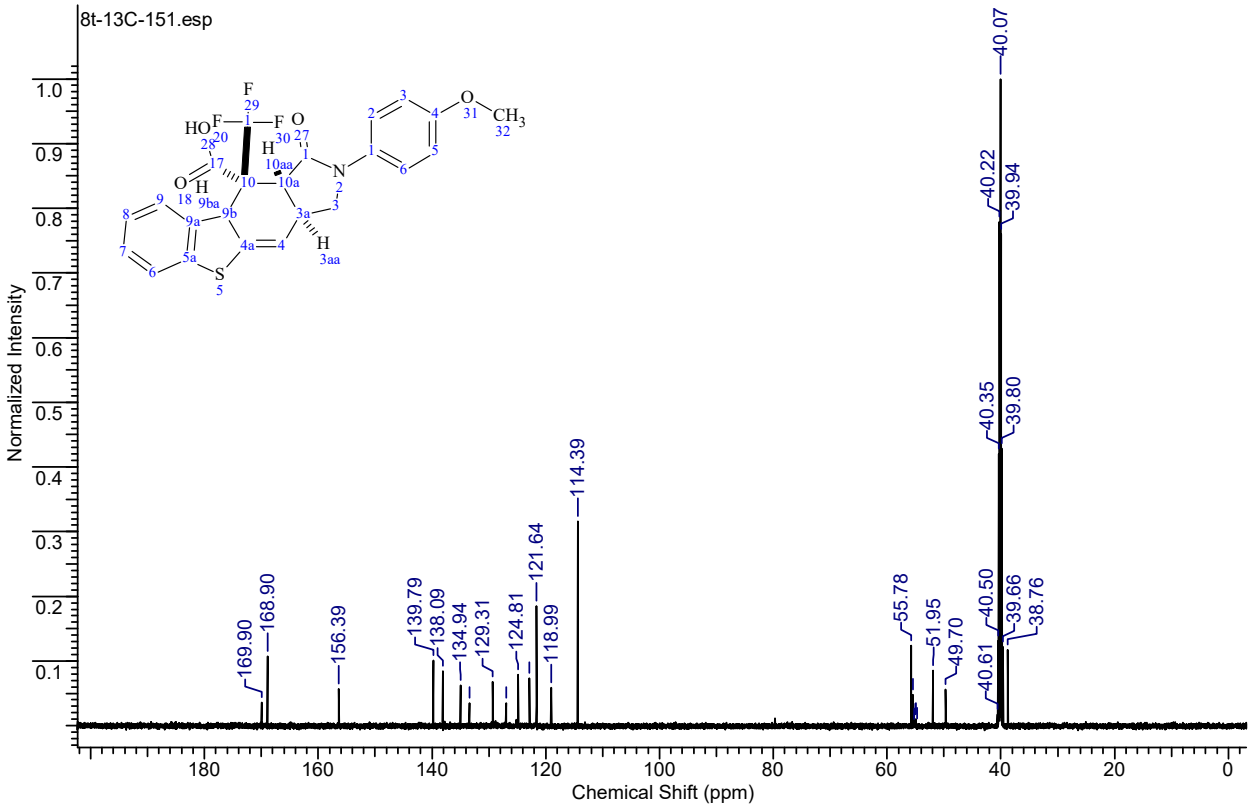


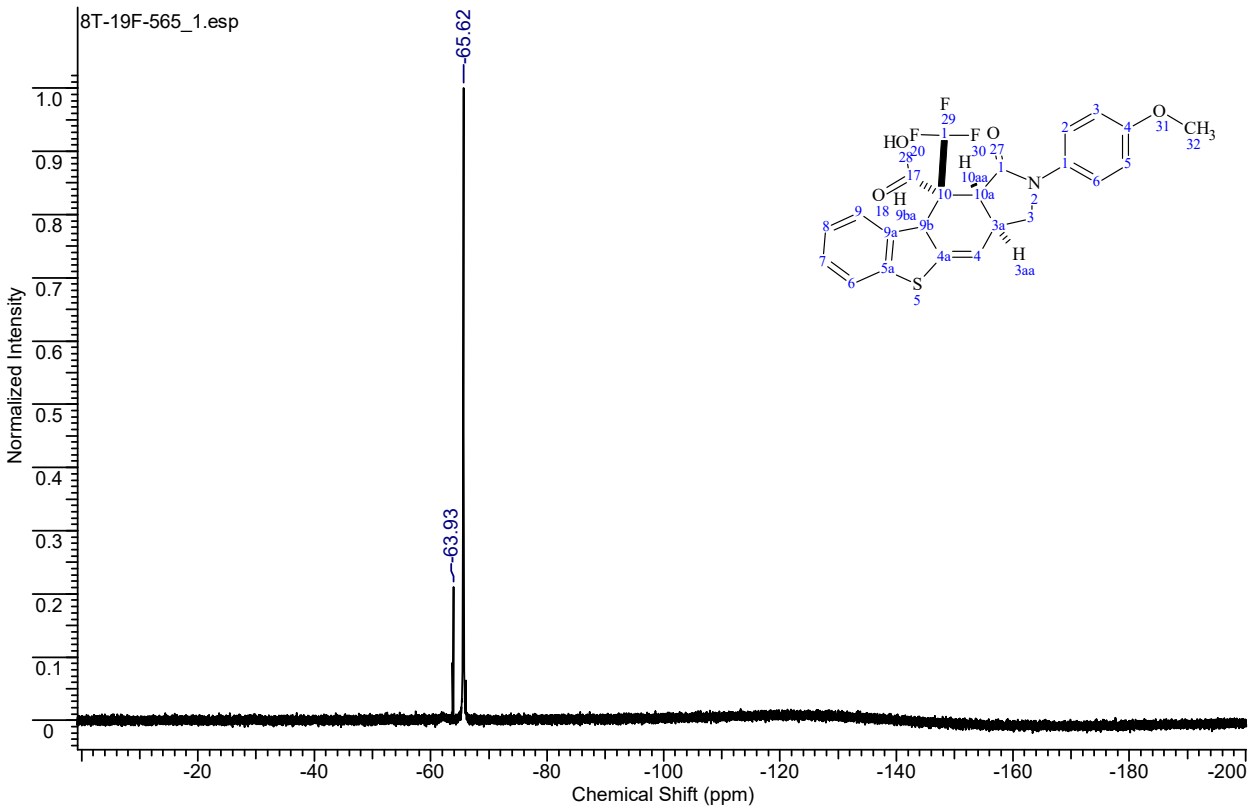



8S-19F-565_1.esp
-63.85
-65.70
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
Chemical Shift (ppm)
F
29
HO
F
20
28
I
F
30
O
27
H
10aa
17
O
H
18
9ba
10
10a
N
2
3
1
1
2
3
4
5
6
8
9
9a
9b
3a
7
6
5a
4a
4
H
3aa
S
5

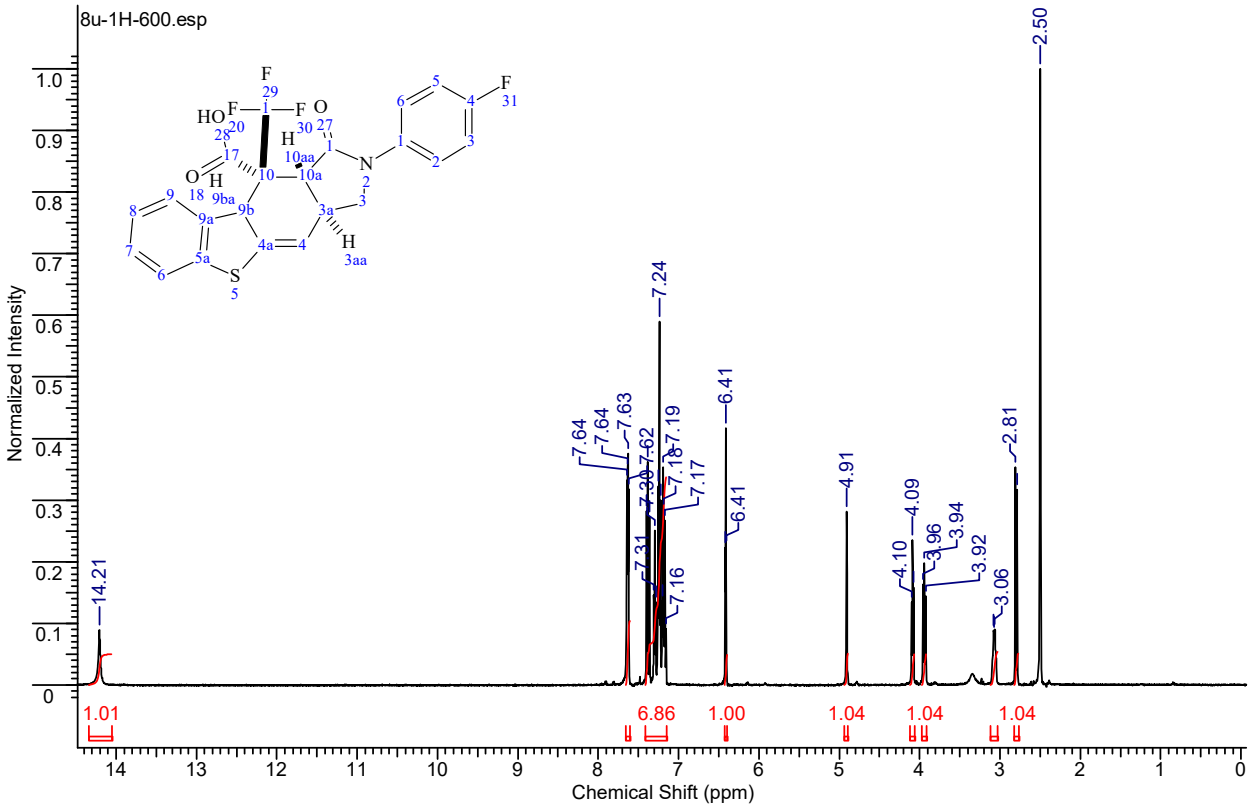
(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8t).

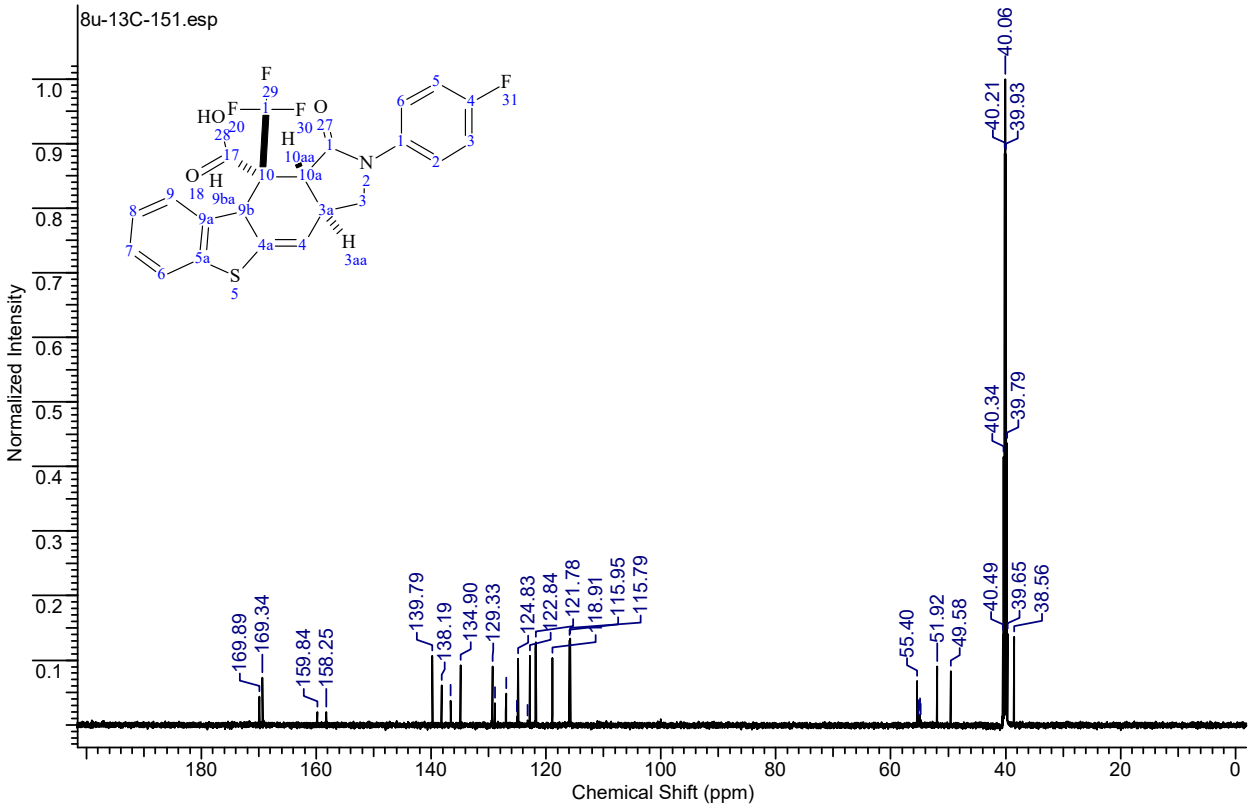


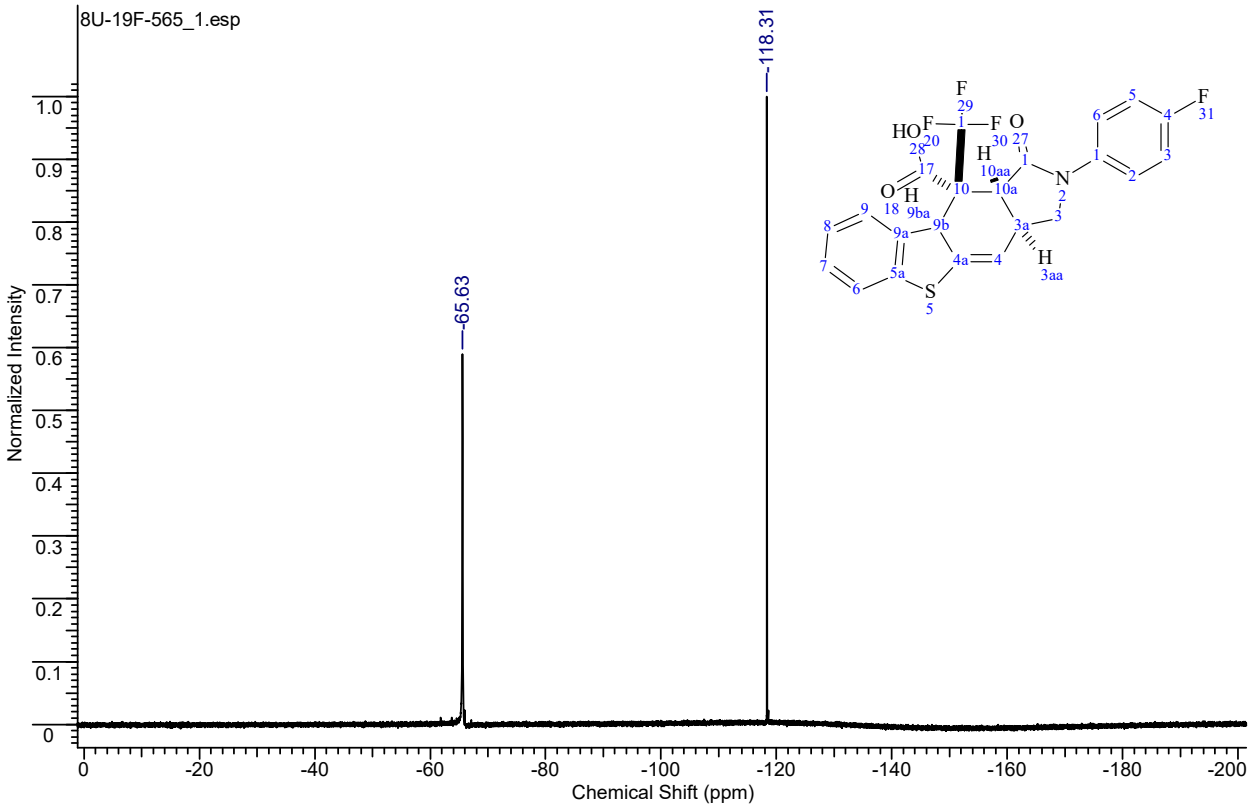



8T-19F-565_1.esp
65.62
63.93
Normalized Intensity
Chemical Shift (ppm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200

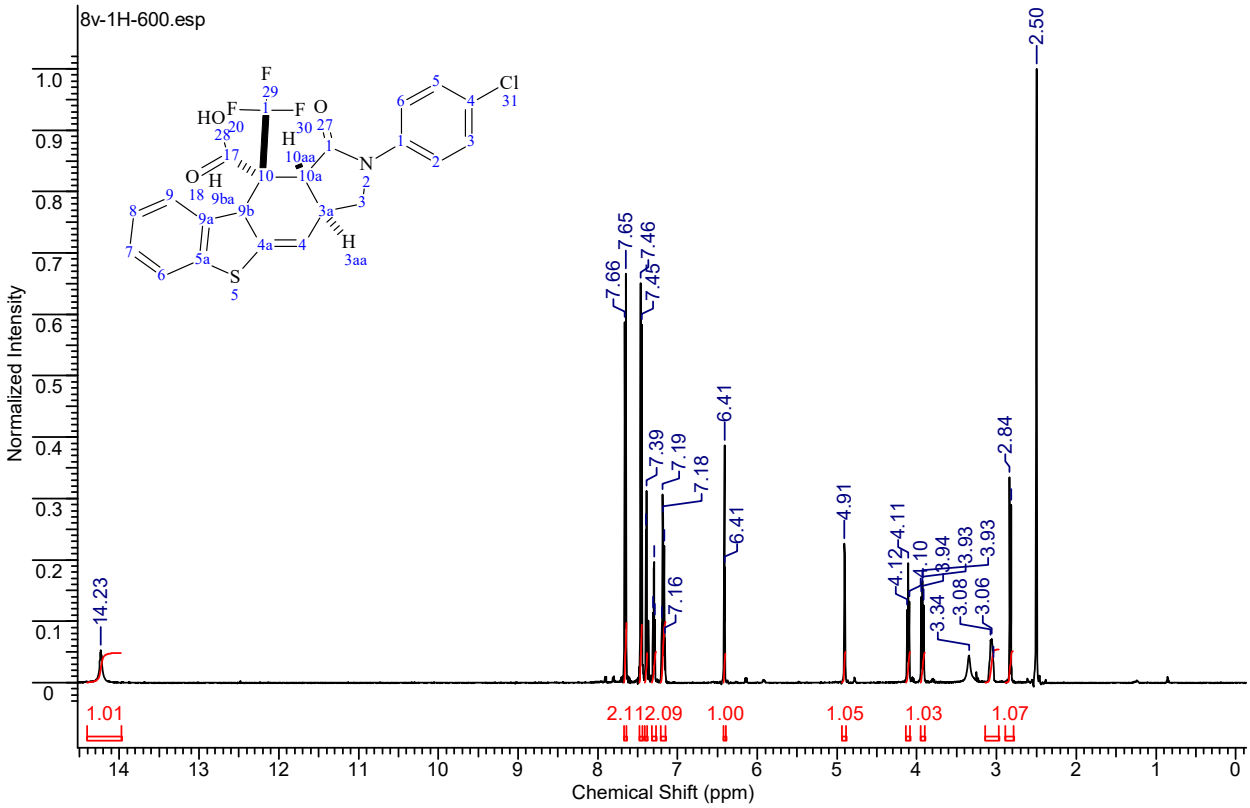
(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8u).

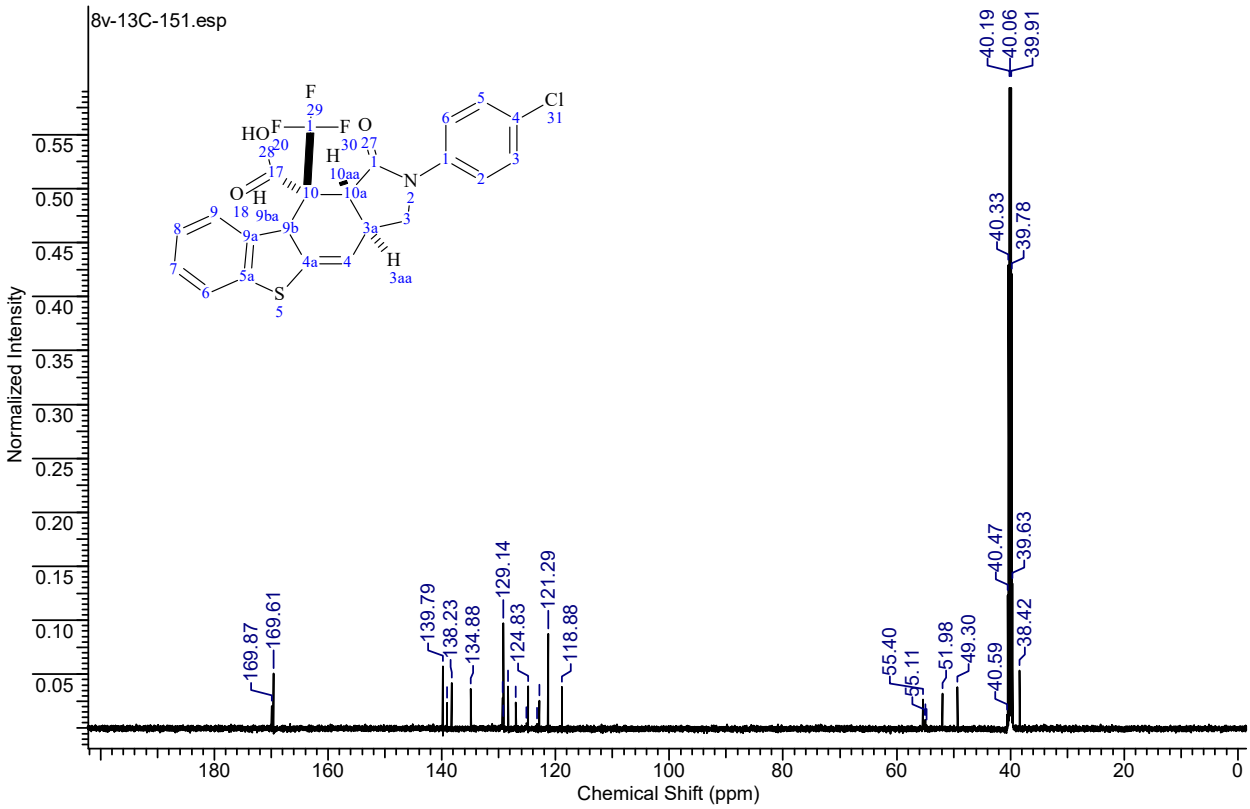


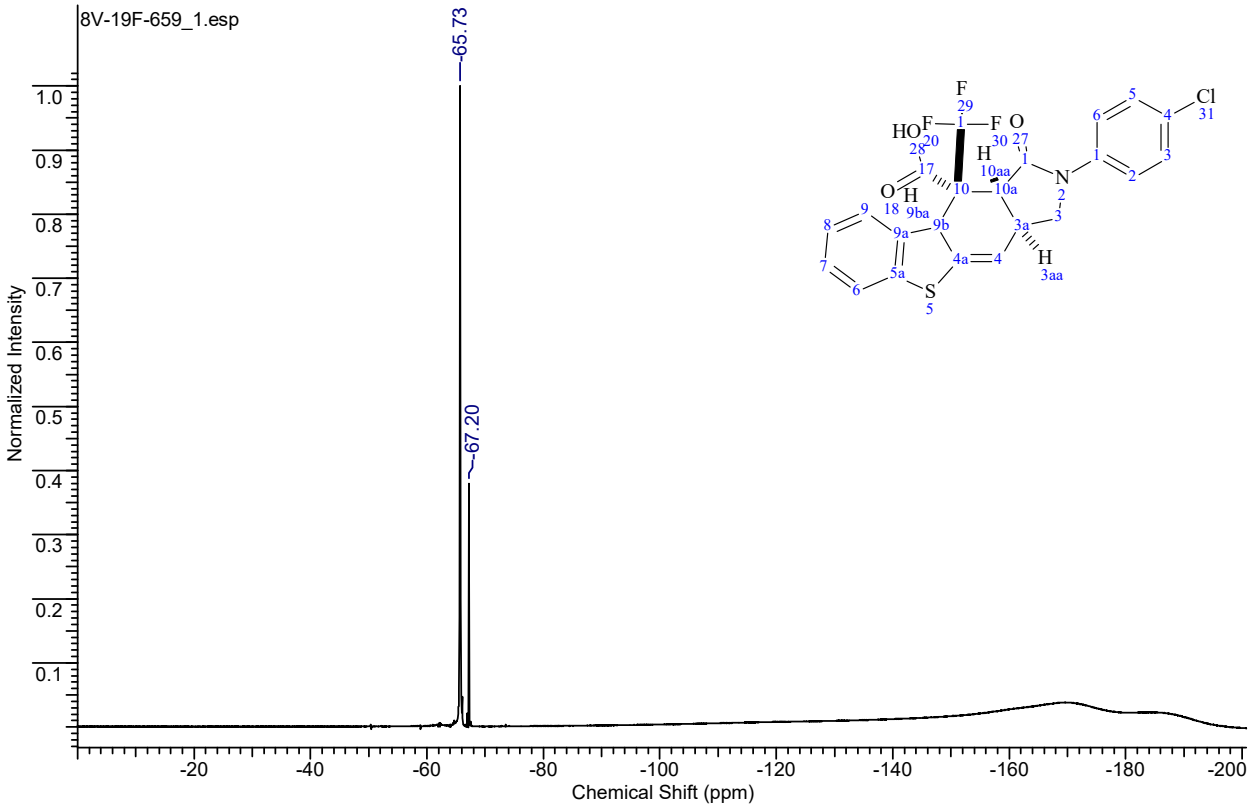



8U-19F-565_1.esp
118.31
65.63
Normalized Intensity
Chemical Shift (ppm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200

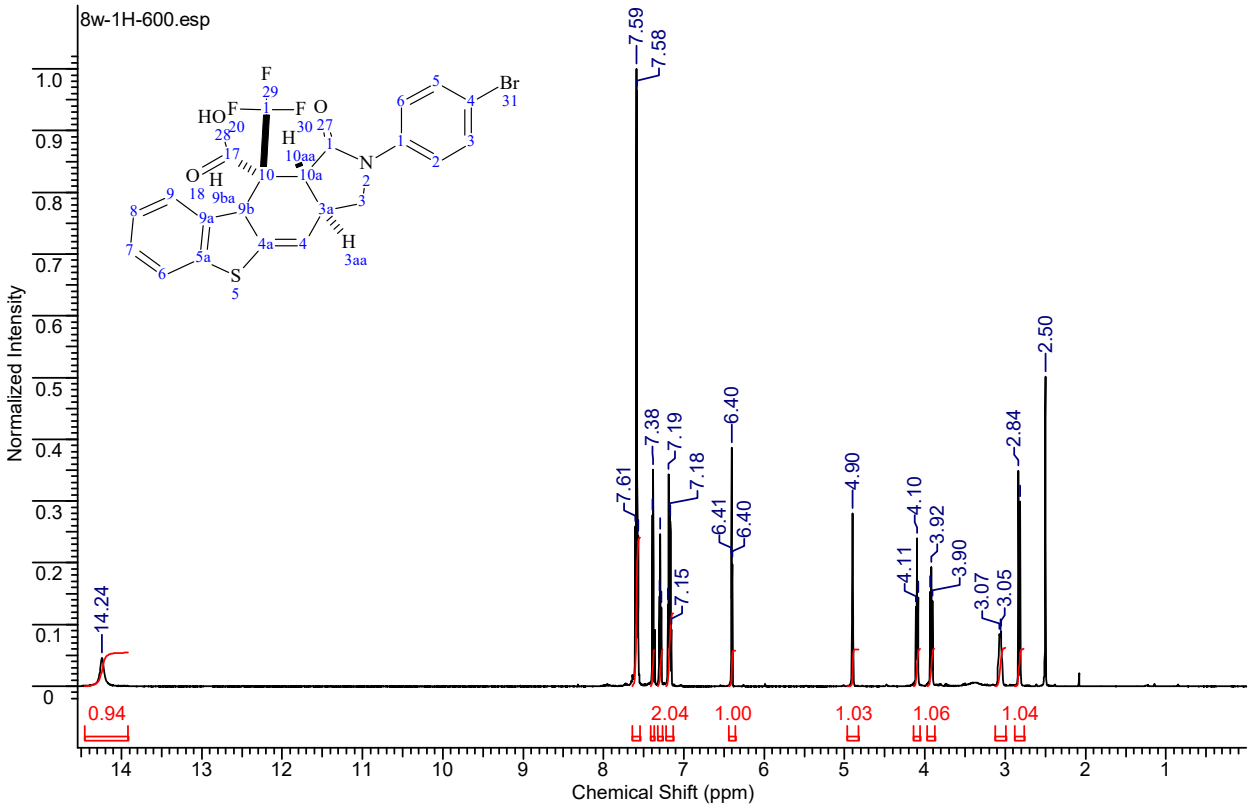
(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Chlorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8v).

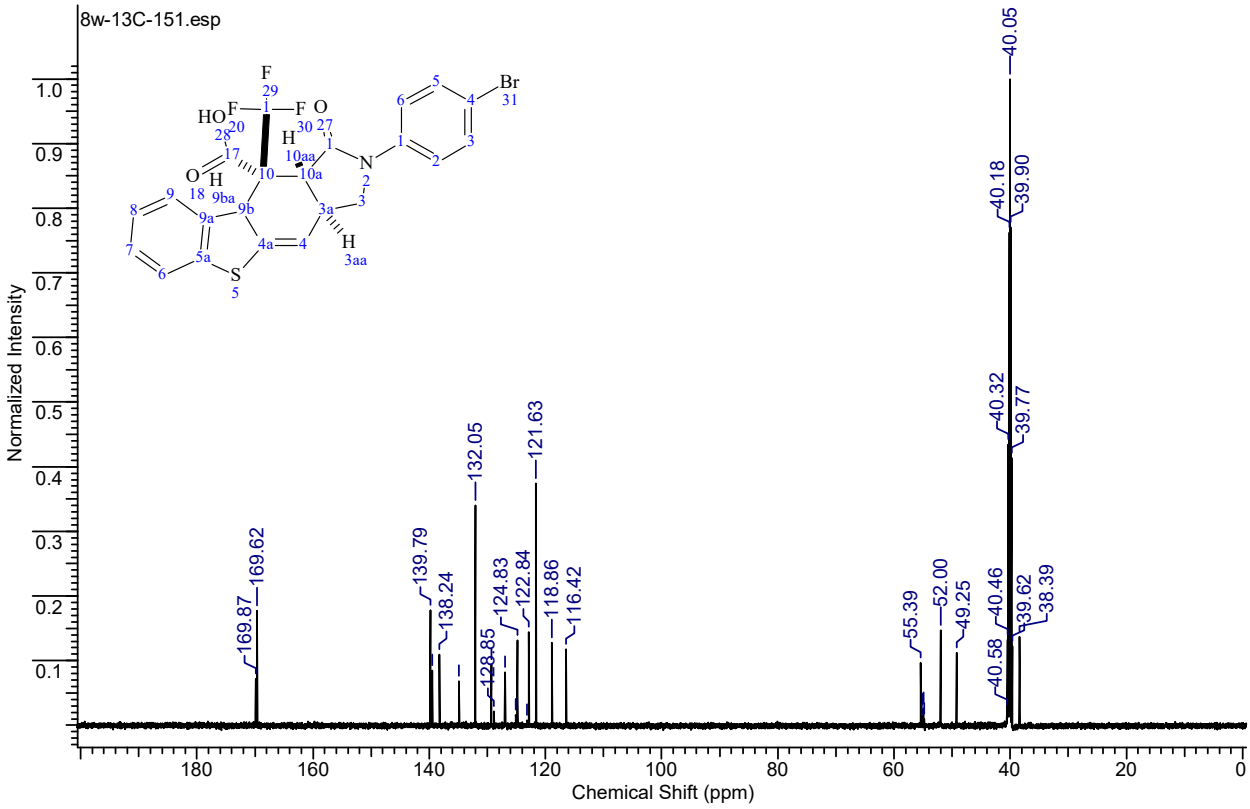


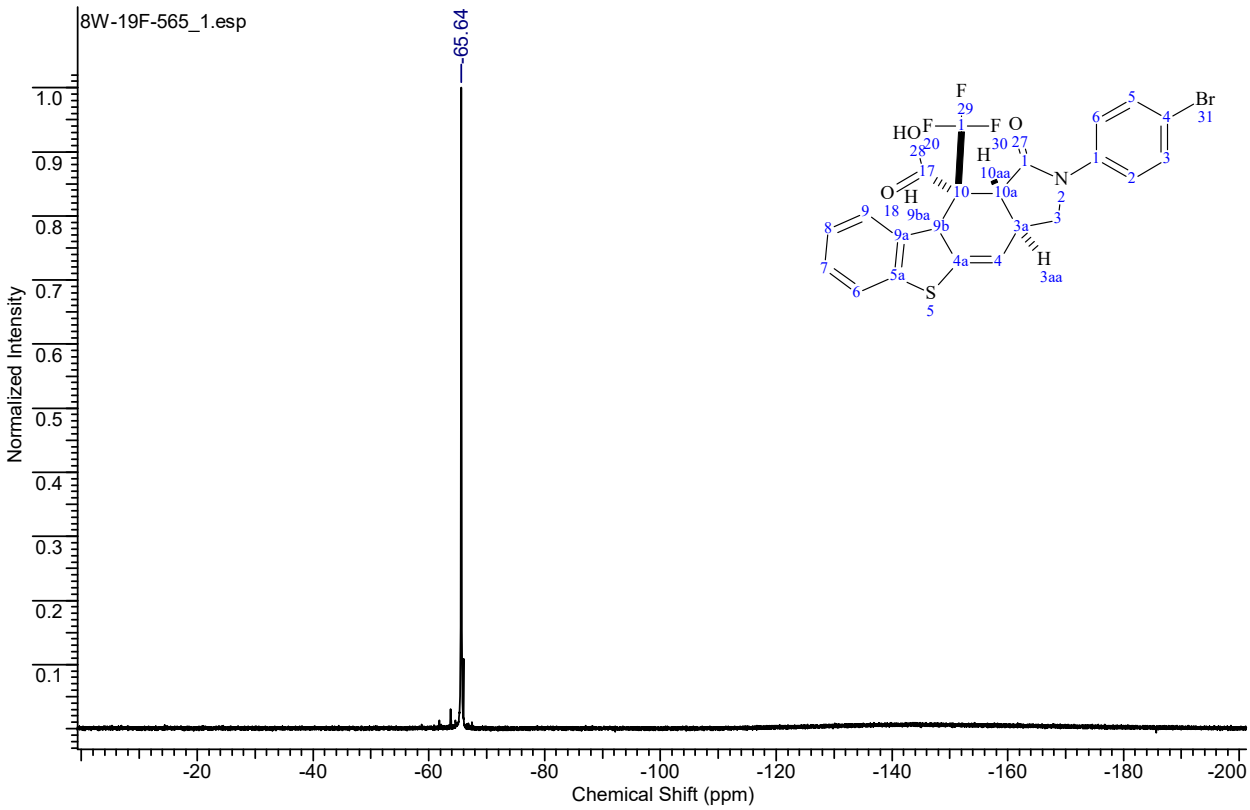



8V-19F-659_1.esp
-65.73
-67.20
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
F
29
HO
28
F
1
F
30
O
27
H
10aa
20
17
1
N
2
3
O
H
18
9ba
10
10a
Cl
31
6
5
4
3
2
1
9
8
7
6
9a
9b
3a
4a
4
5a
S
5
H
3aa

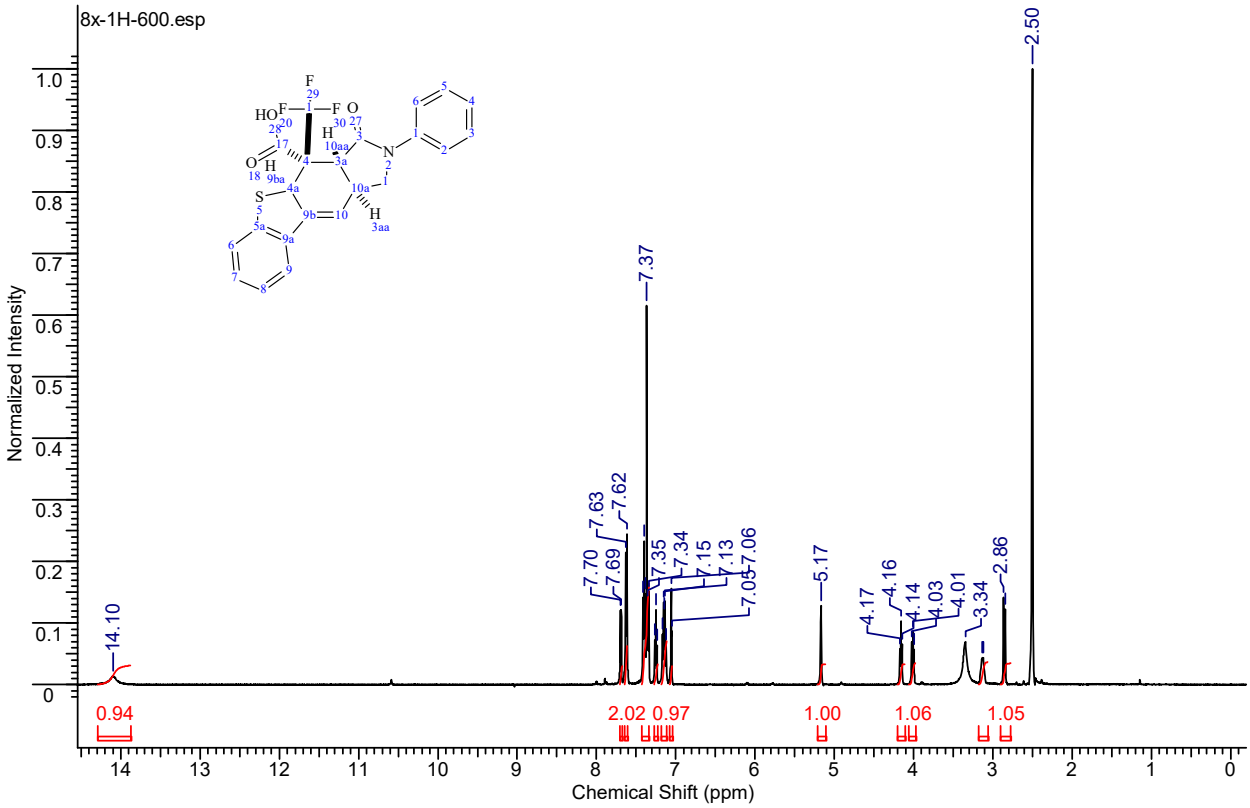
(3a*RS*,9b*RS*,10*SR*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (8w).

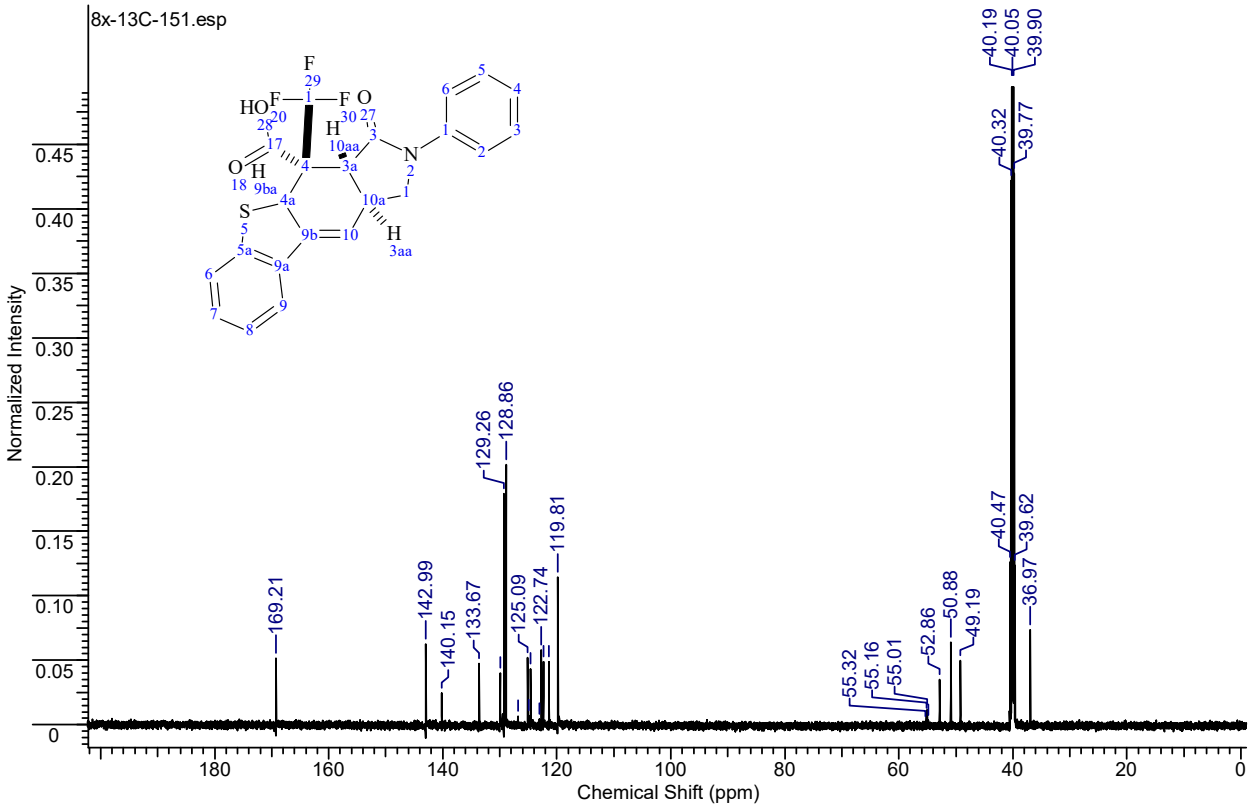


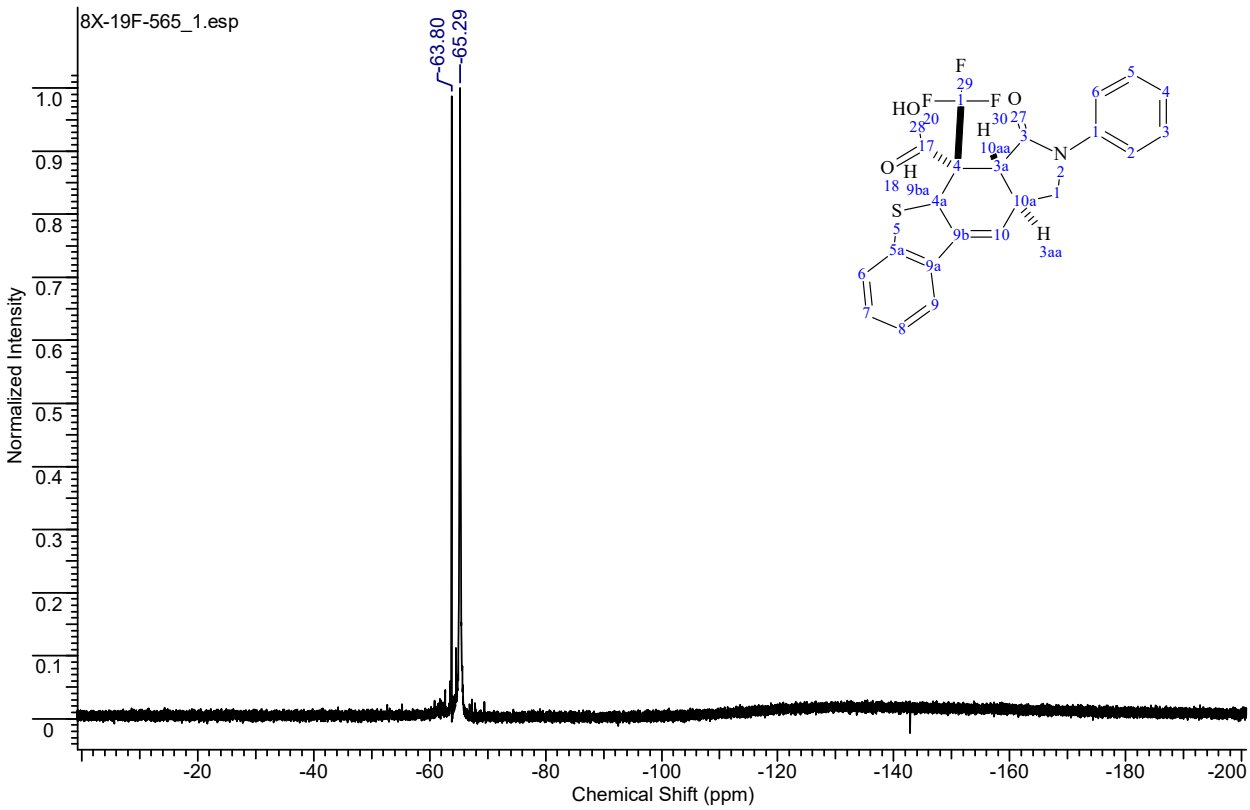



8W-19F-565_1.esp
-65.64
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
F
29
HO
F
1
F
O
20
28
30
27
H
17
10aa
1
N
2
O
H
18
9ba
10
10a
3
9
9a
9b
3a
8
4a
4
H
7
5a
3aa
6
S
5
5
6
4
Br
31
1
2
3

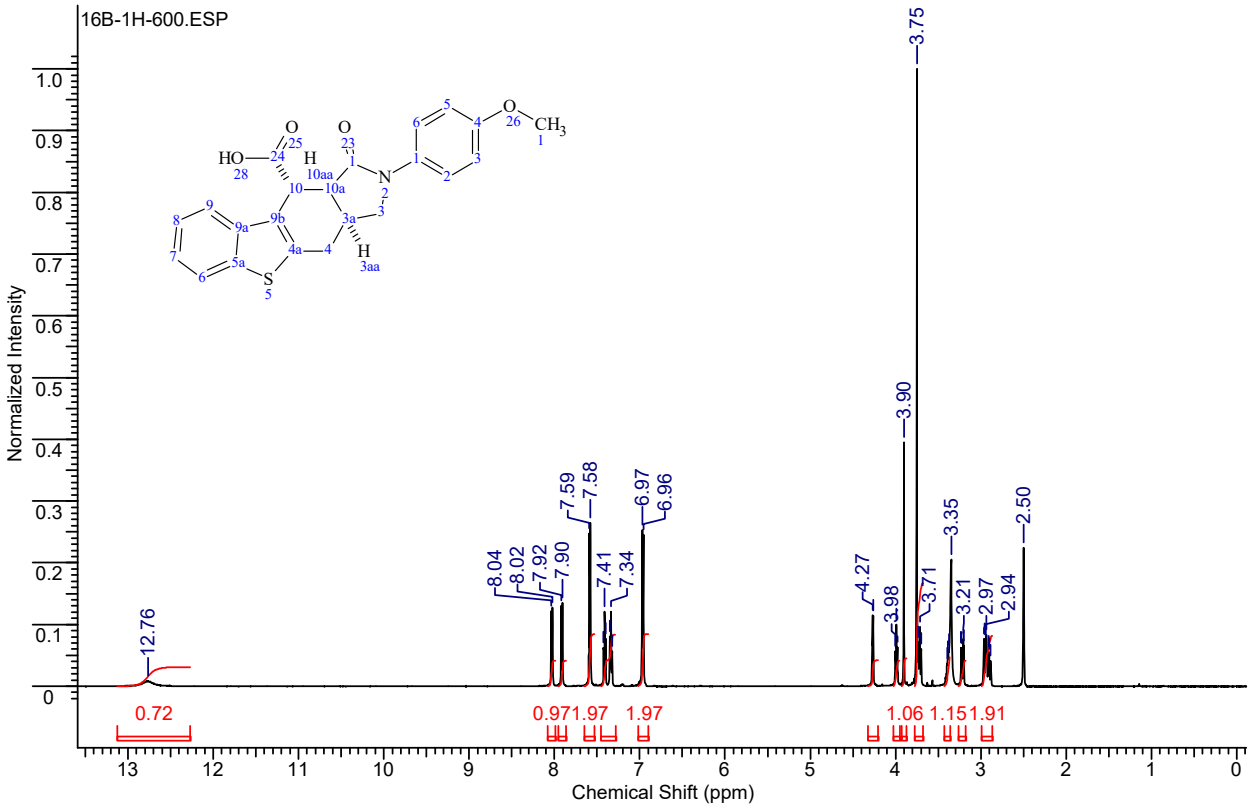
(3a*RS*,4*SR*,4a*RS*,10a*SR*)-2-Phenyl-3-oxo-4-(trifluoromethyl)-2,3,3a,4,4a,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-4-carboxylic acid (8x). *Contains an impurity of benzene*

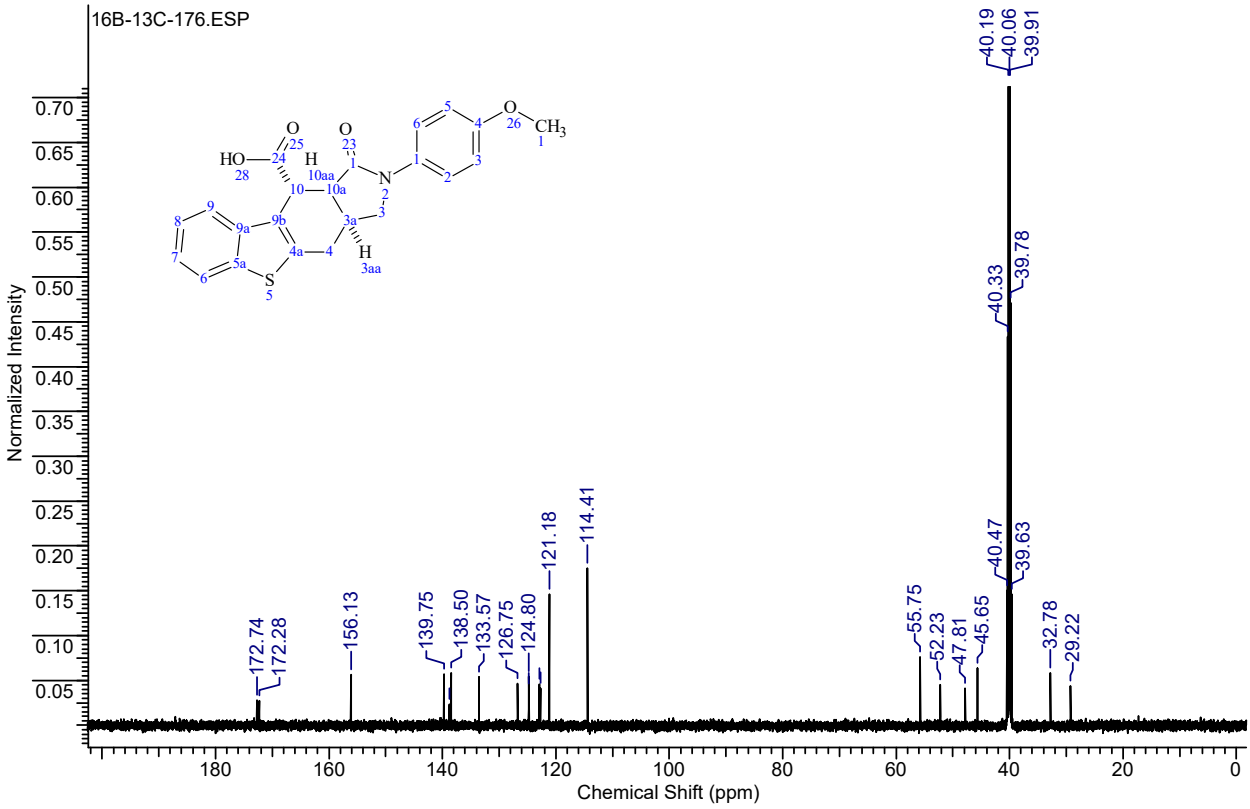




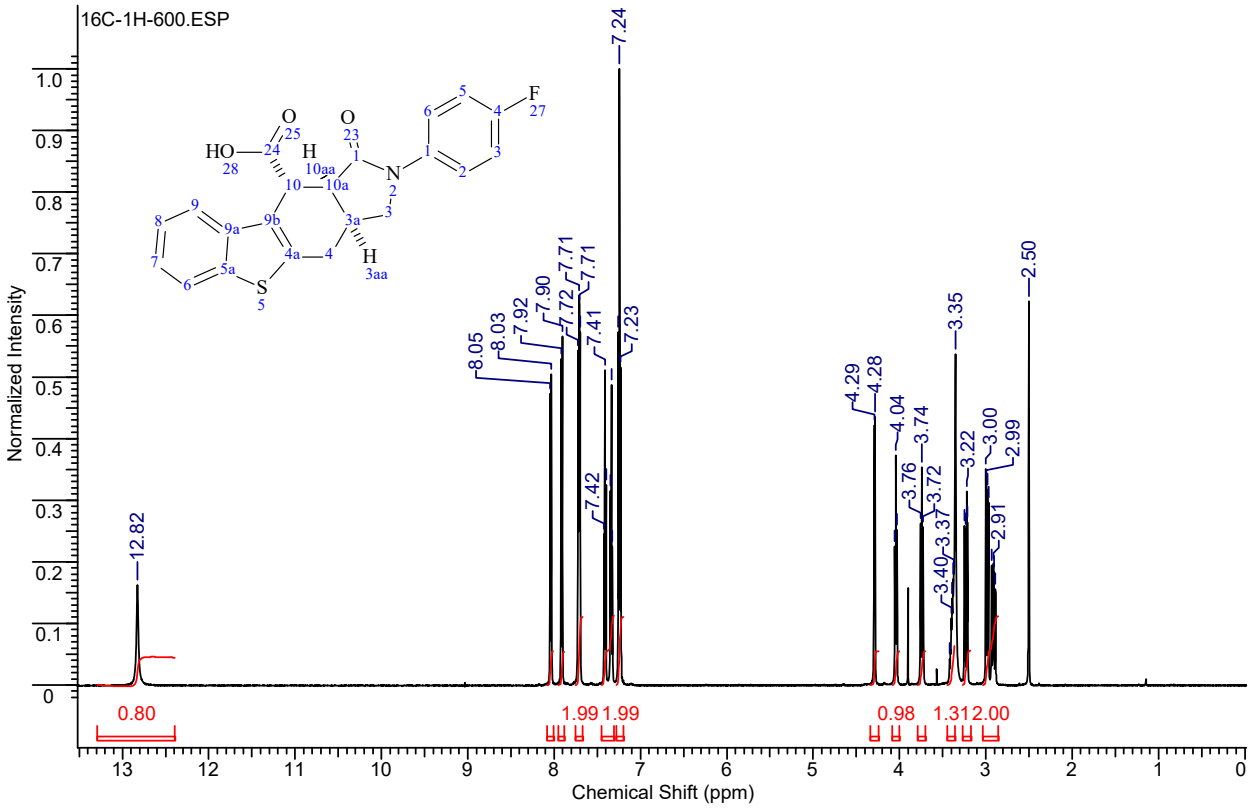

8X-19F-565_1.esp
-63.80
-65.29
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
F
29
HO
F
1
F
O
20
28
30
27
H
17
3
10aa
N
O
H
18
9ba
4
3a
2
1
S
4a
10a
5
9b
10
H
5a
9a
3aa
6
9
7
8
5
6
4
3
1
2

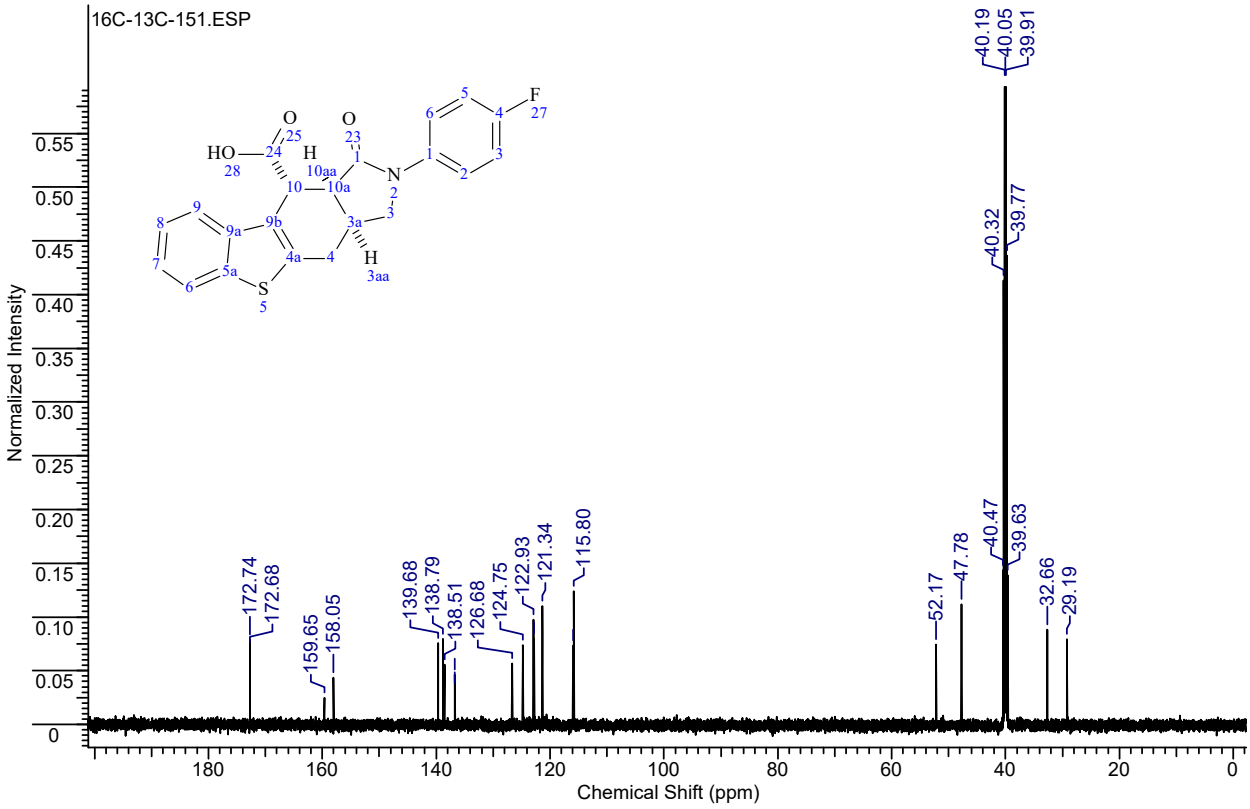
(3a*SR*,10*RS*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16b).

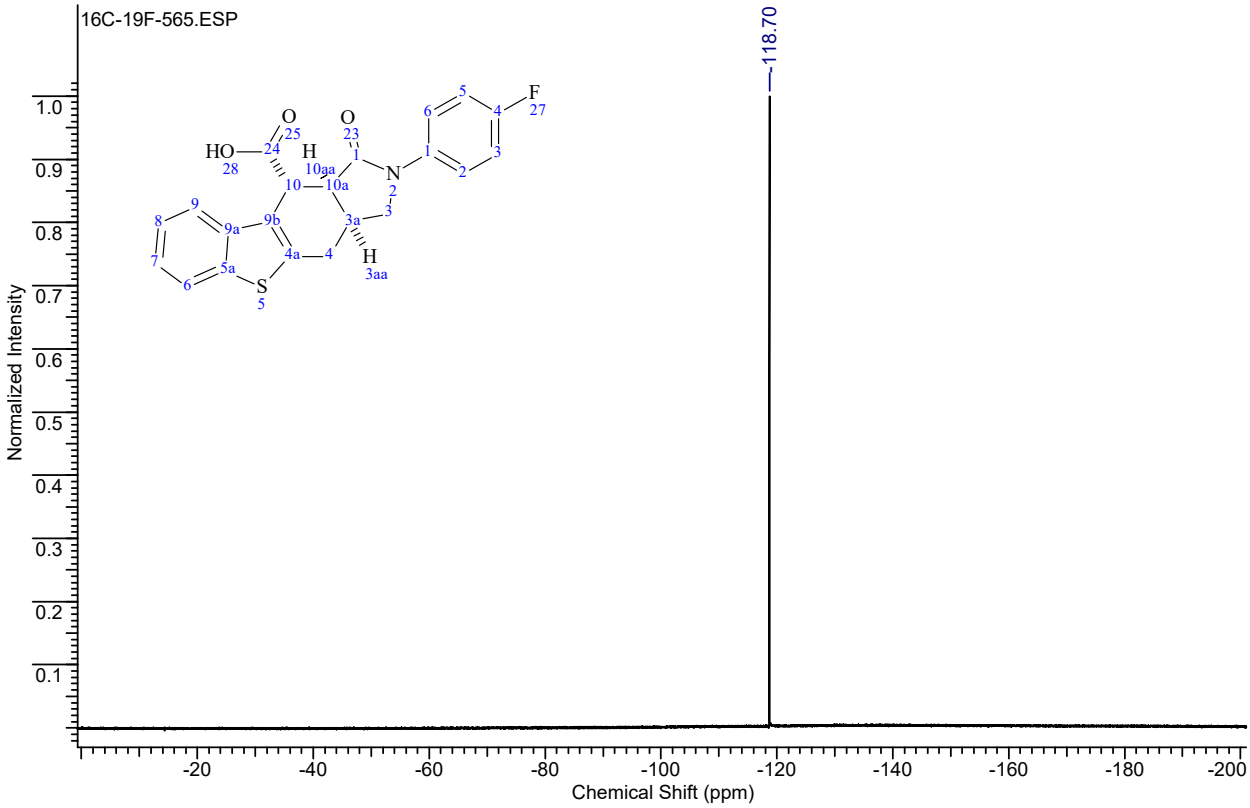




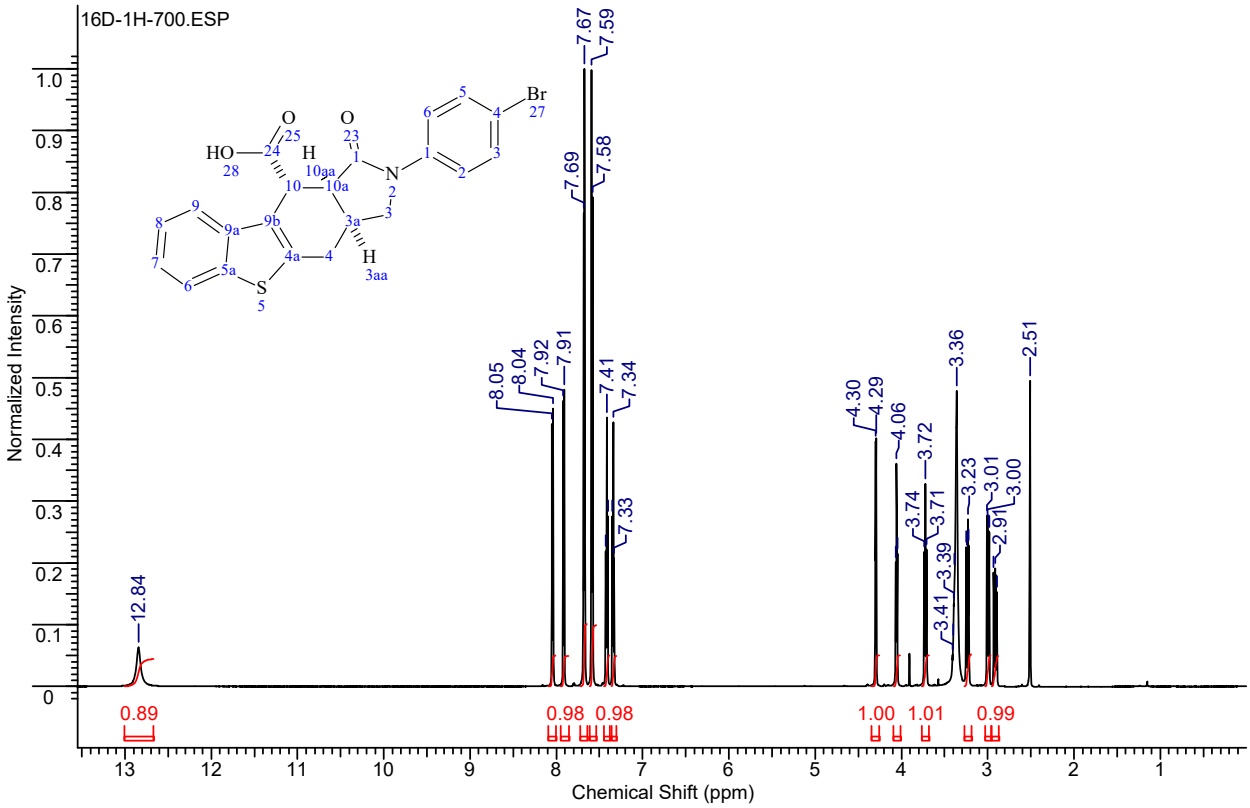
(3a*SR*,10*RS*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16c).

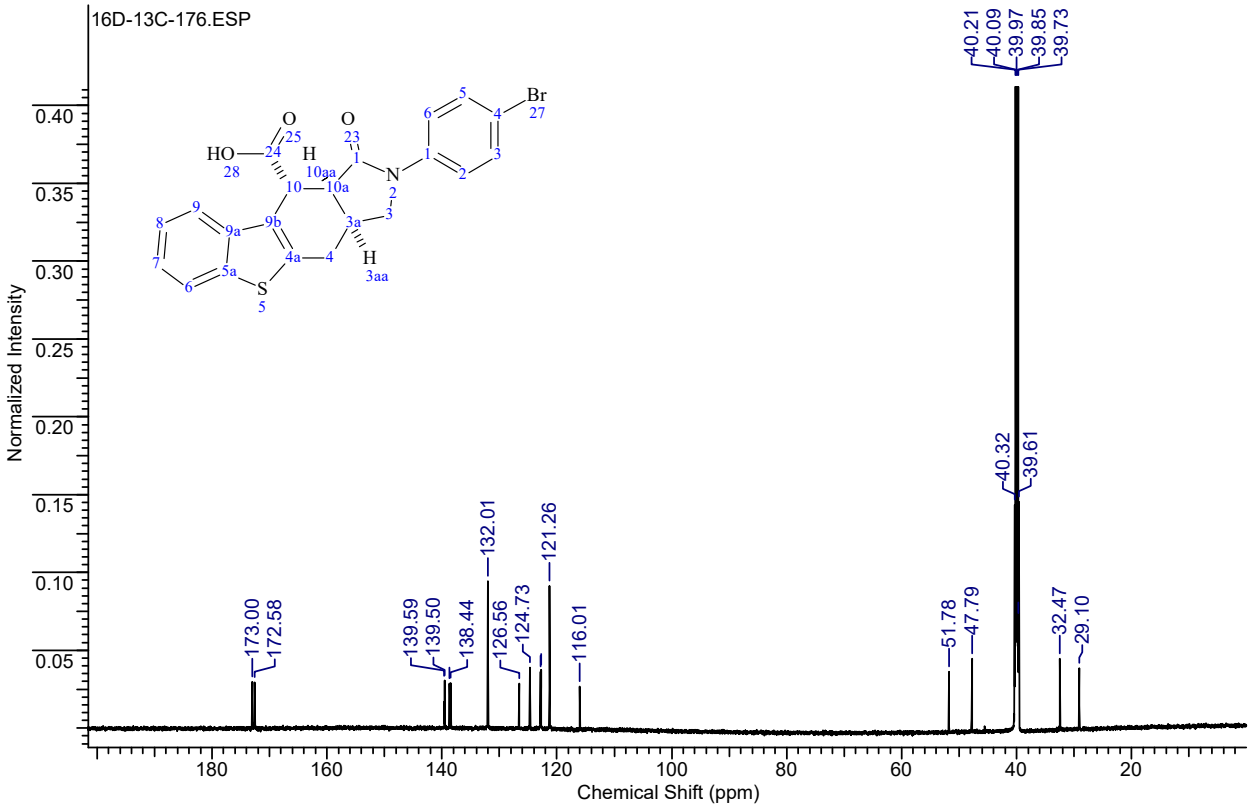




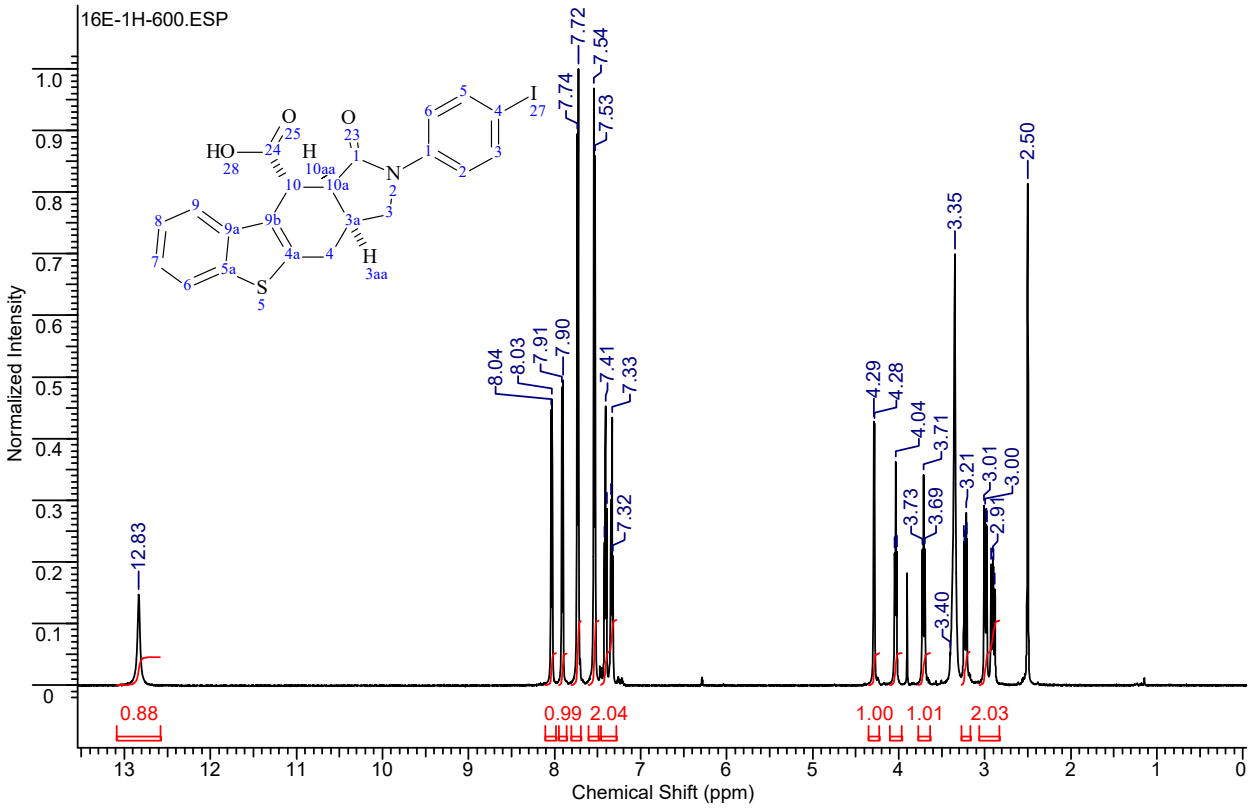

16C-19F-565.ESP
118.70
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
HO
O
O
H
N
F
S

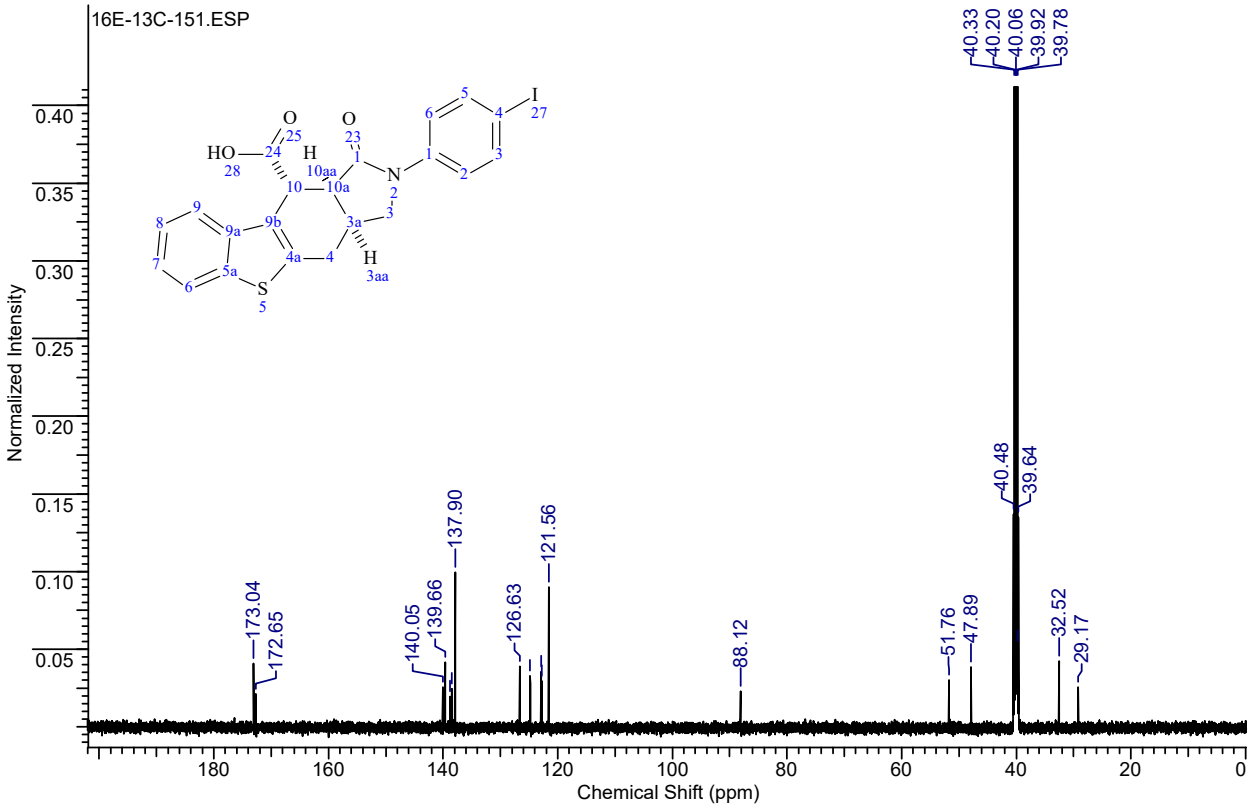
(3a*SR*,10*RS*,10a*RS*)-2-(4-Bromophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16d).



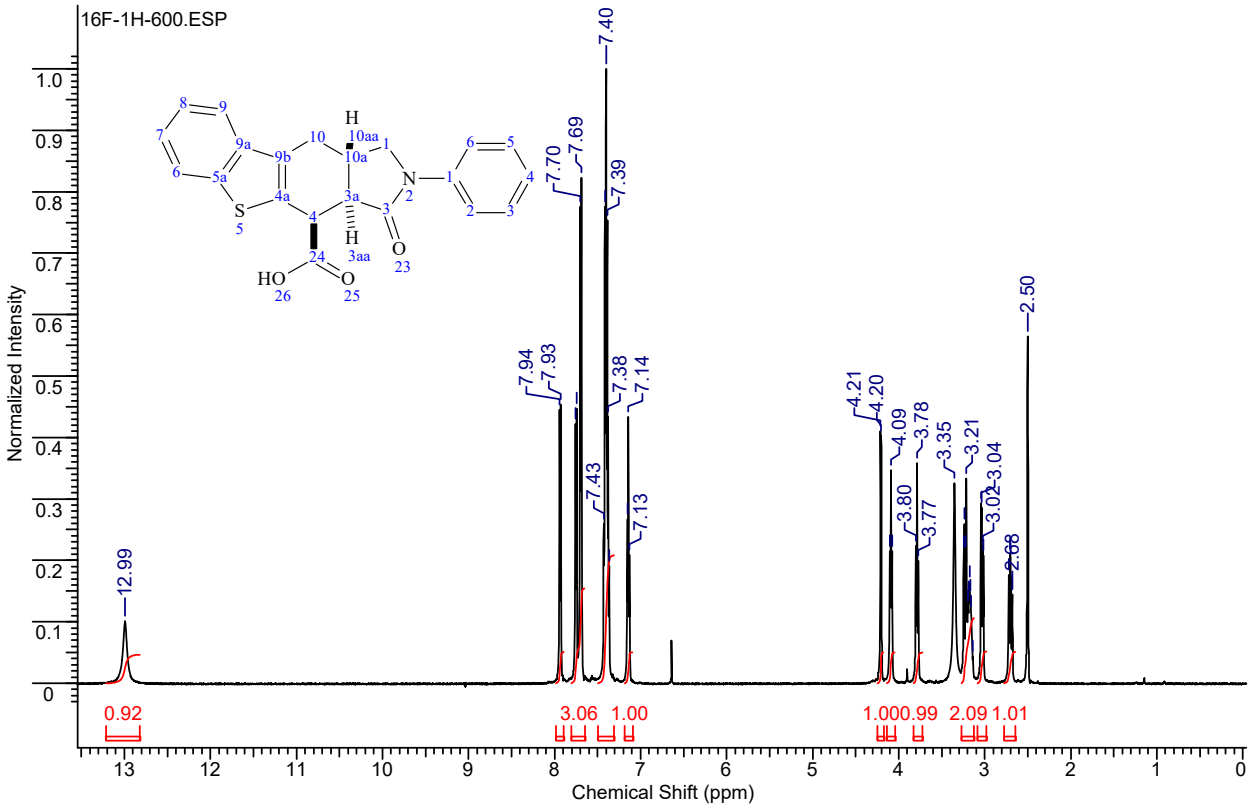


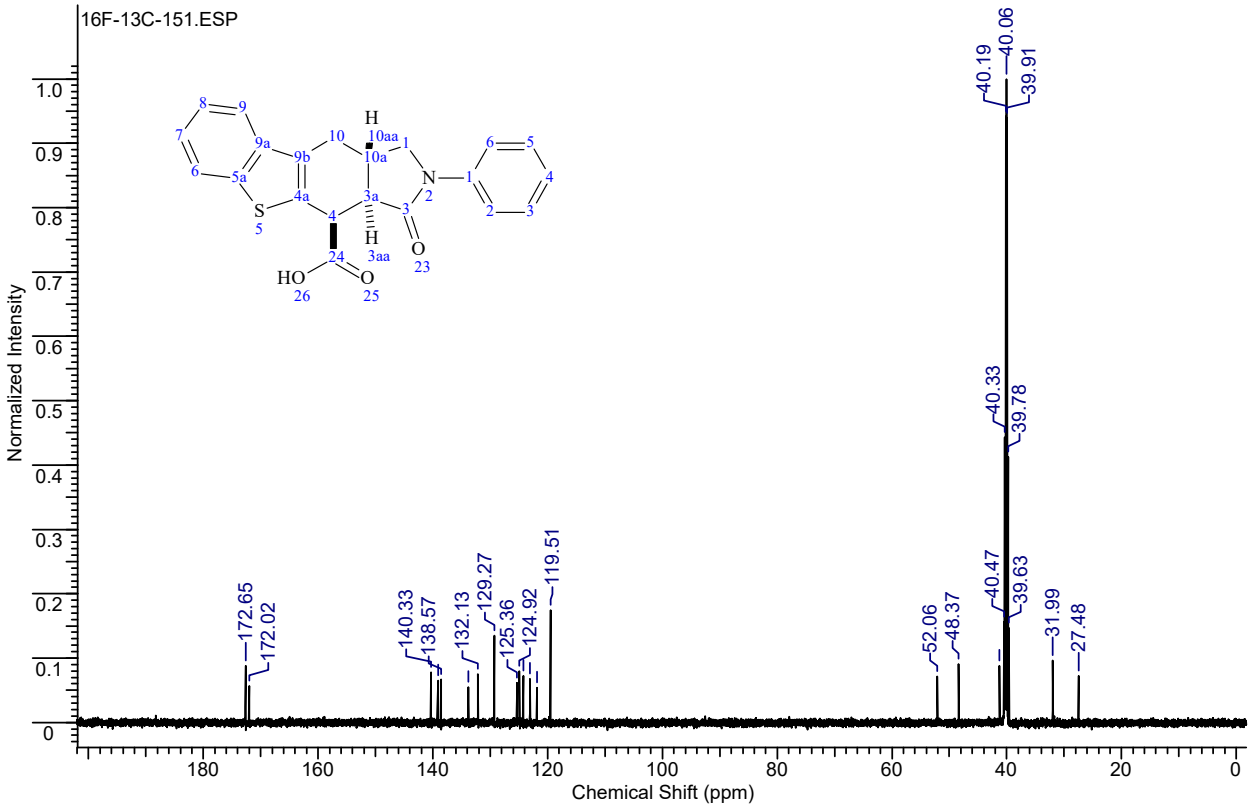
(3a*SR*,10*RS*,10a*RS*)-2-(4-Iodophenyl)-1-oxo-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (16e).



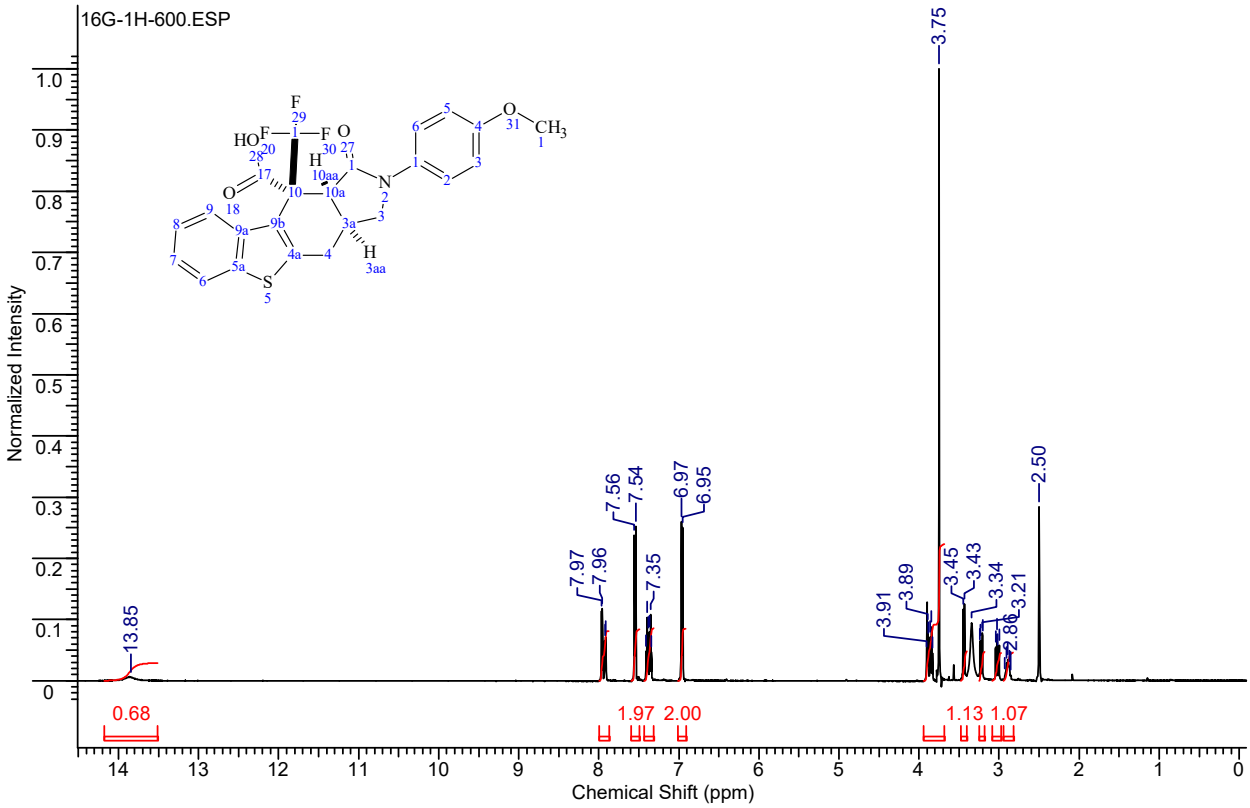


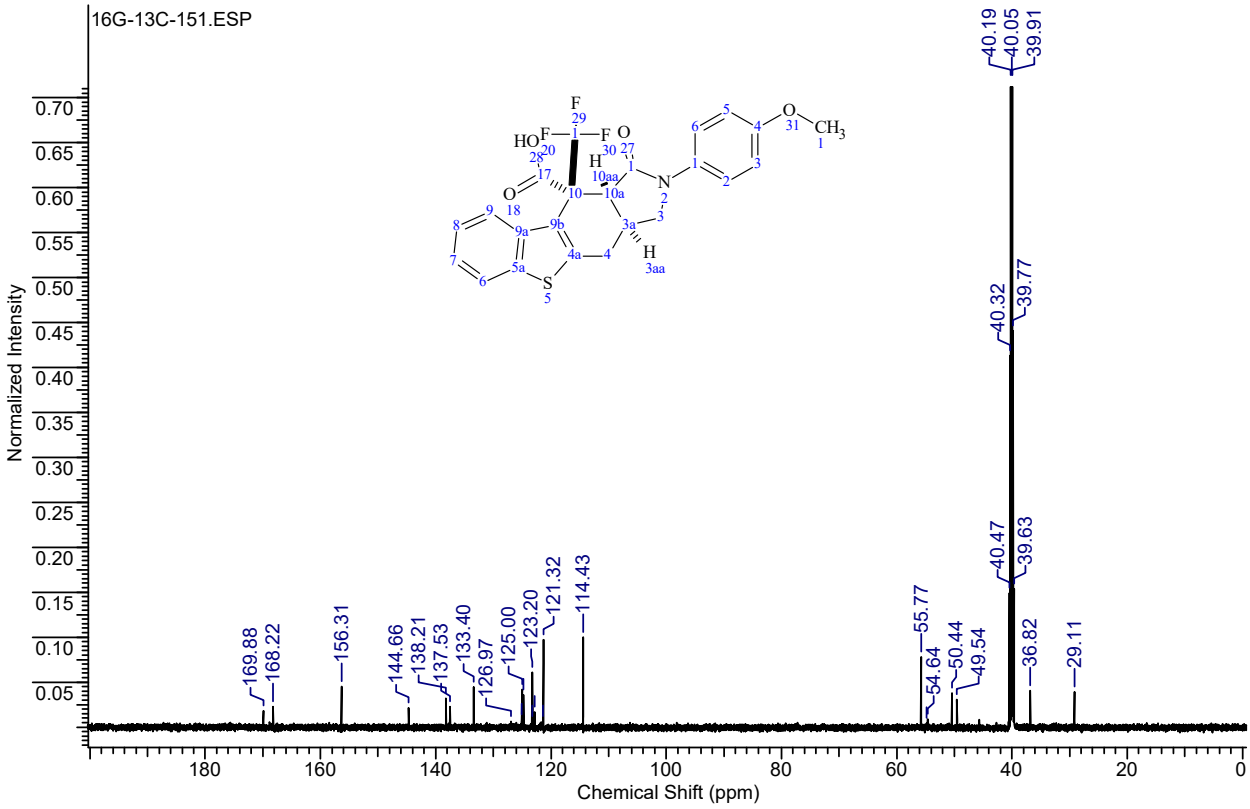
(3a*RS*,4*SR*,10a*SR*)-3-Oxo-2-phenyl-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-4-carboxylic acid (16f).

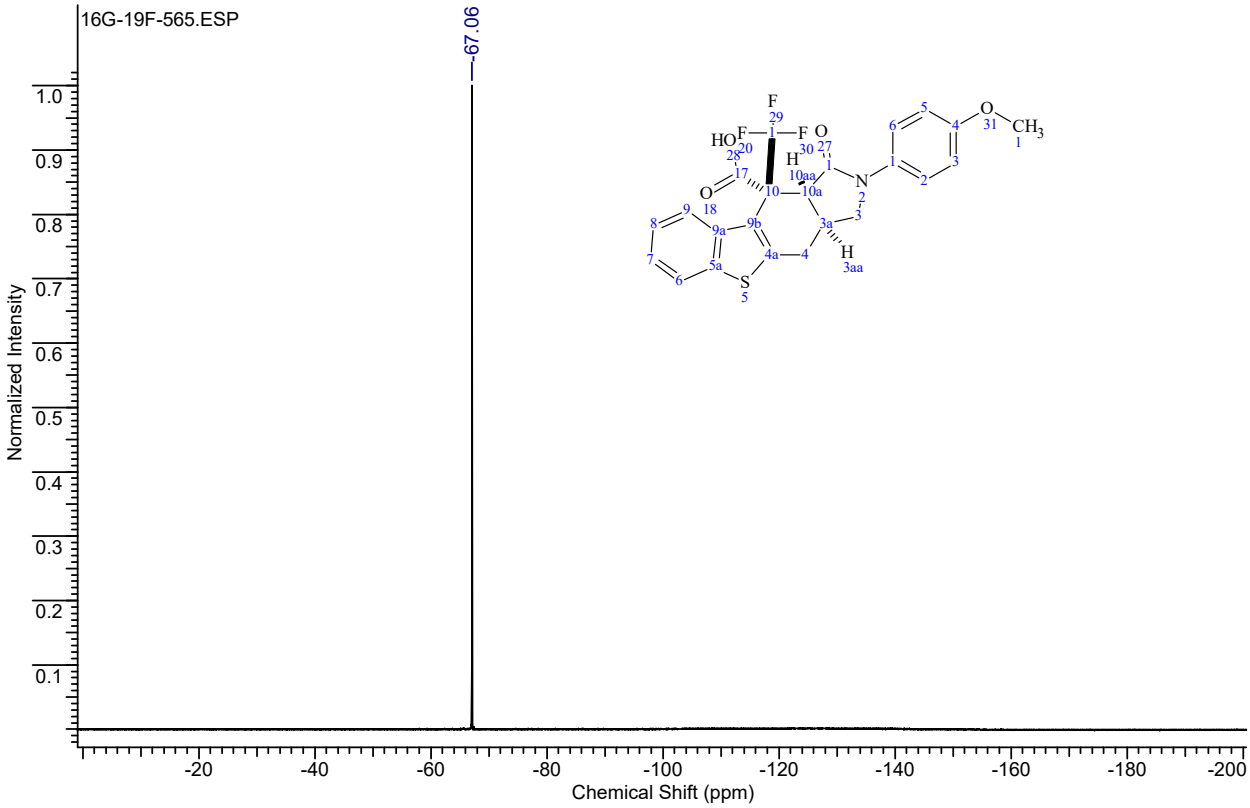




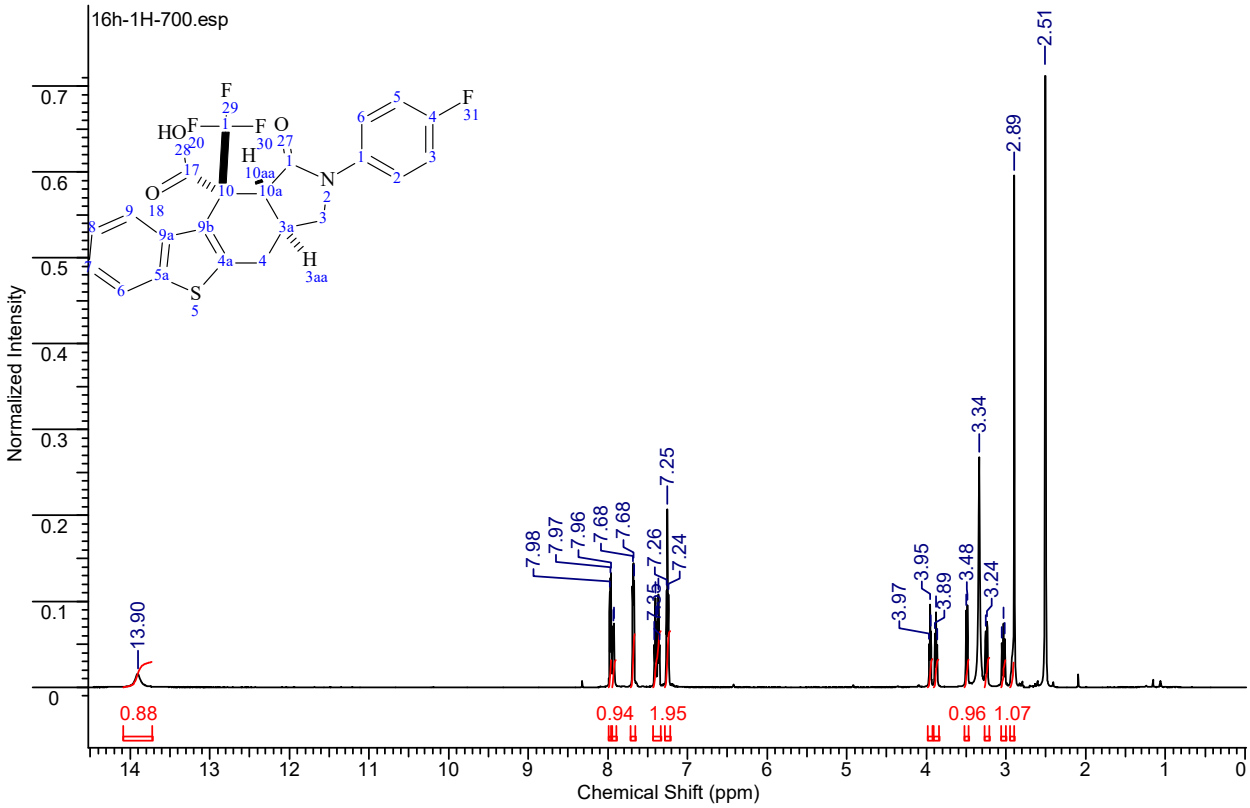
(3a*SR*,10*SR*,10a*RS*)-2-(4-Methoxyphenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-10-carboxylic acid (16g).

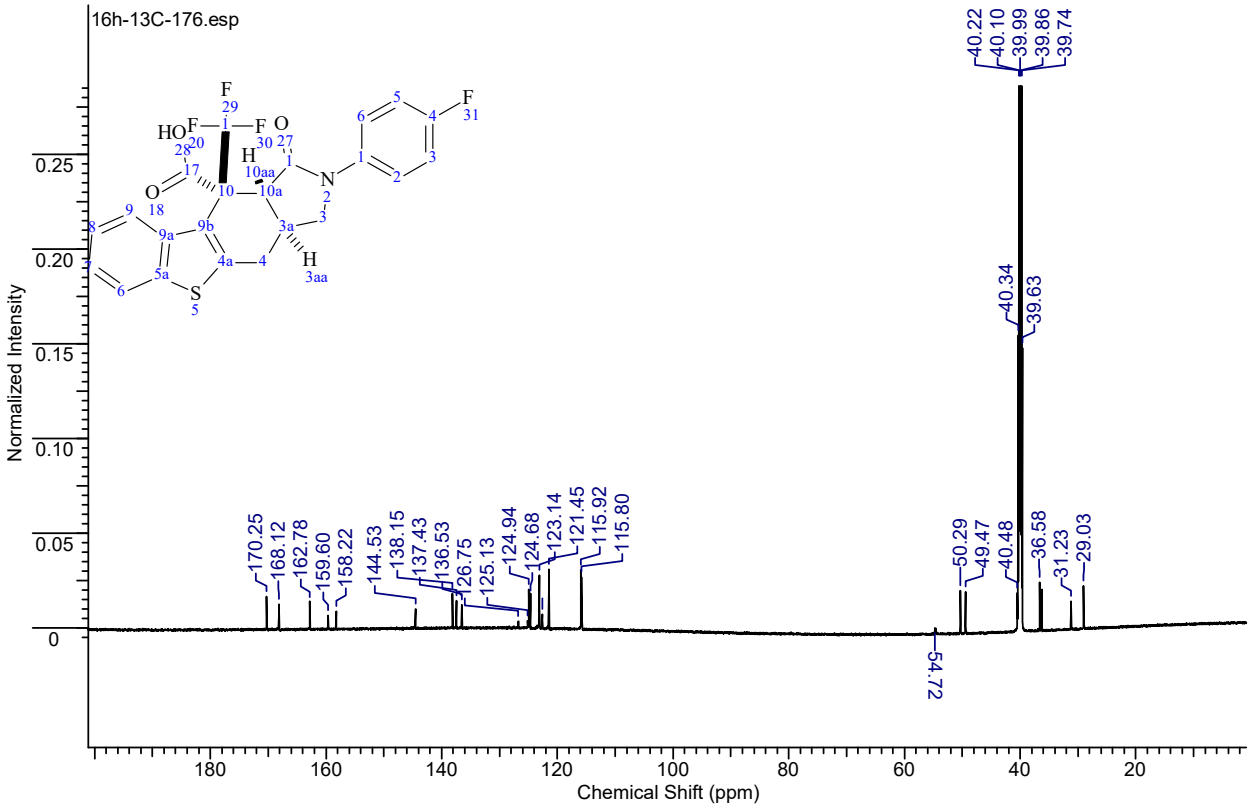


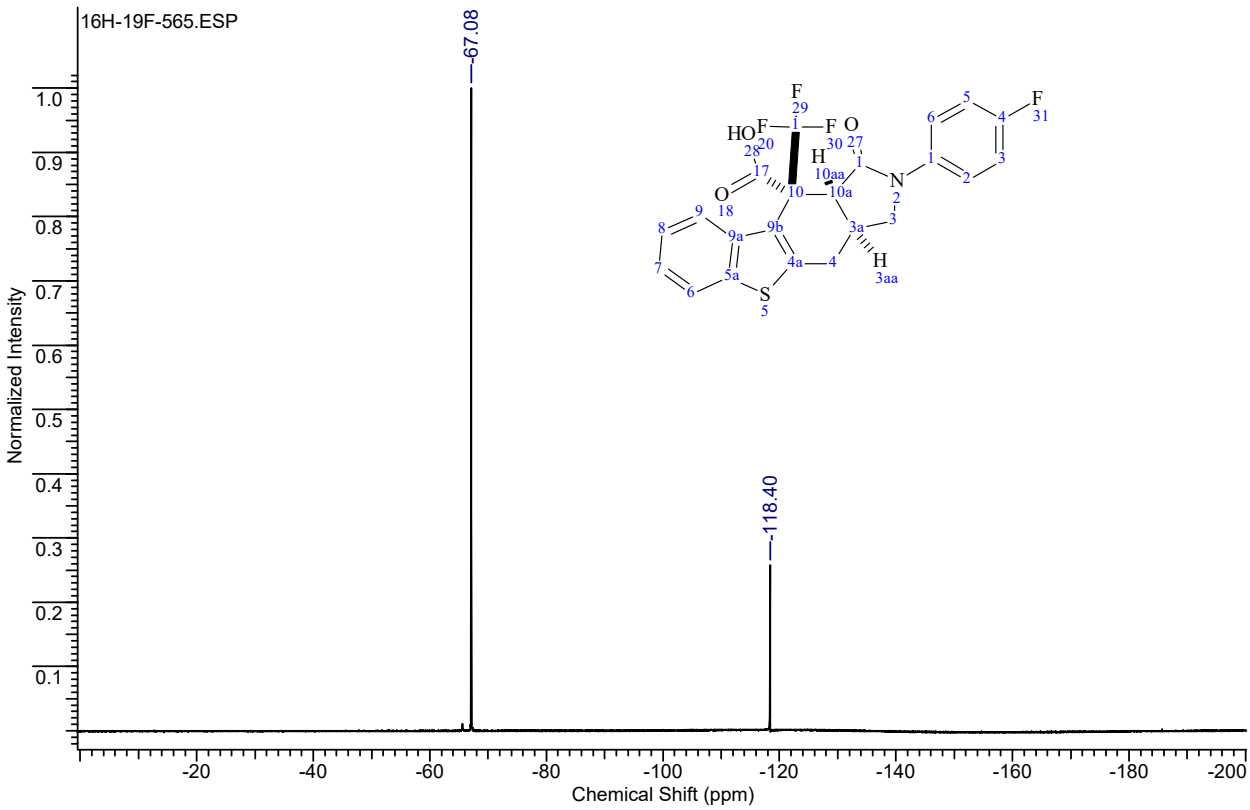



16G-19F-565.ESP
-67.06
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
F
29
HO
F
1
F
O
20
28
30
27
H
17
10aa
1
O
10
10a
N
18
2
9
3
8
9a
9b
3a
7
4a
4
H
5a
3aa
6
S
5

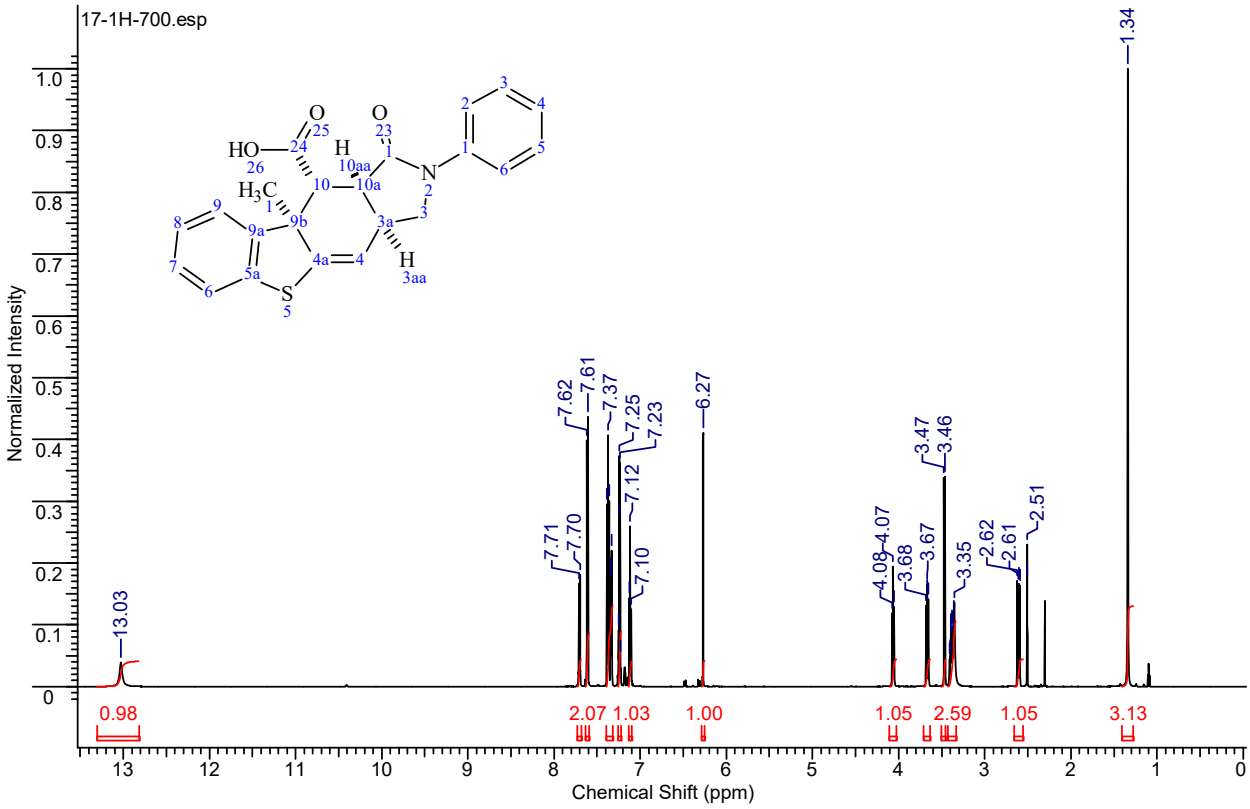
(3a*SR*,10*SR*,10a*RS*)-2-(4-Fluorophenyl)-1-oxo-10-(trifluoromethyl)-2,3,3a,4,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-f]isoindole-10-carboxylic acid (16h).

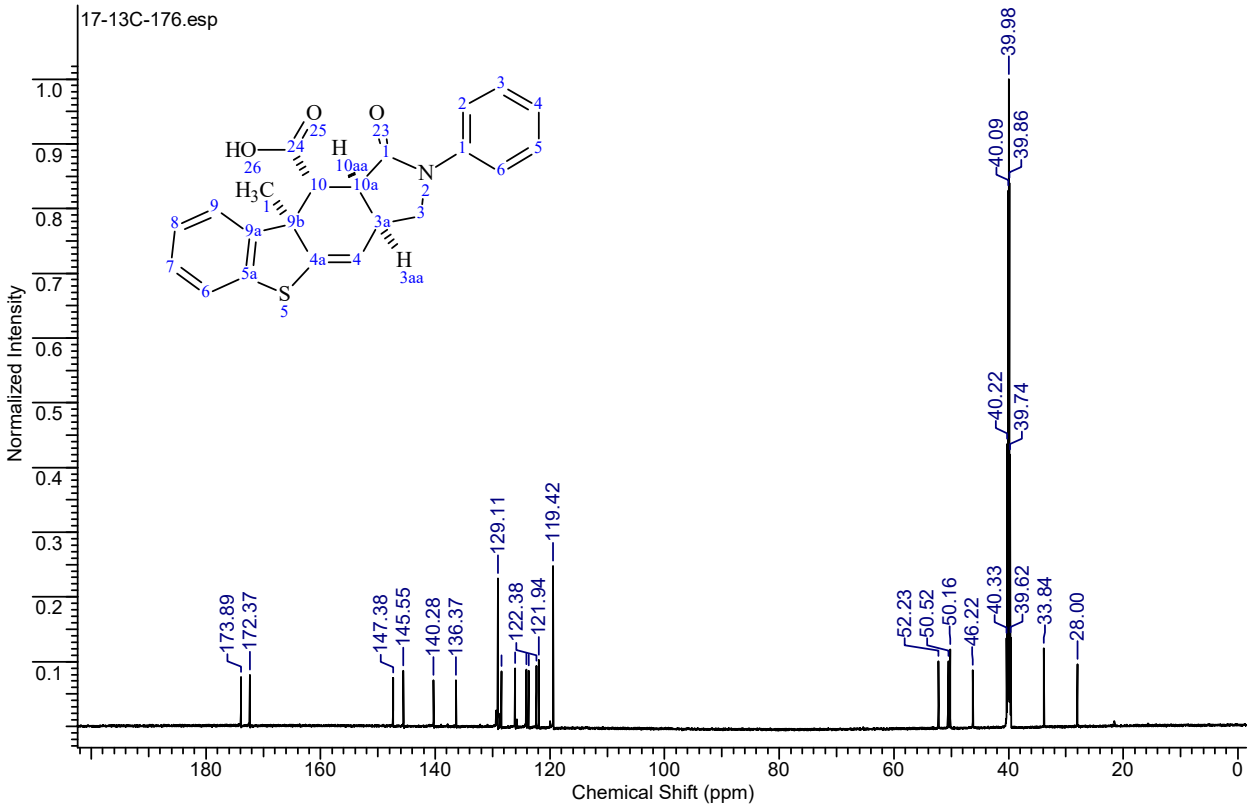




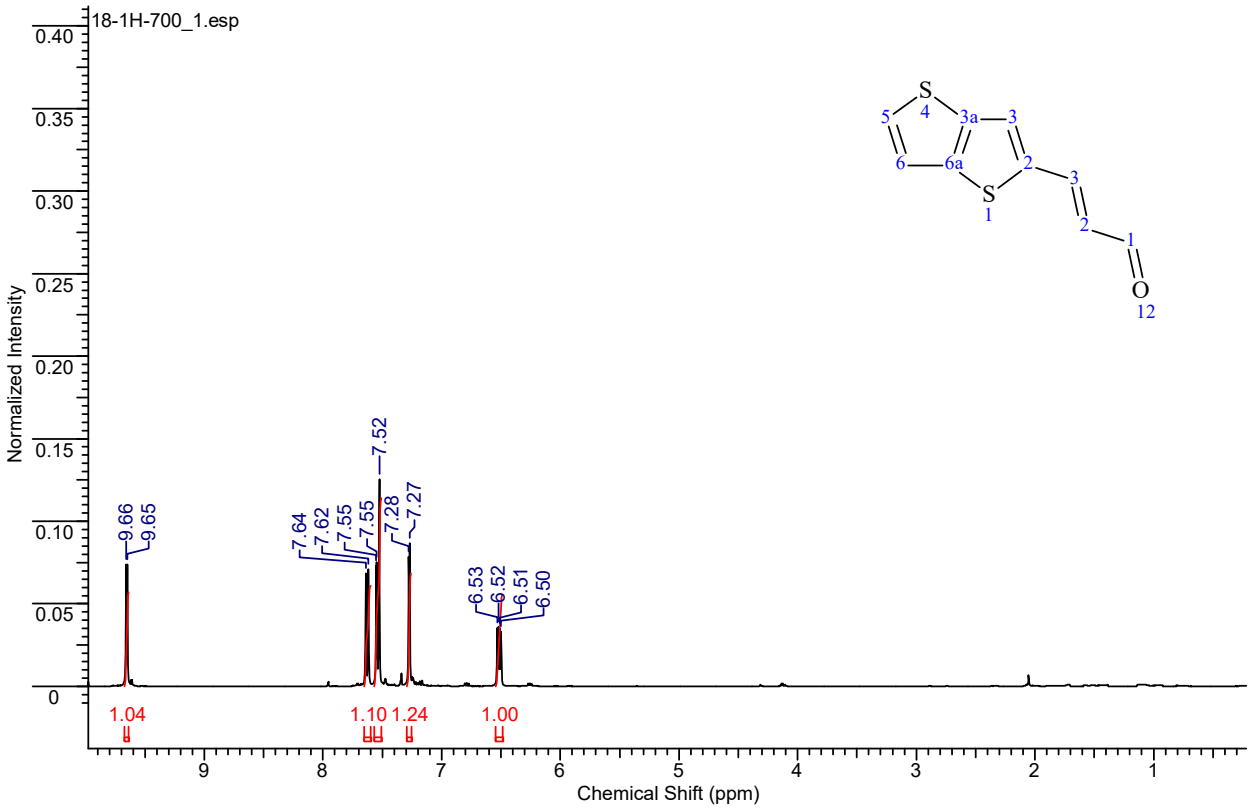

16H-19F-565.ESP
67.08
118.40
Normalized Intensity
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
Chemical Shift (ppm)
F
29
HO
28
F
1
F
20
O
30
27
H
10aa
1
N
2
O
18
17
10
10a
3
9
8
9a
9b
3a
7
4a
4
H
3aa
5a
6
S
5
5
6
4
F
31
1
2
3

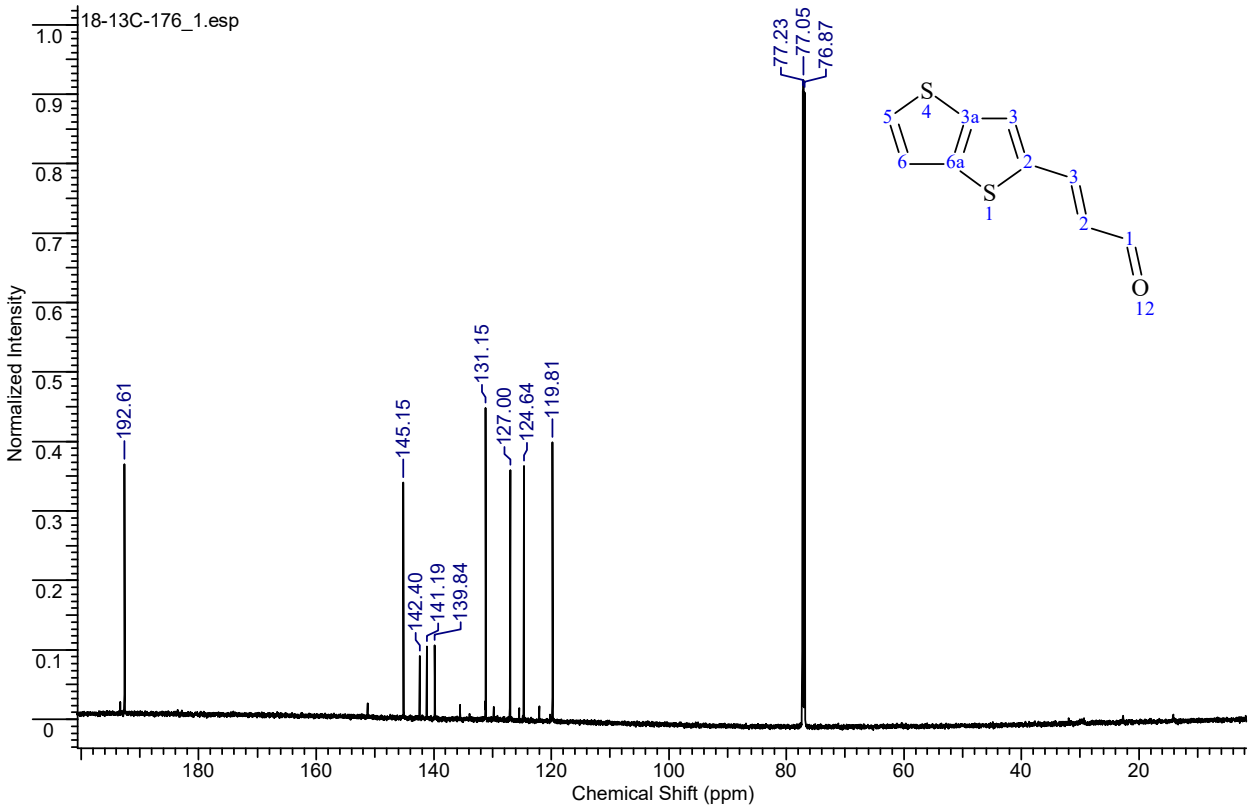
(3a*RS*,9b*RS*,10*RS*,10a*RS*)-9b-Methyl-1-oxo-2-phenyl-2,3,3a,9b,10,10a-hexahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (17).



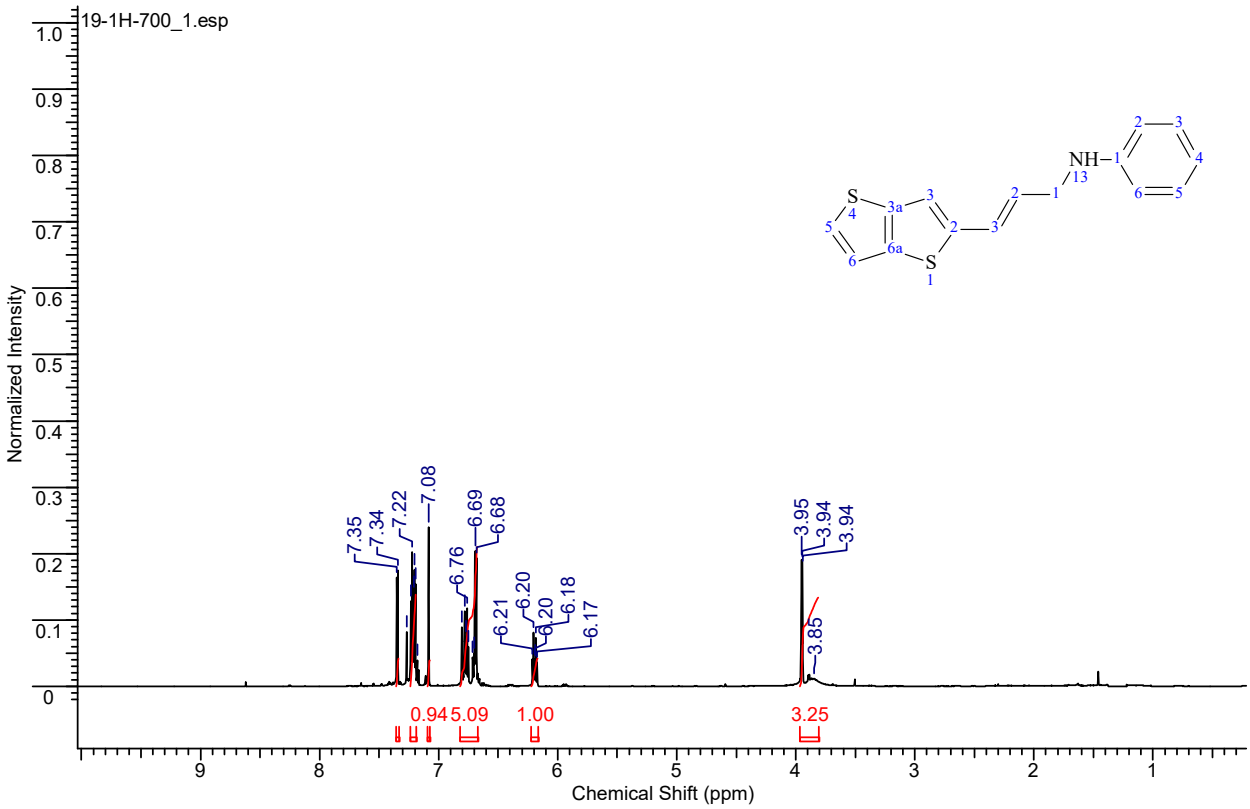


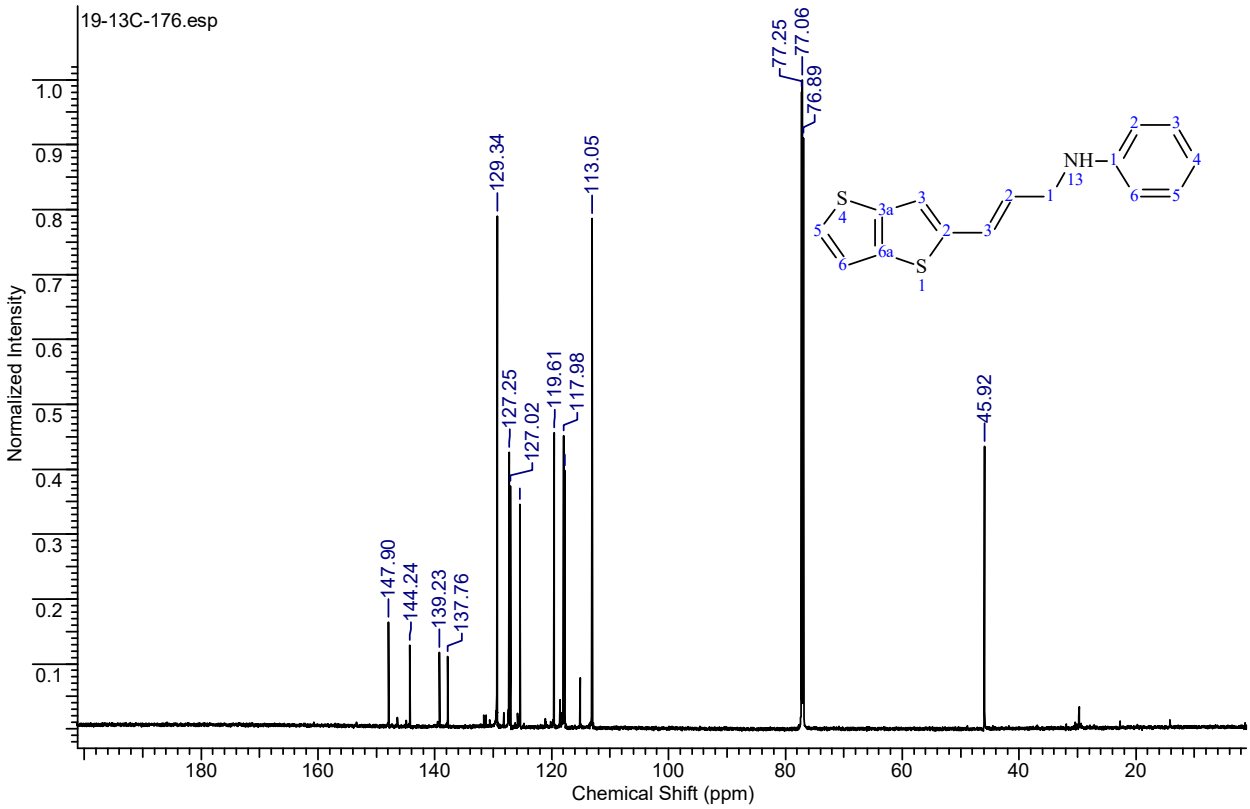
(*E*)-3-(Thieno[3,2-*b*]thiophen-2-yl)acrylaldehyde (18).



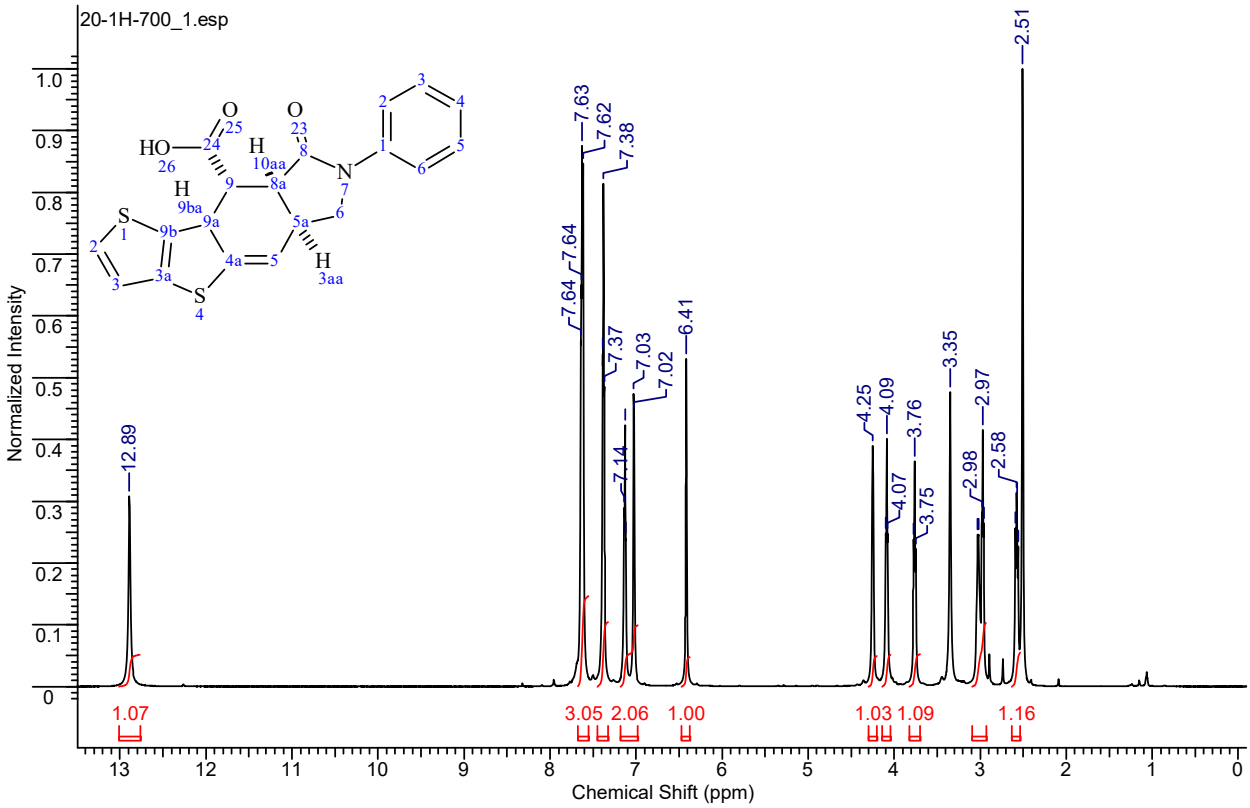


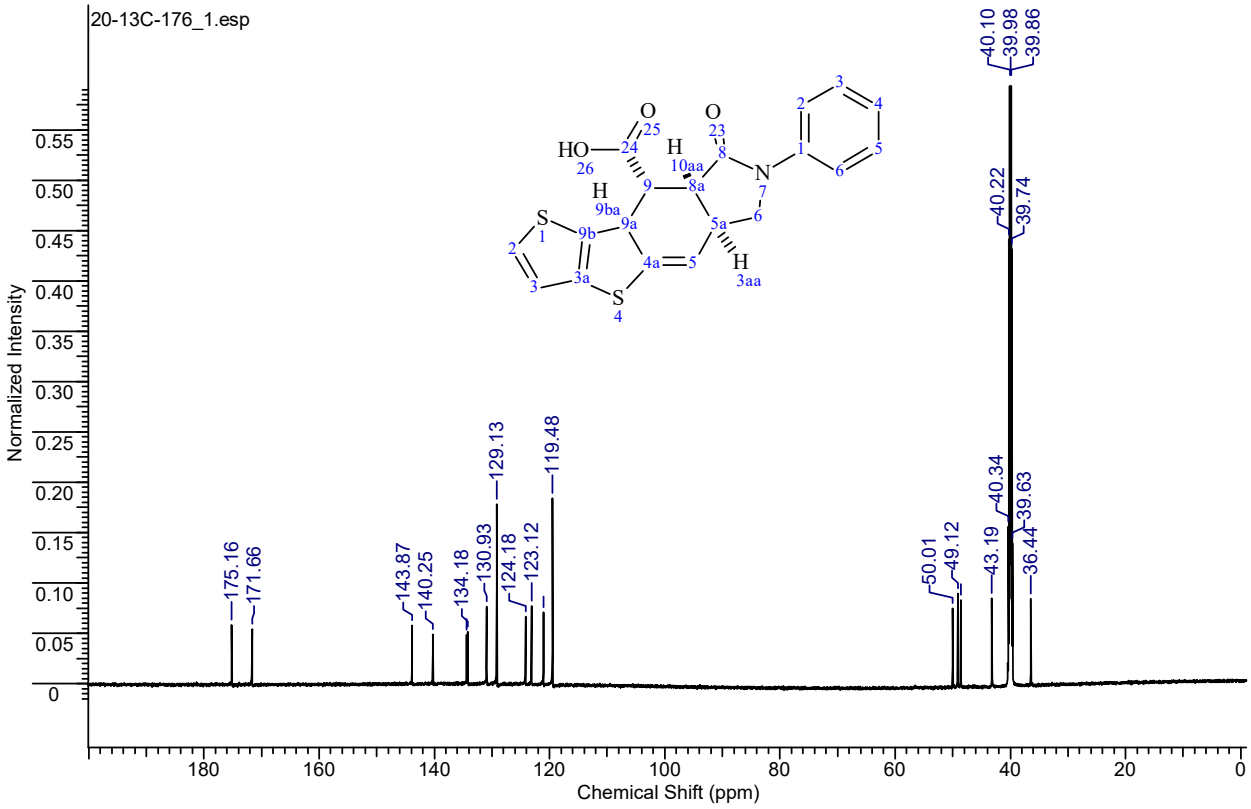
(*E*)-*N*-(3-(Thieno[3,2-*b*]thiophen-2-yl)allyl)aniline (19).



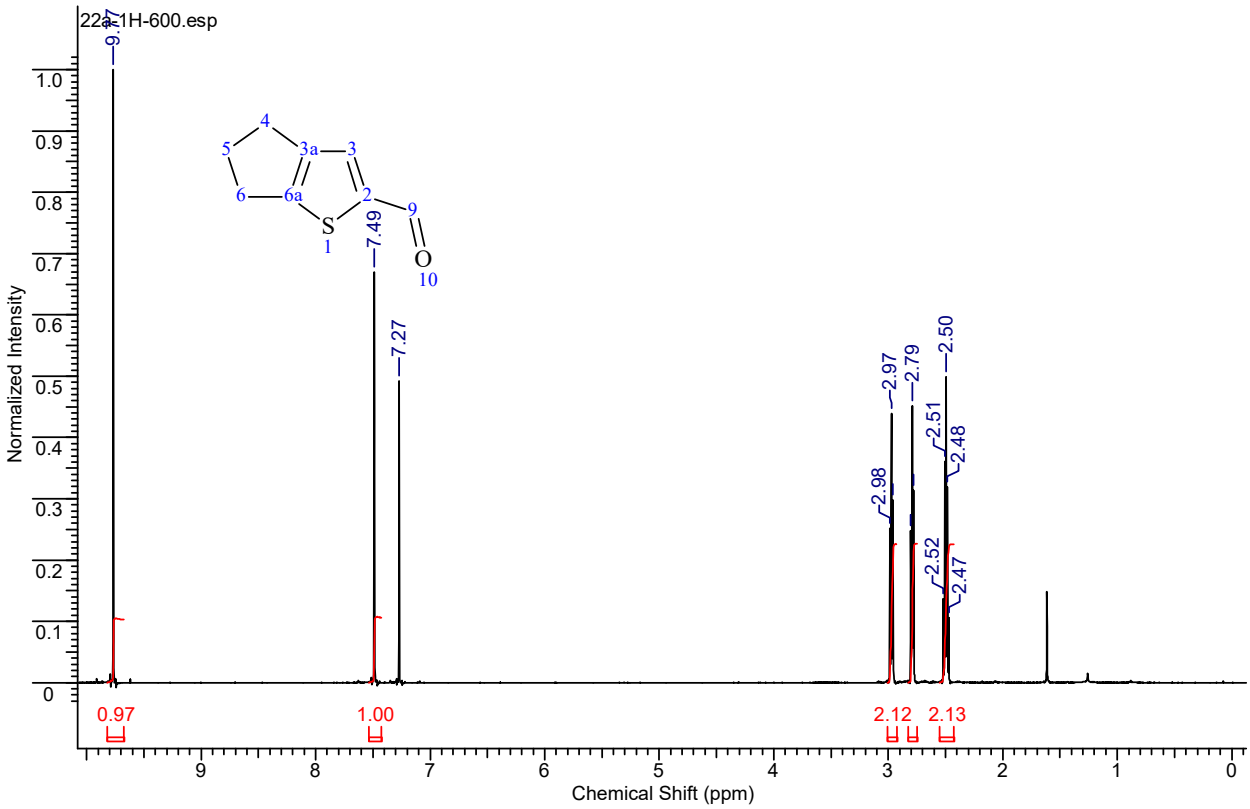


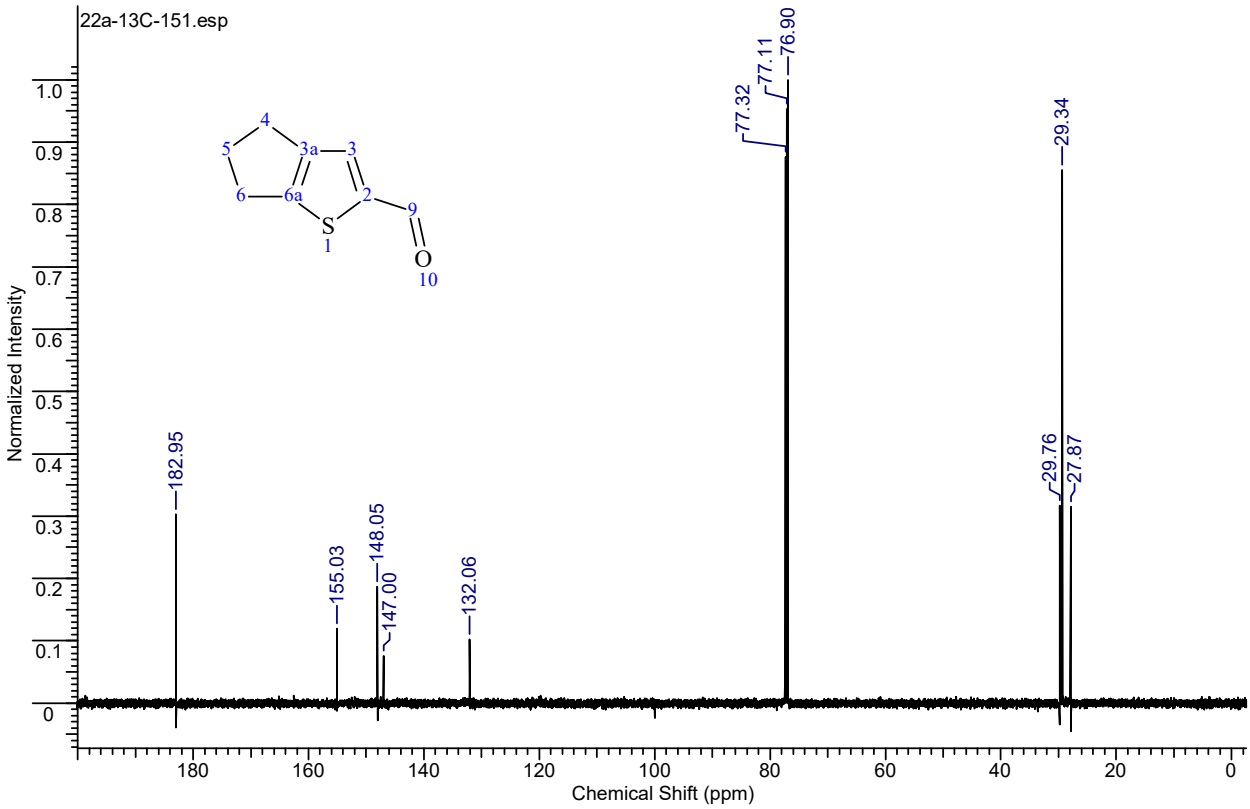
(5a*RS*,8a*RS*,9*RS*,9a*SR*)-8-Oxo-7-phenyl-5a,7,8,8a,9,9a-hexahydro-6*H*-thieno[2',3':4,5]thieno[2,3-*f*]isoindole-9-carboxylic acid (20).



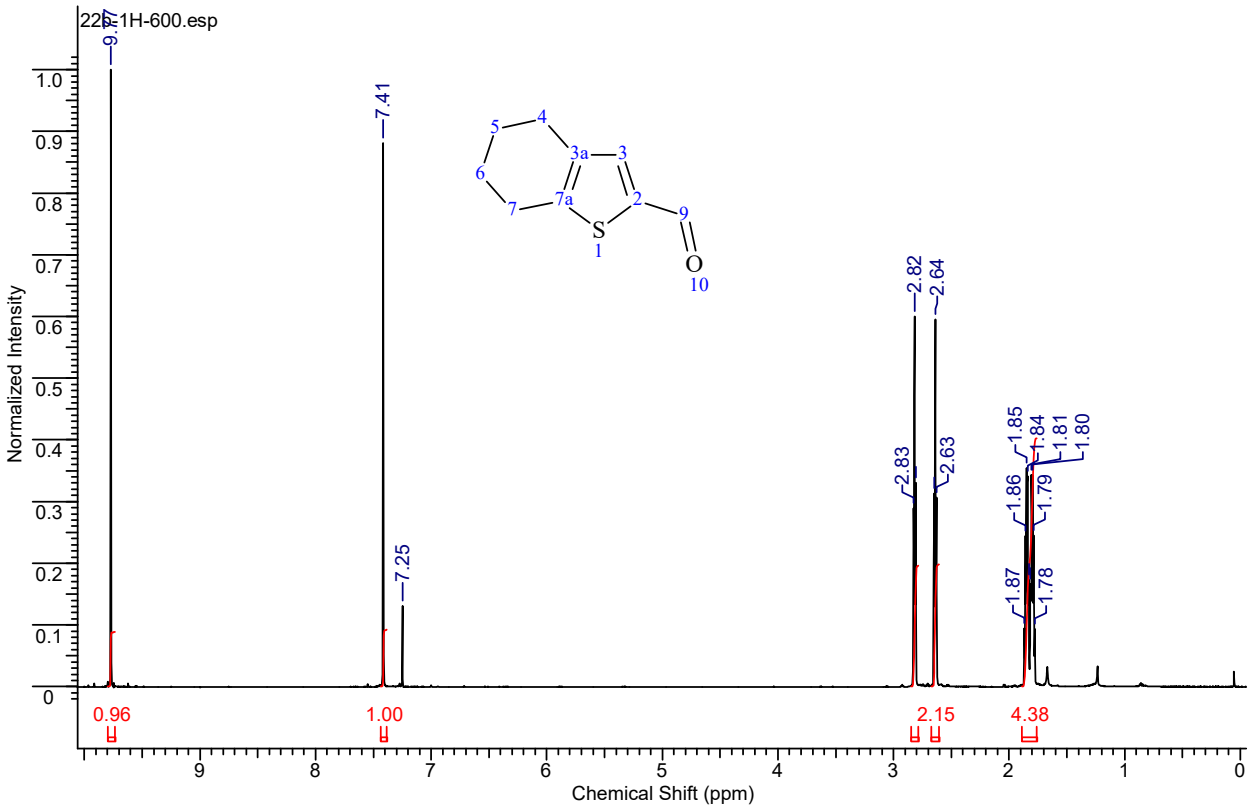


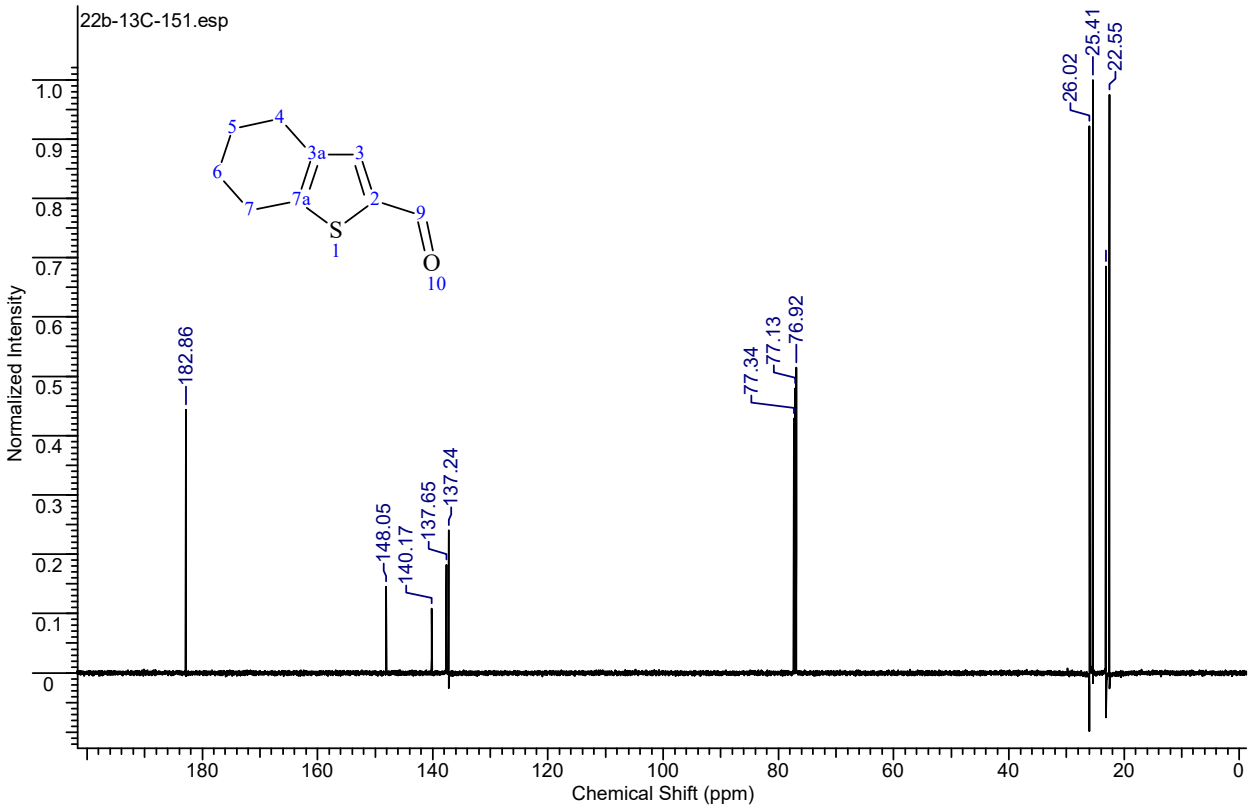
5,6-Dihydro-4*H*-cyclopenta[*b*]thiophene-2-carbaldehyde (22a).



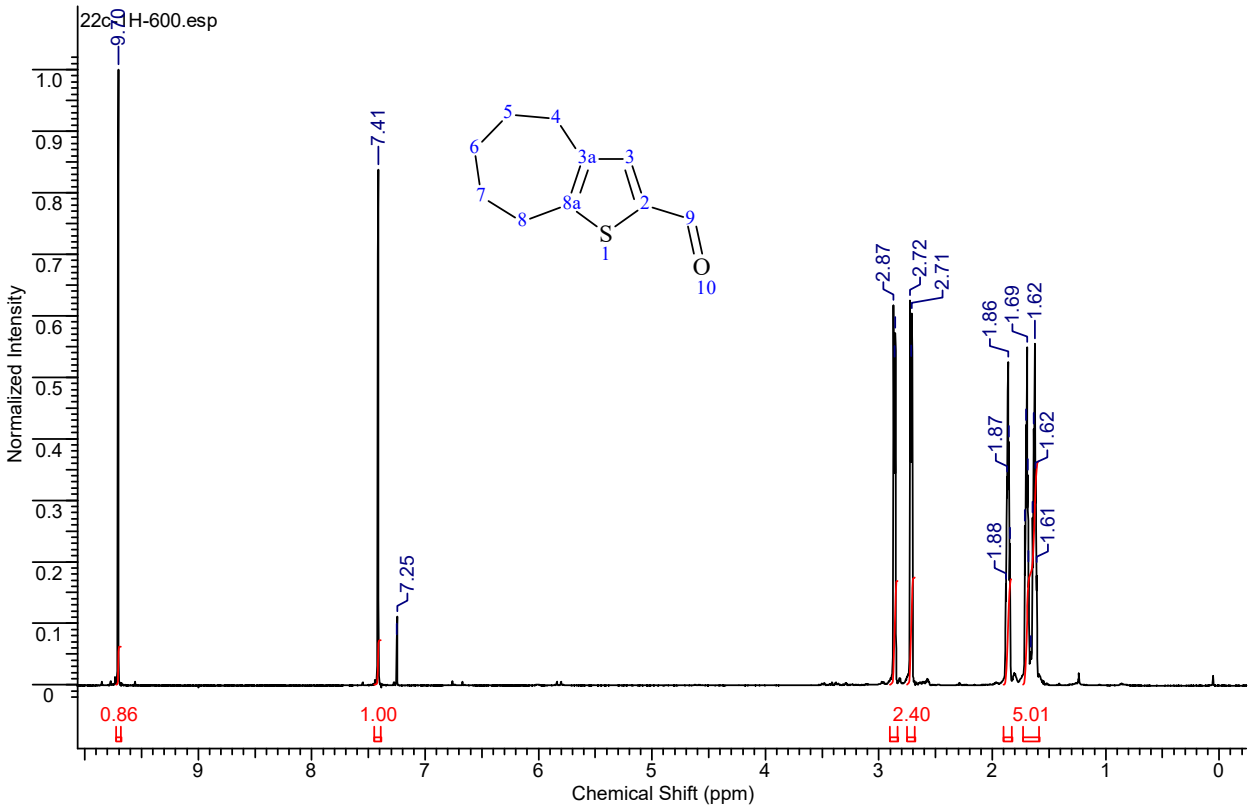


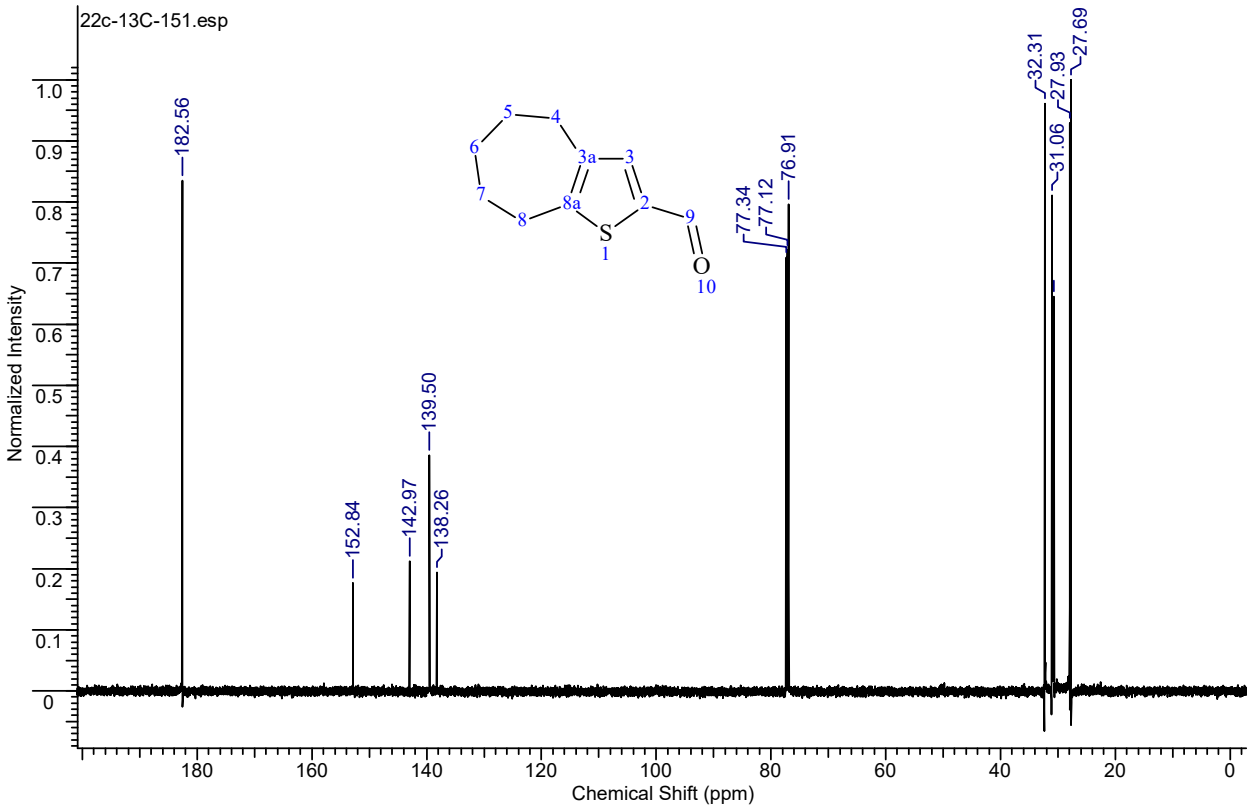
4,5,6,7-Tetrahydrobenzo[*b*]thiophene-2-carbaldehyde (22b).



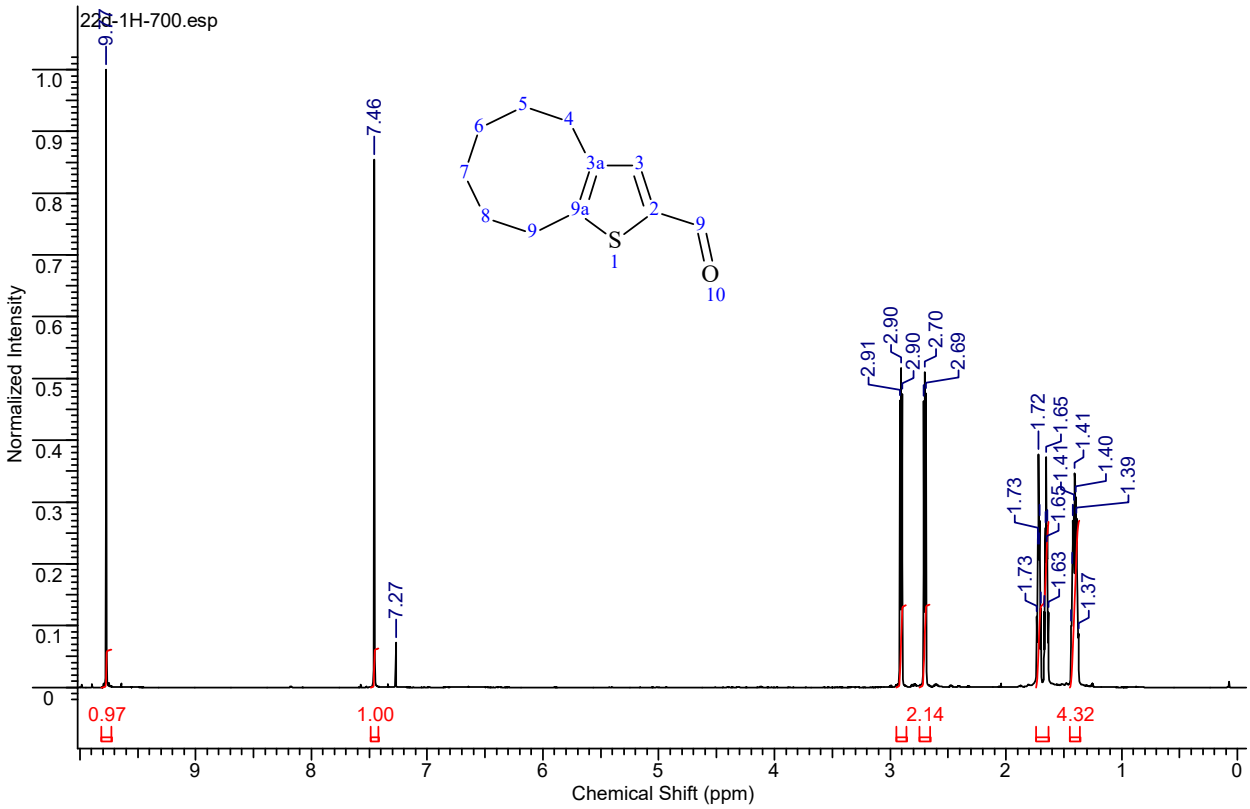


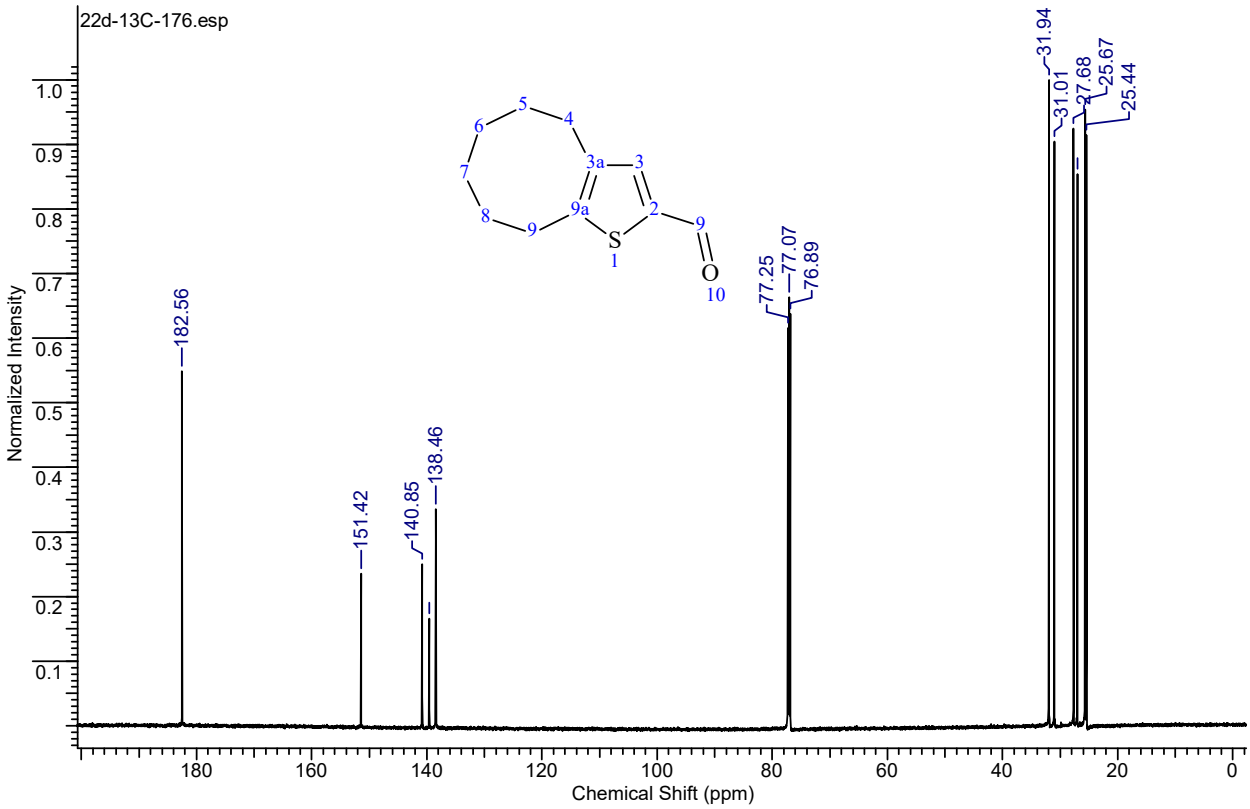
5,6,7,8-Tetrahydro-4*H*-cyclohepta(b]thiophene-2-carbaldehyde (22c).



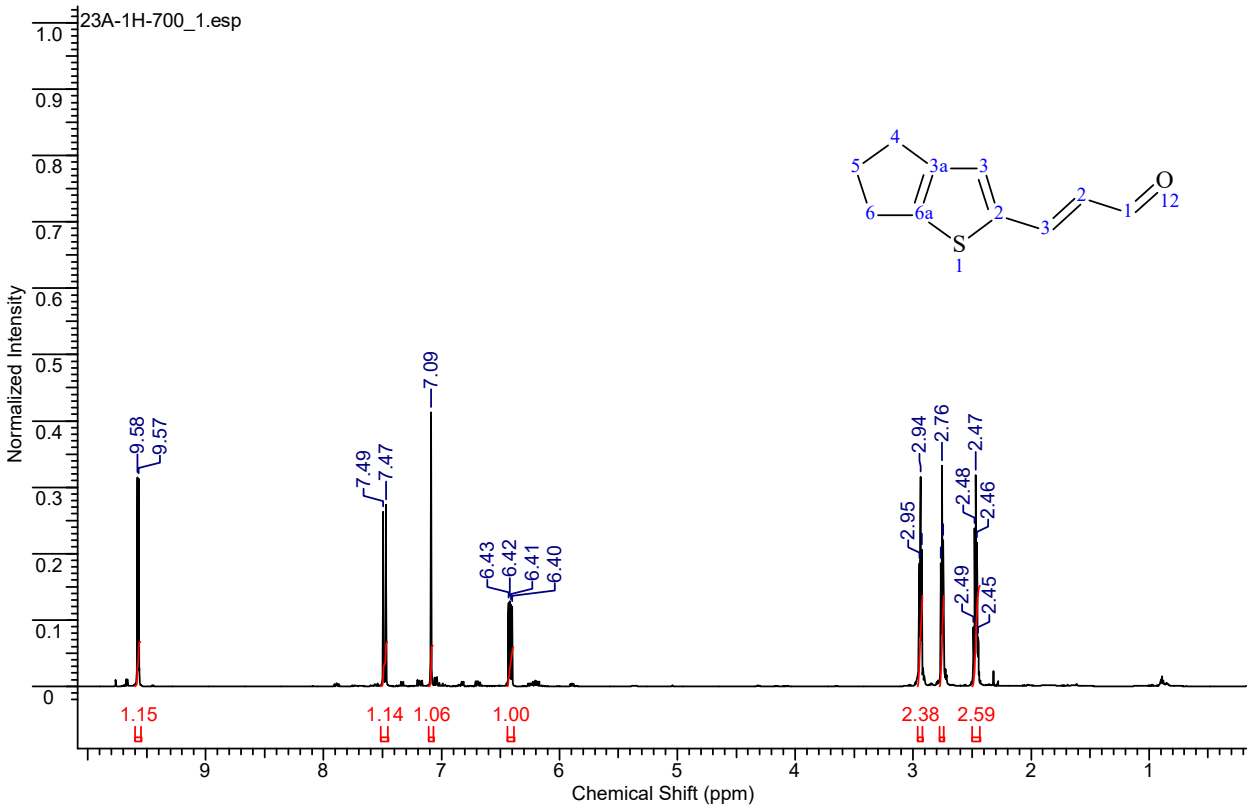


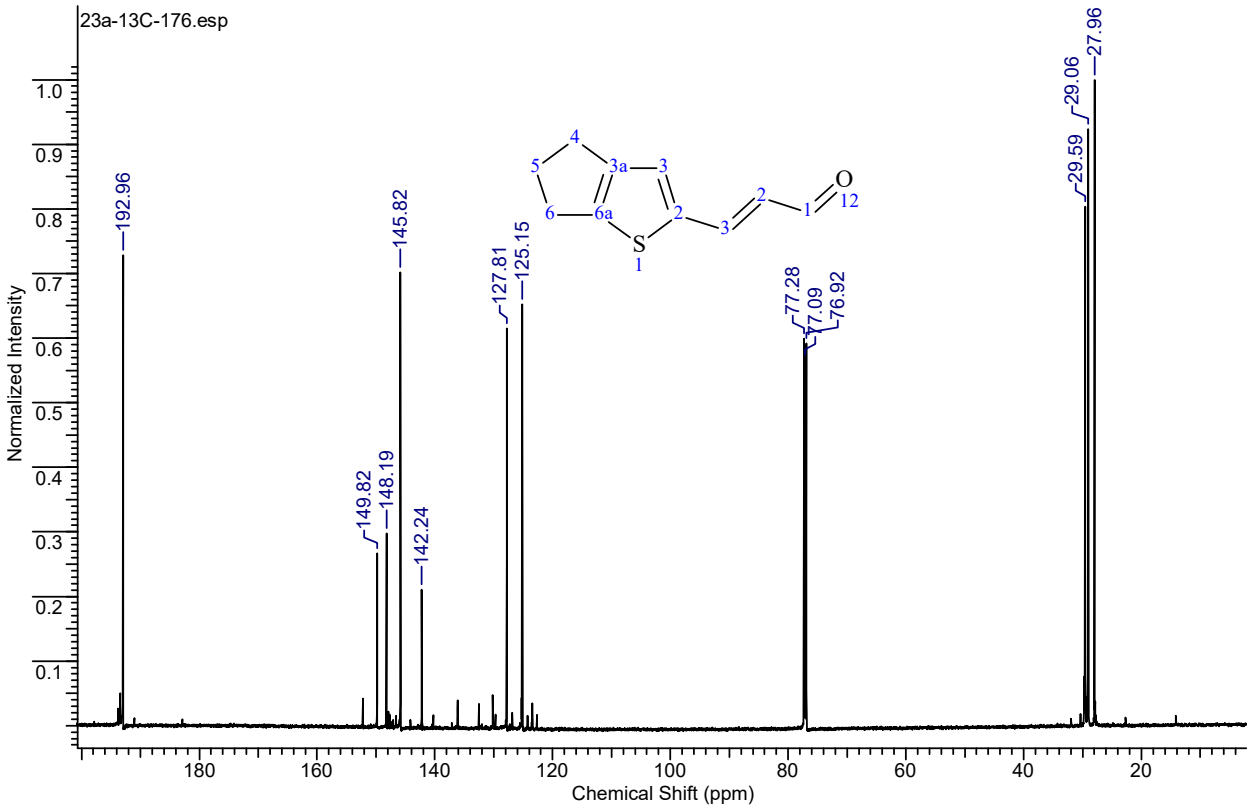
4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophene-2-carbaldehyde (22d).



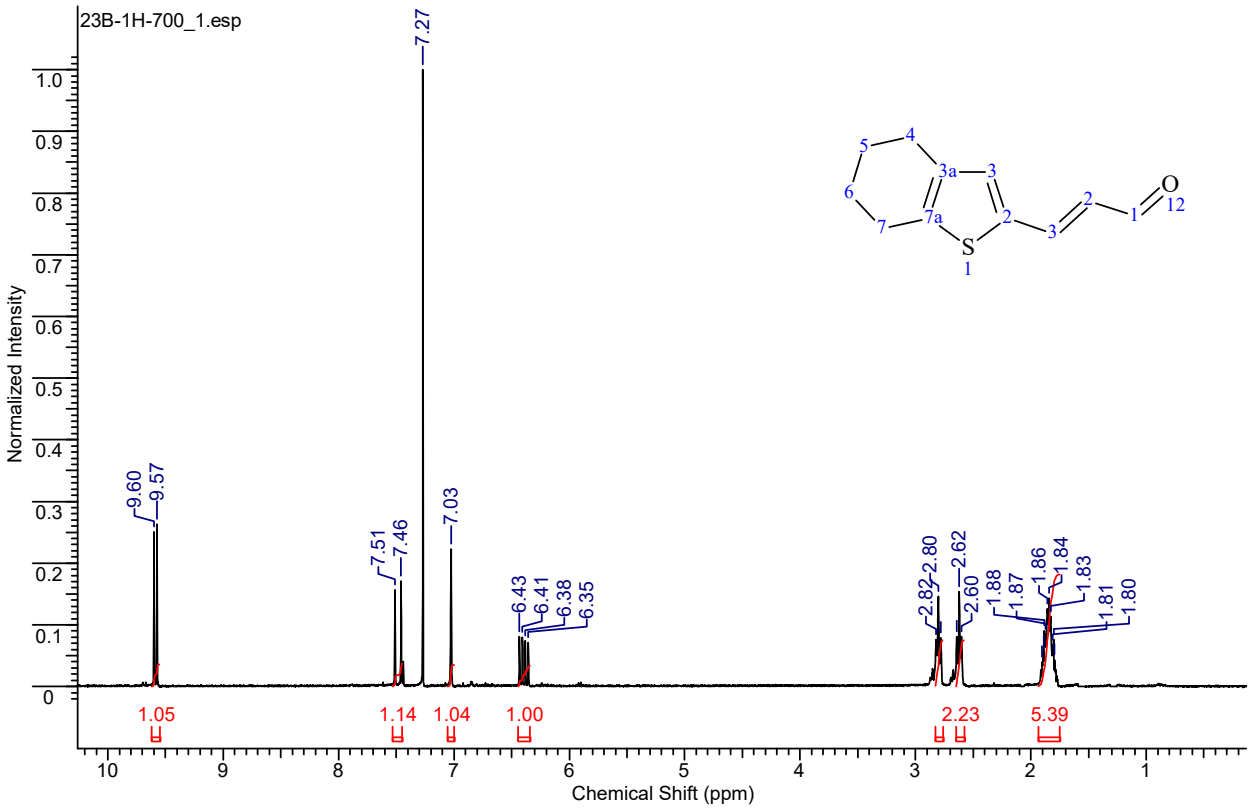


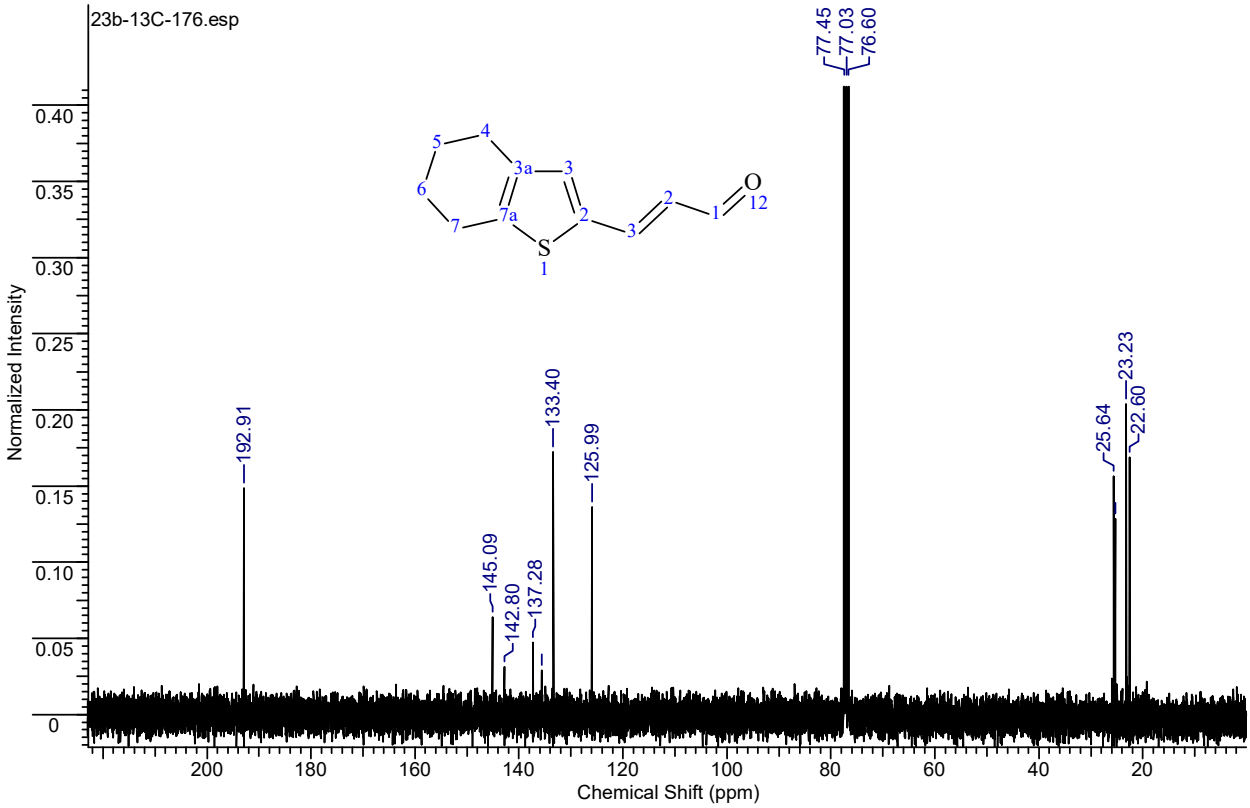
(*E*)-3-(5,6-Dihydro-4H-cyclopenta[*b*]thiophen-2-yl)acrylaldehyde (23a).



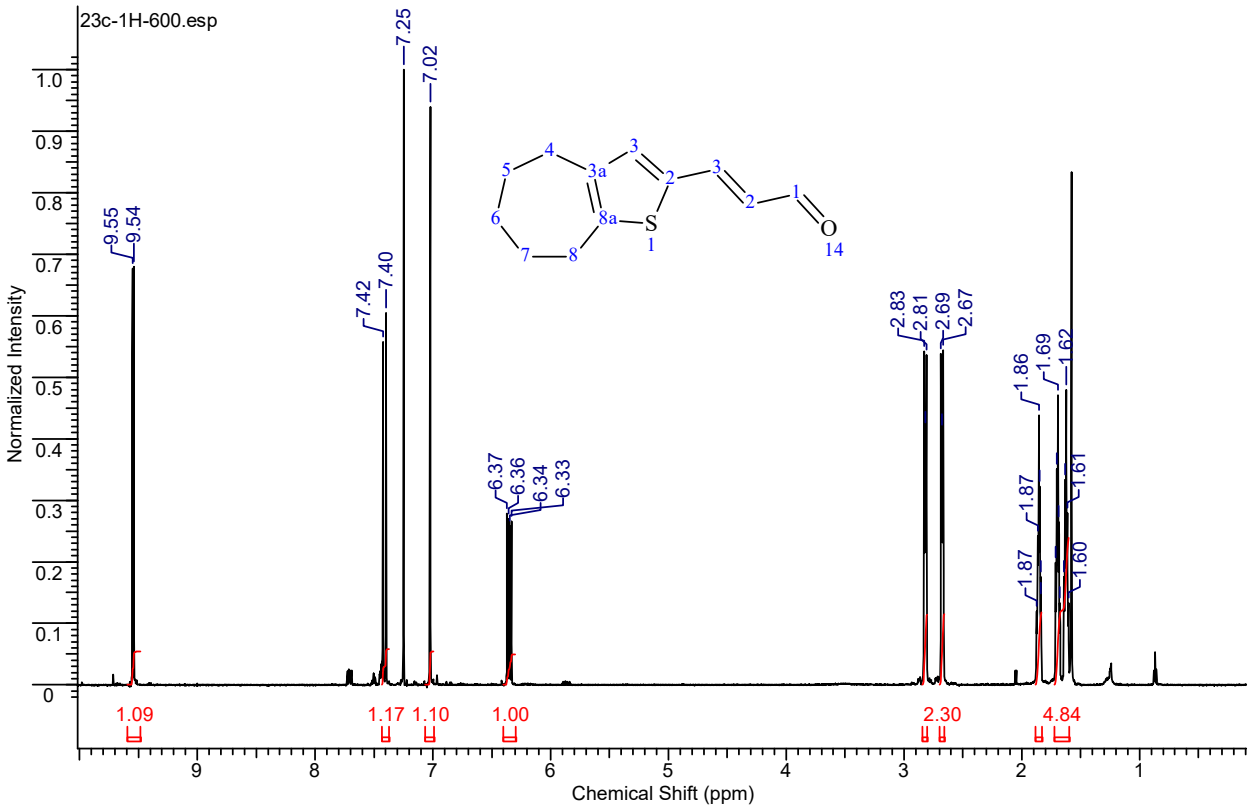


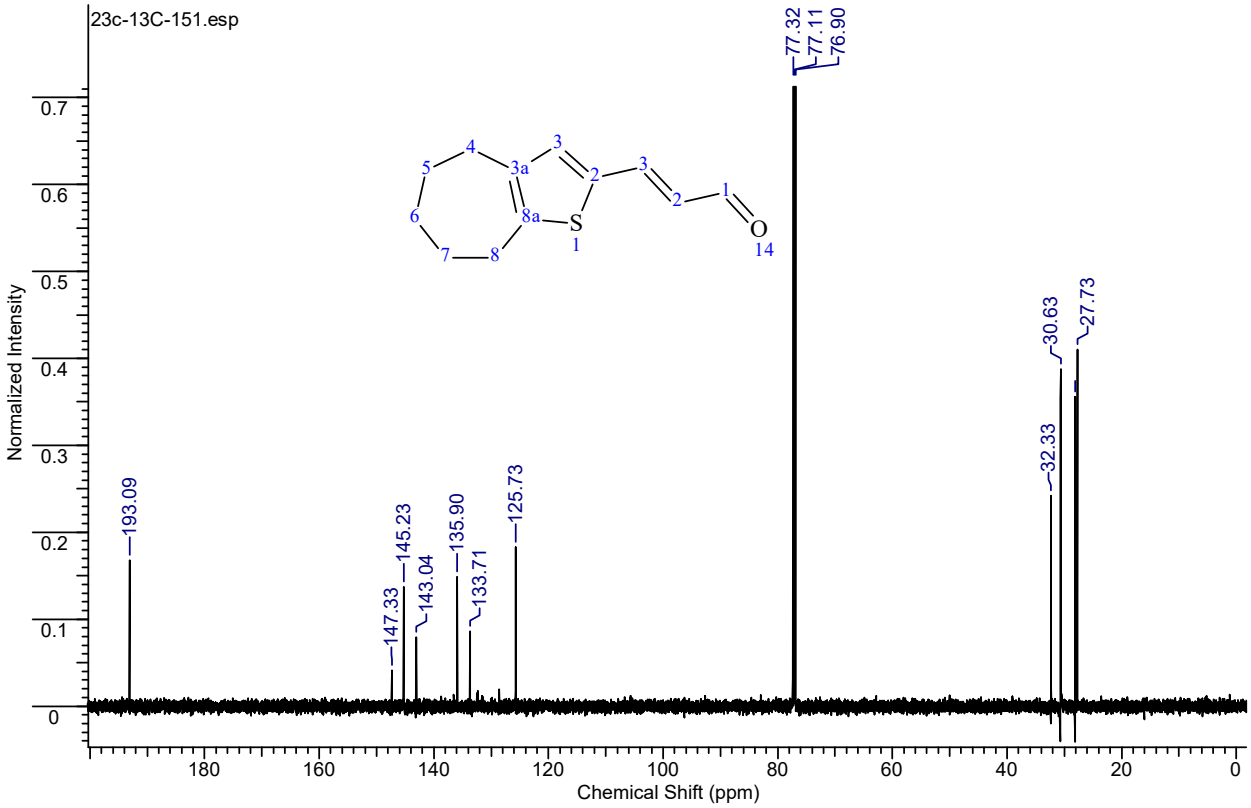
(*E*)-3-(4,5,6,7-Tetrahydrobenzo[*b*]thiophen-2-yl)acrylaldehyde (23b).



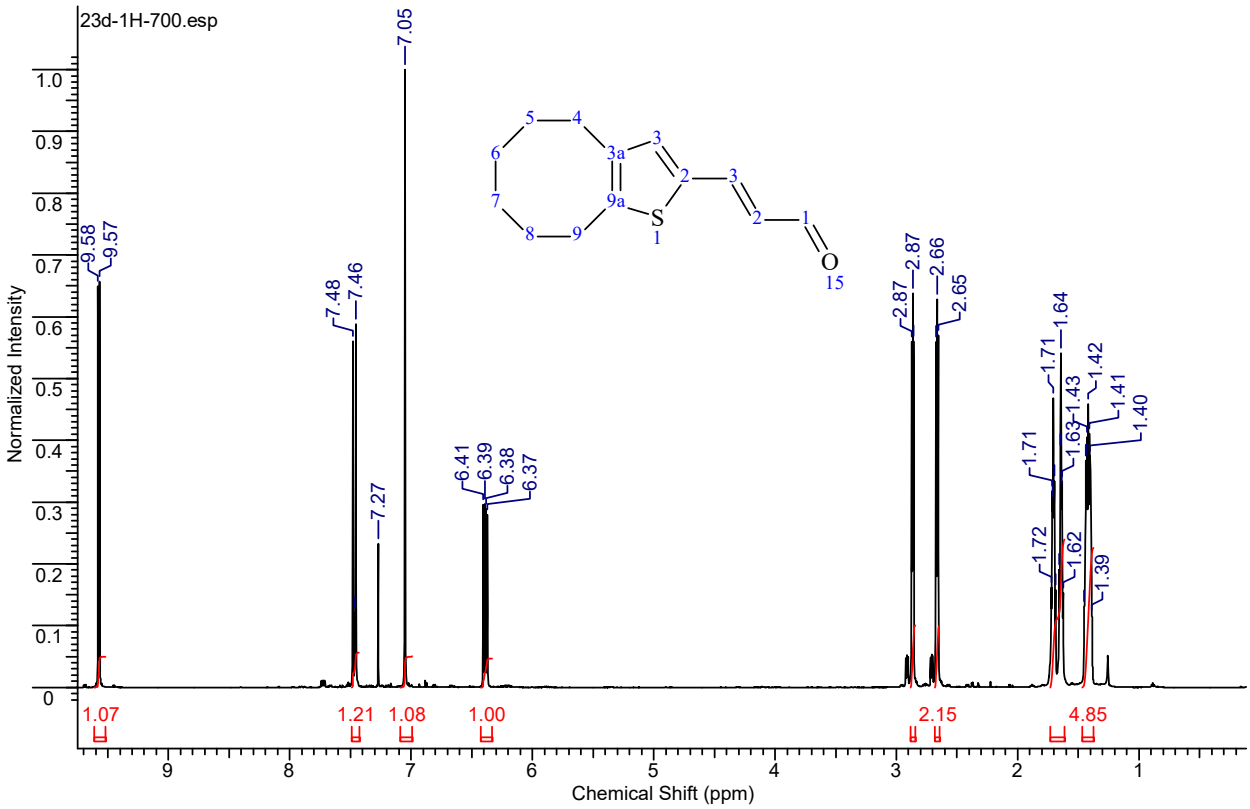


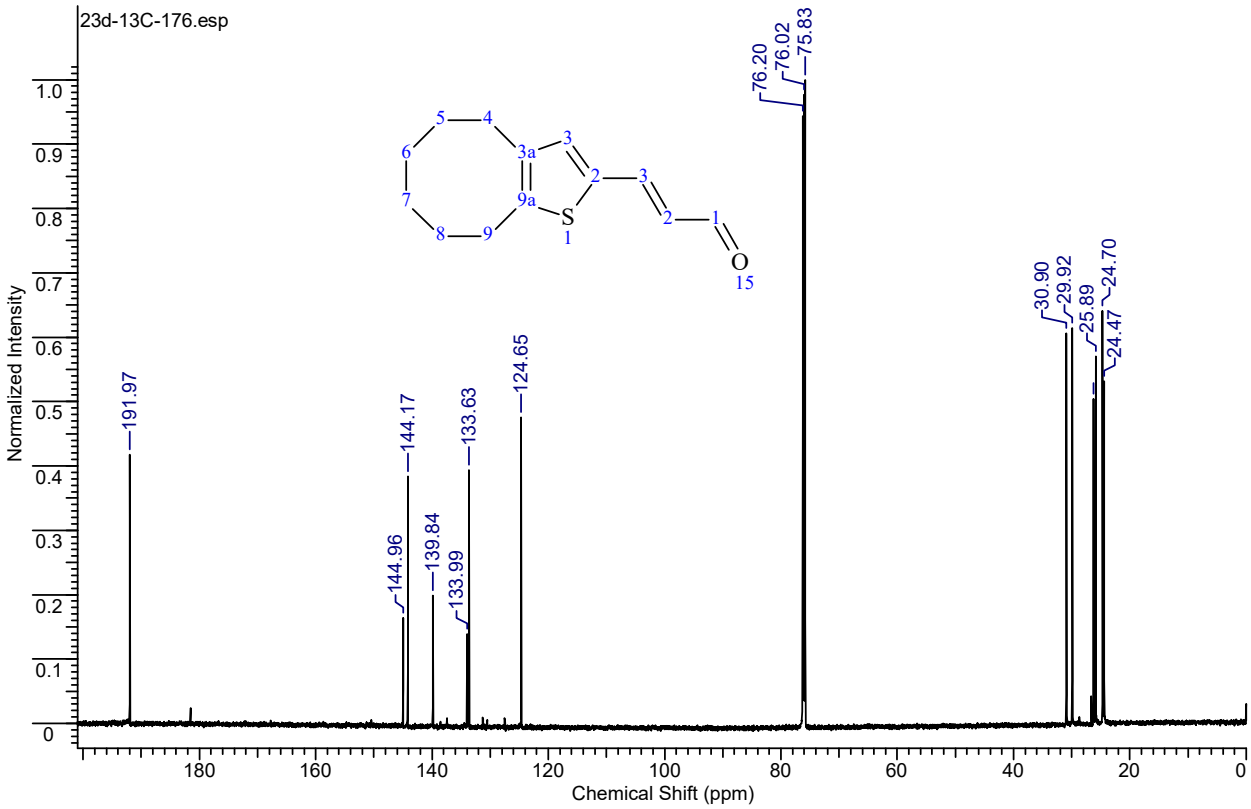
(*E*)-3-(5,6,7,8-Tetrahydro-4*H*-cyclohepta[*b*]thiophen-2-yl)acrylaldehyde (23c).



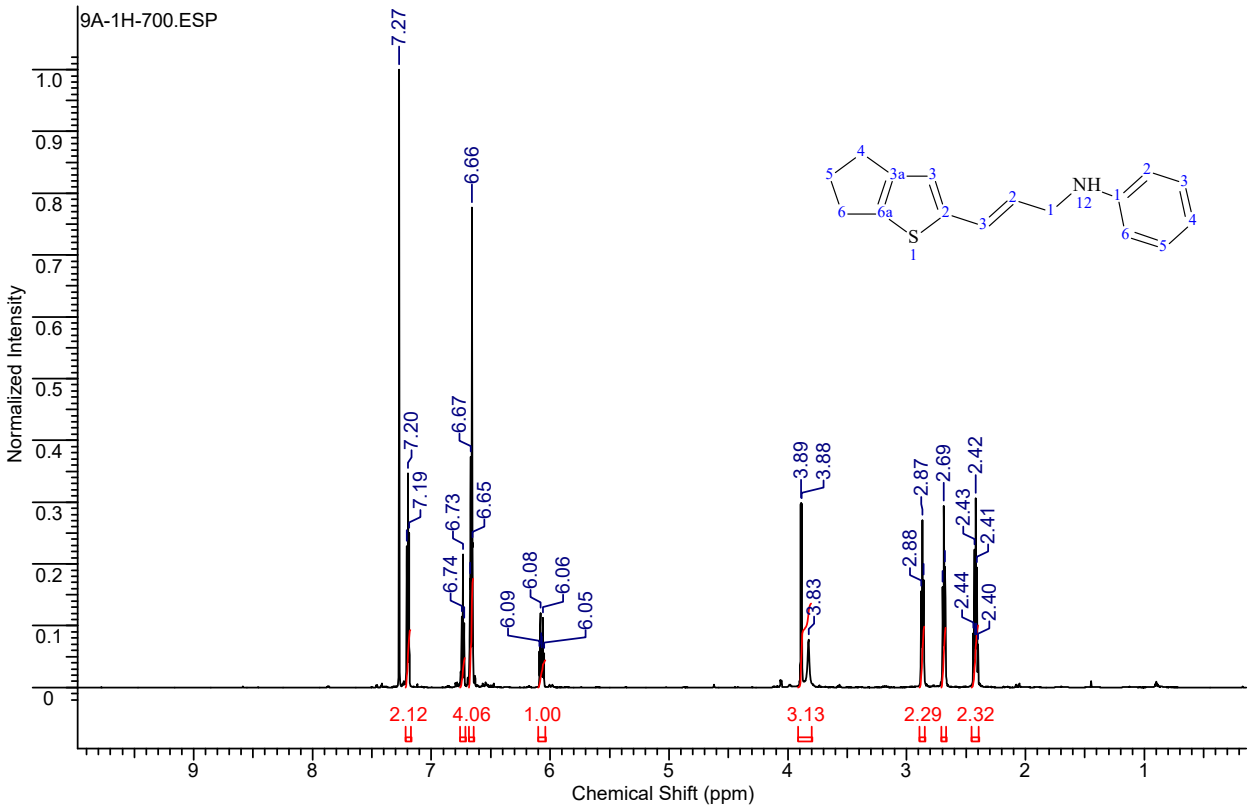


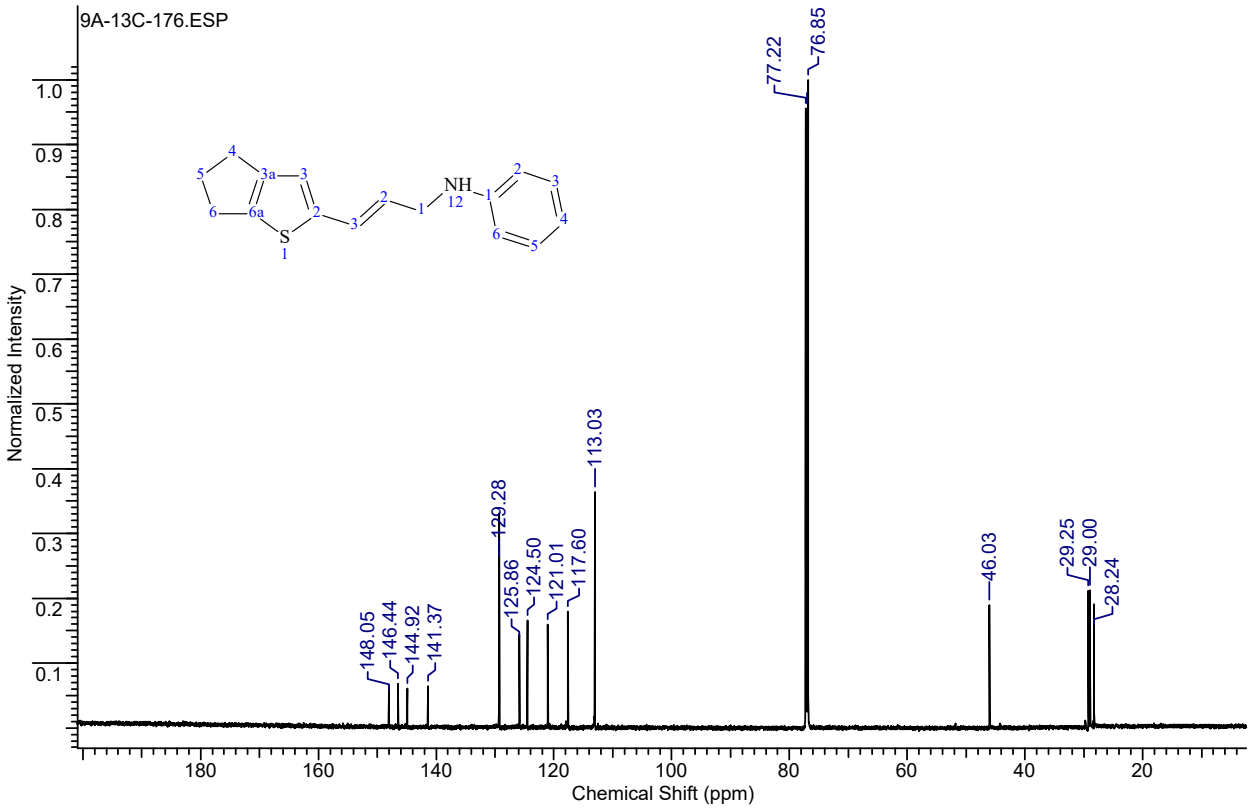
(*E*)-3-(4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophen-2-yl)acrylaldehyde (23d).



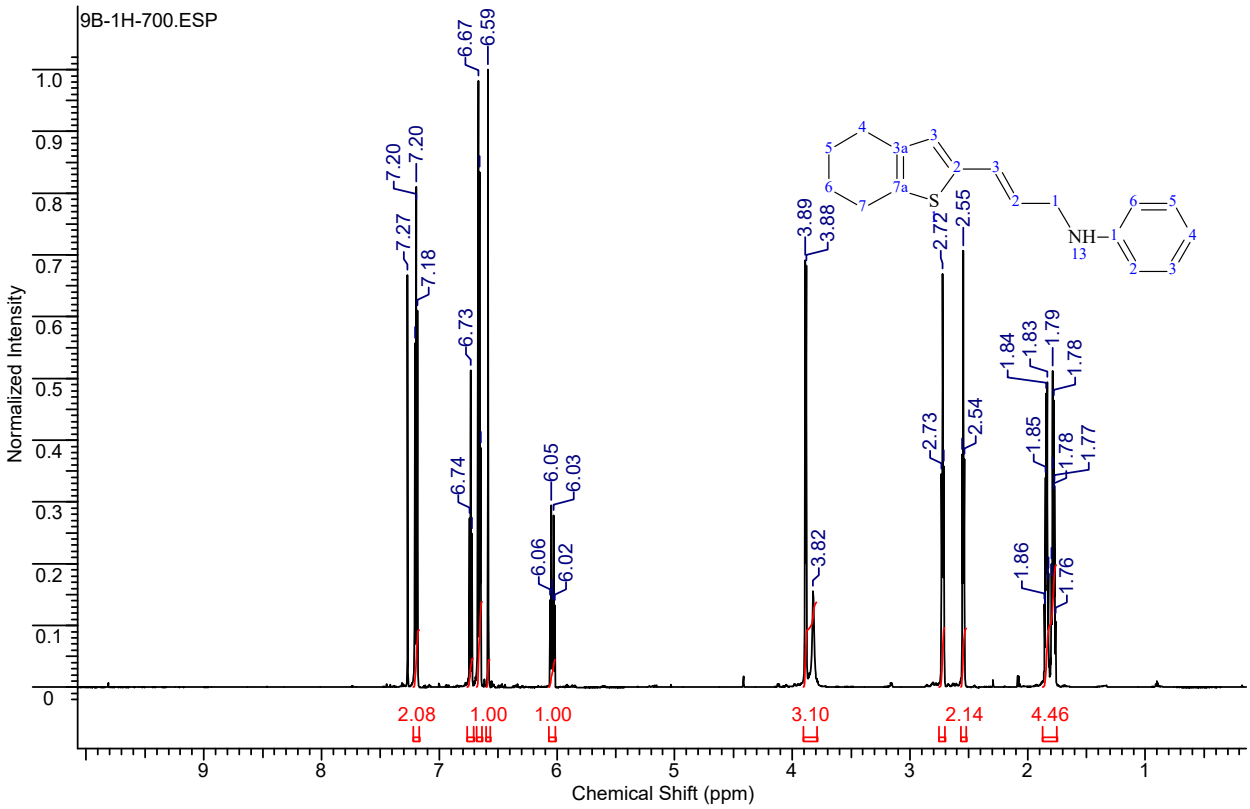


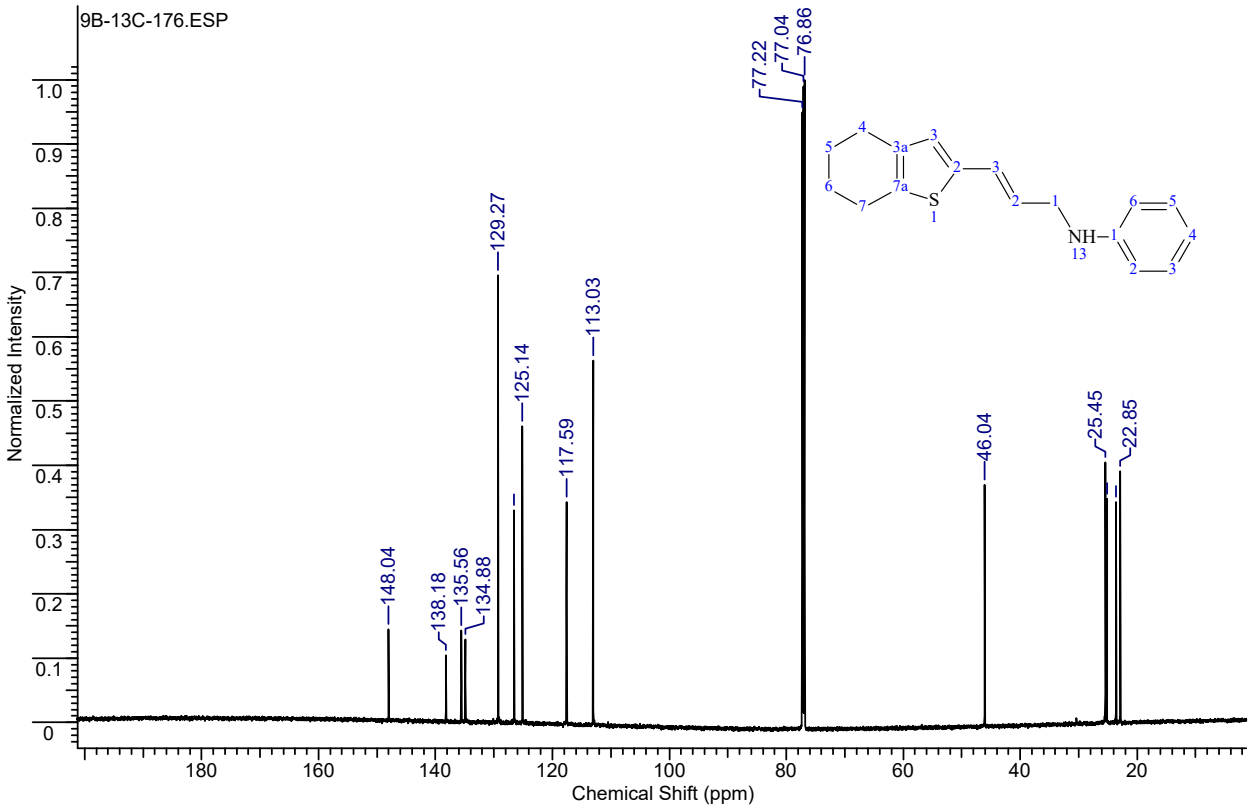
(*E*)-*N*-(3-(5,6-Dihydro-4H-cyclopenta[*b*]thiophen-2-yl)allyl)aniline (9a).



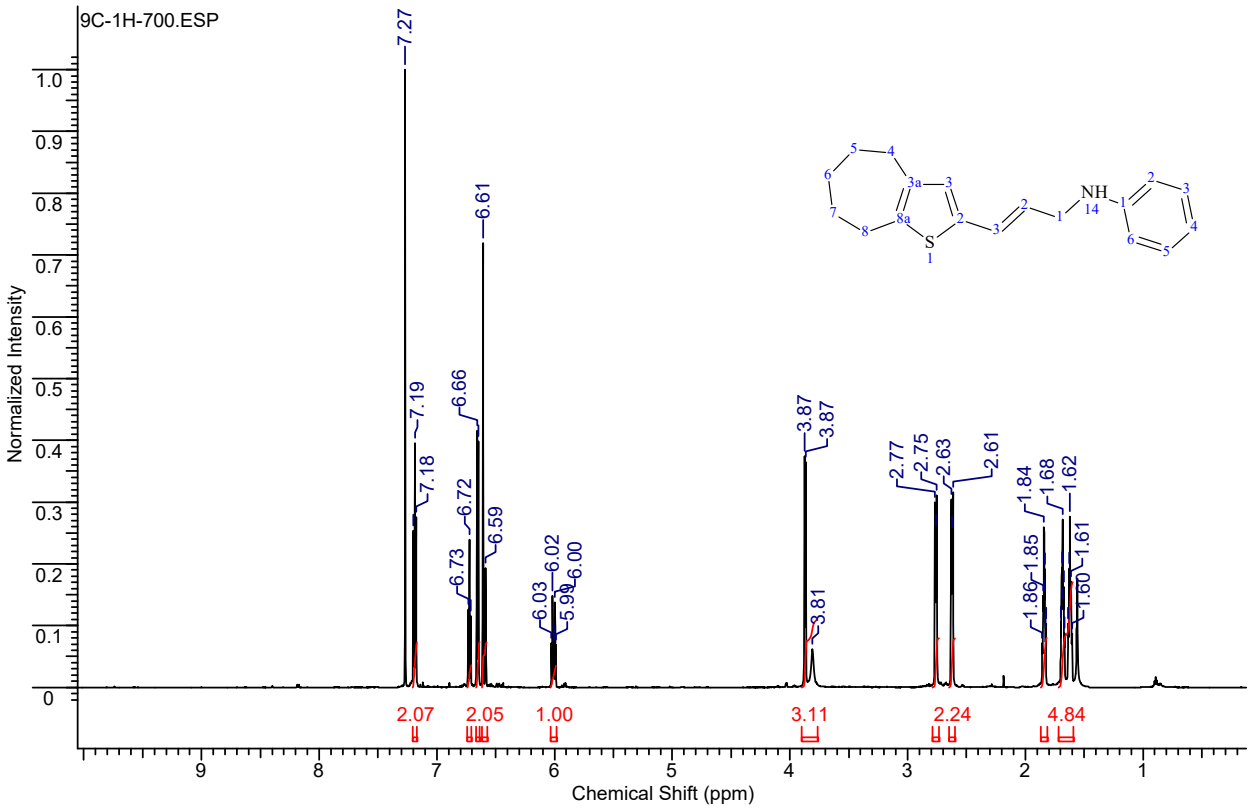


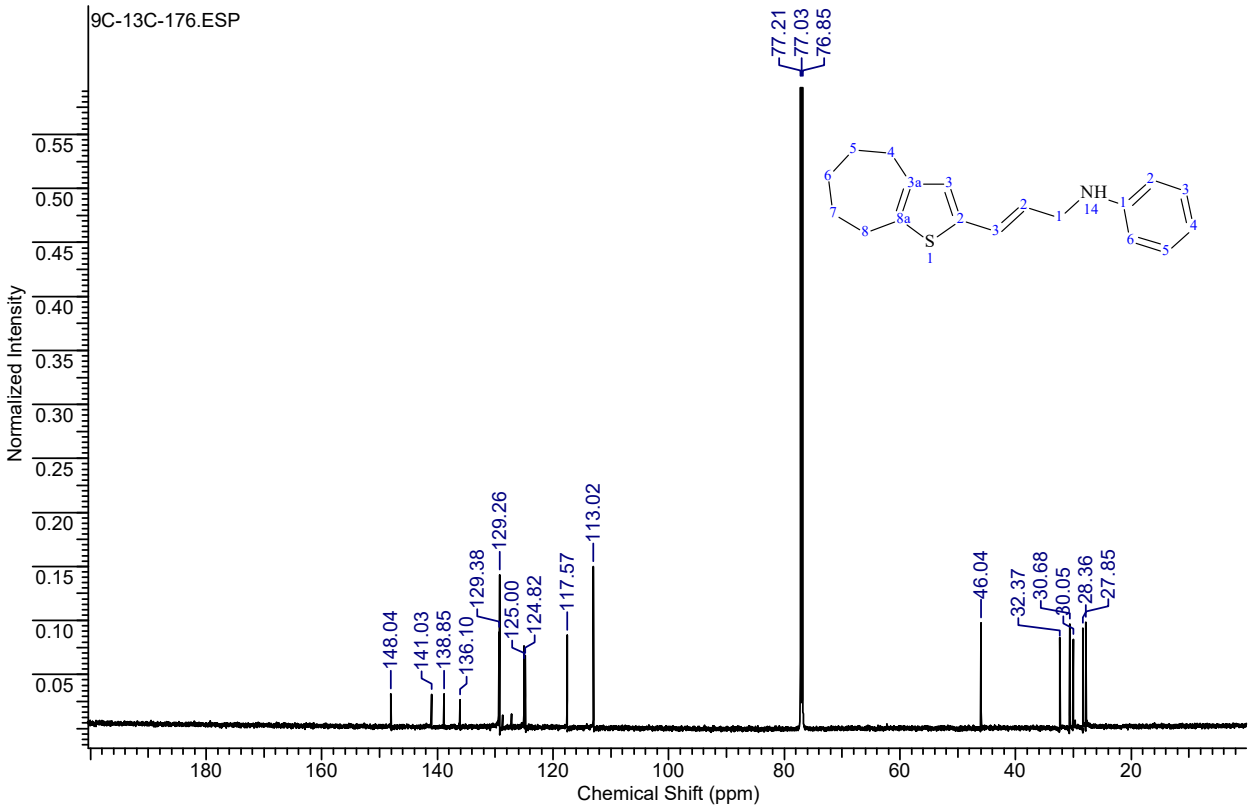
(*E*)-*N*-(3-(4,5,6,7-Tetrahydrobenzo[*b*]thiophen-2-yl)allyl)aniline (9b).



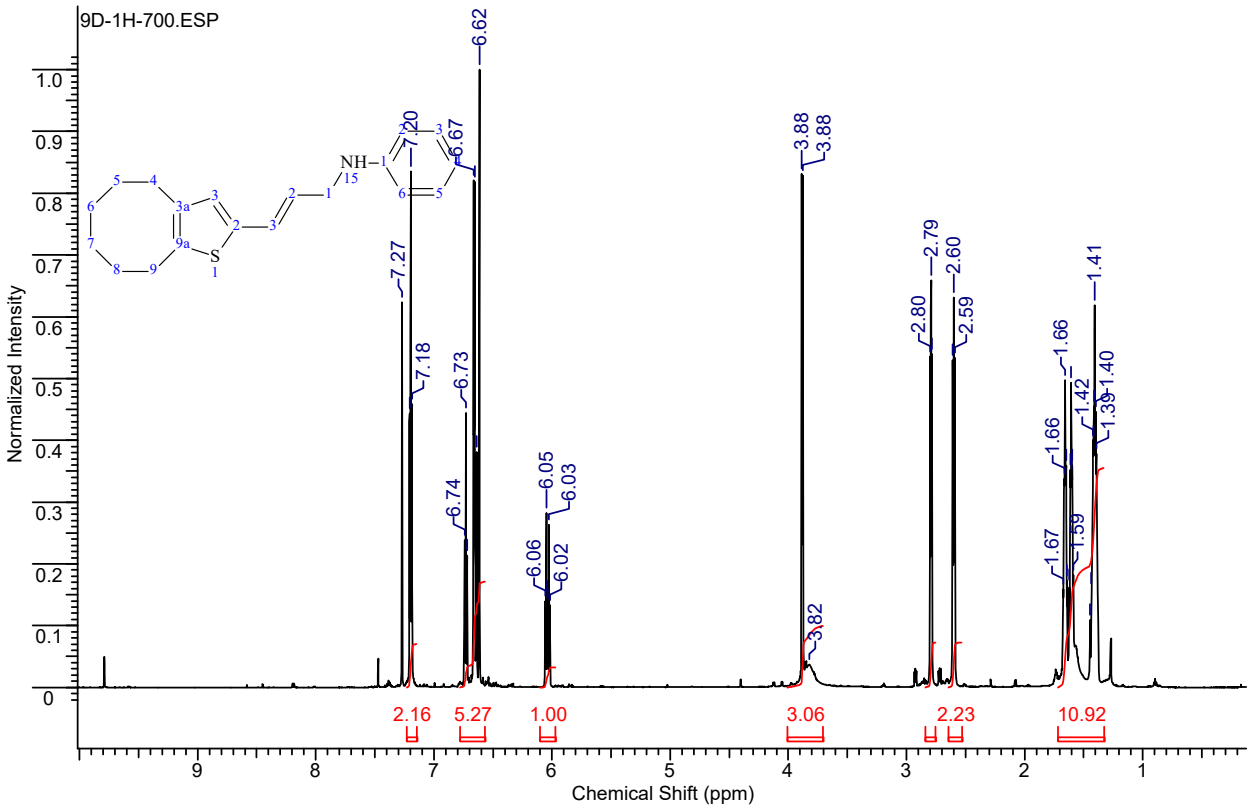


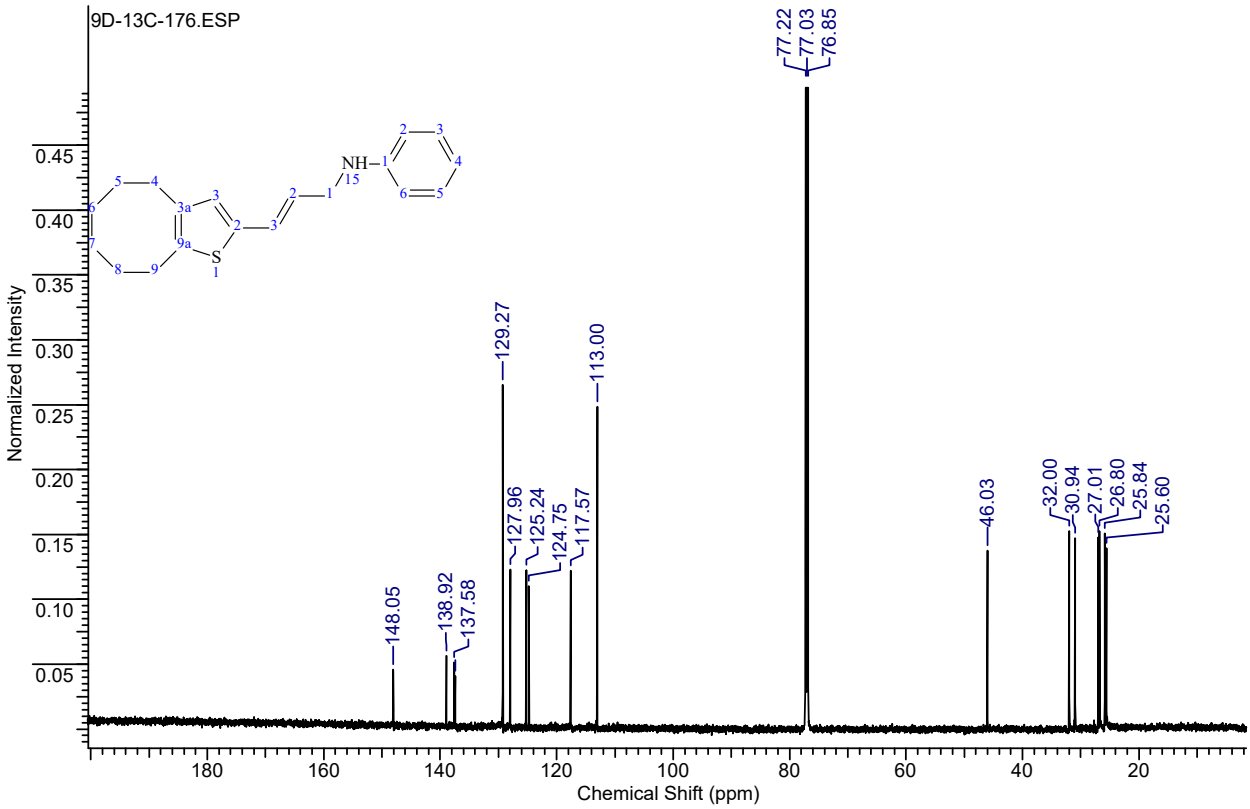
(*E*)-*N*-(3-(5,6,7,8-Tetrahydro-4*H*-cyclohepta[*b*]thiophen-2-yl)allyl)aniline (9c).



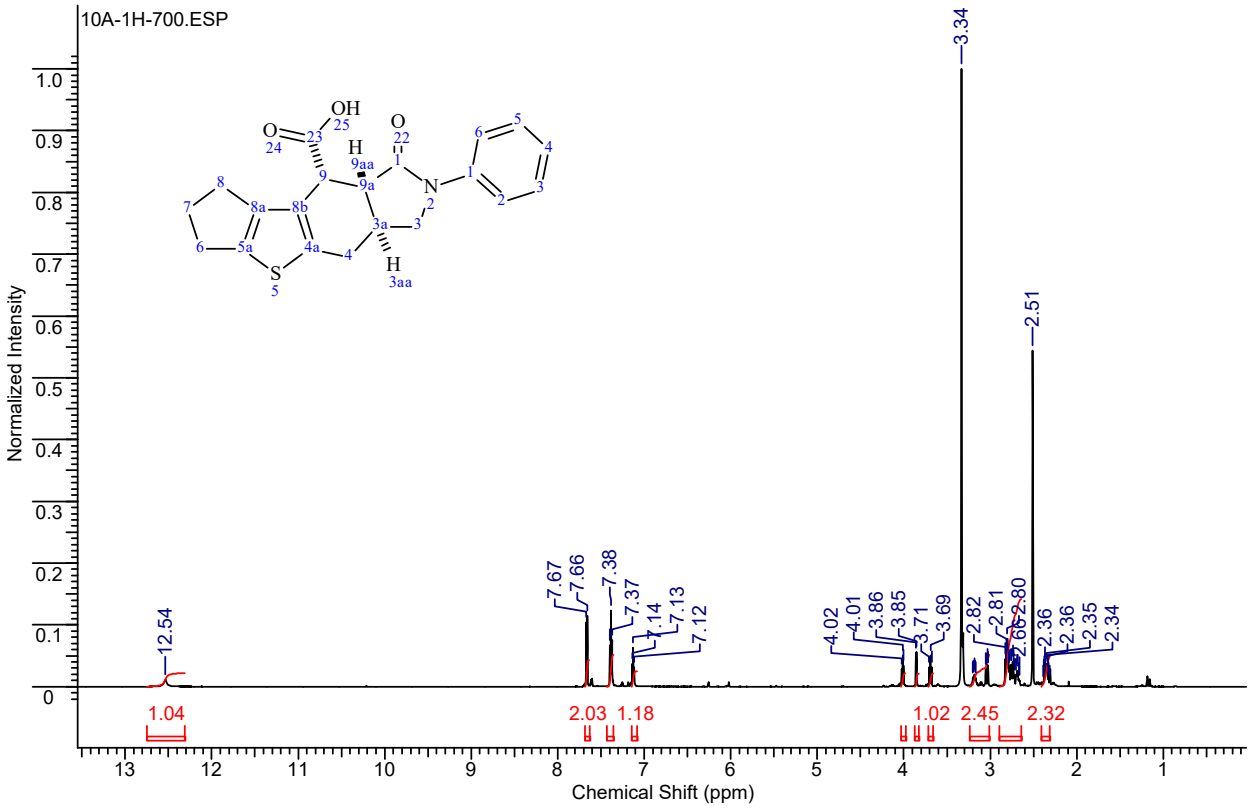


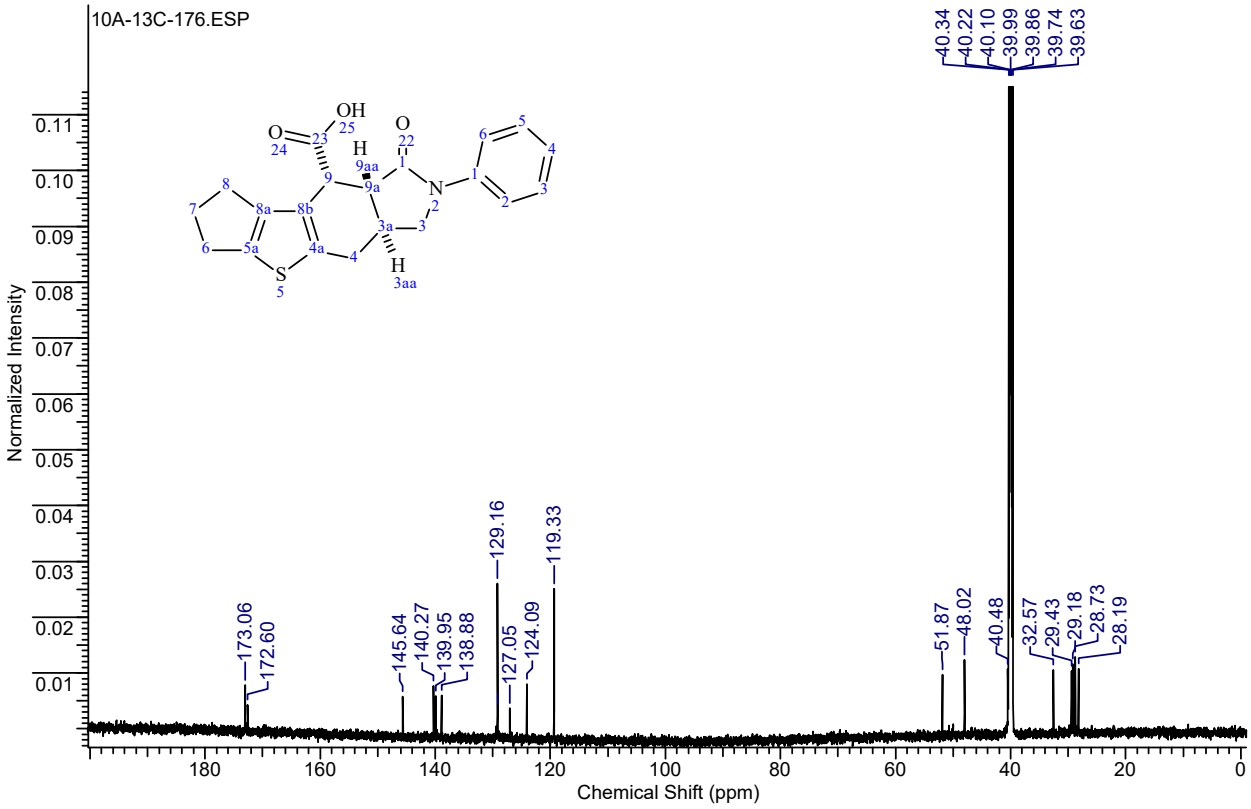
(*E*)-*N*-(3-(4,5,6,7,8,9-Hexahydrocycloocta[*b*]thiophen-2-yl)allyl)aniline (9d).



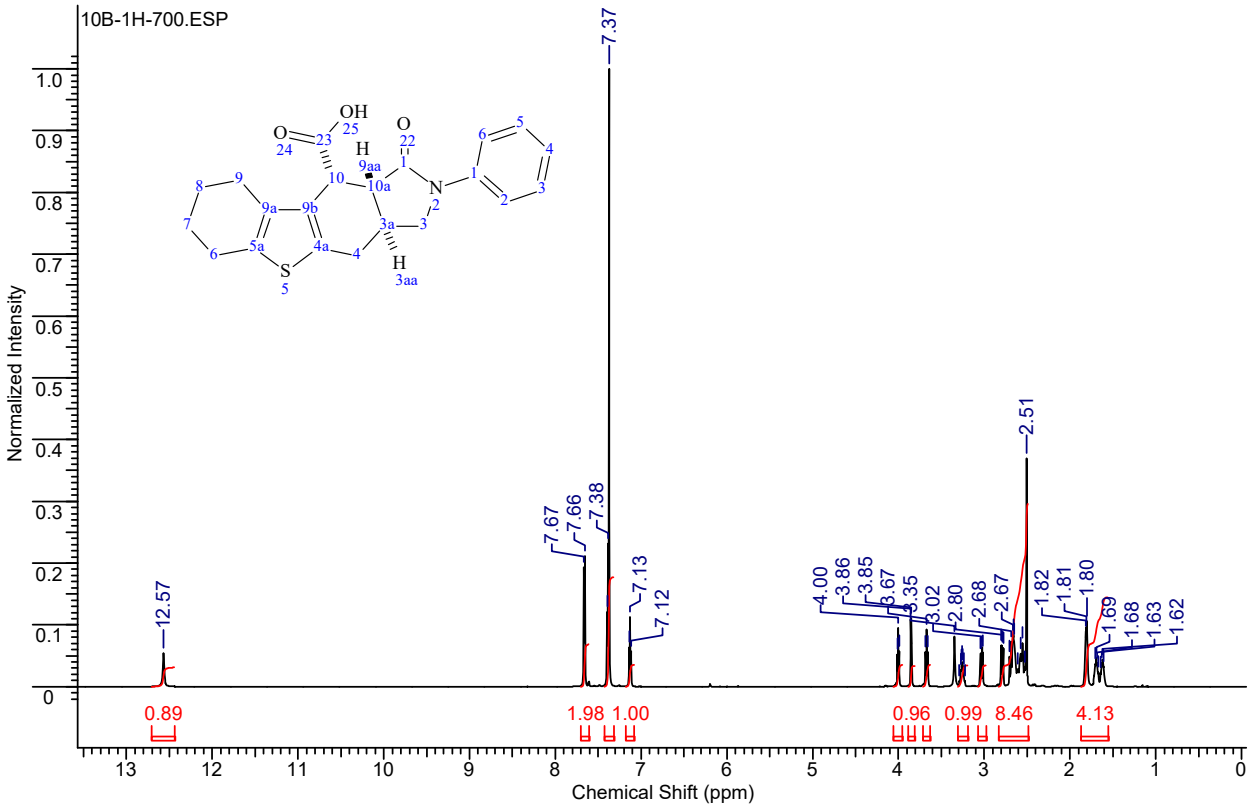


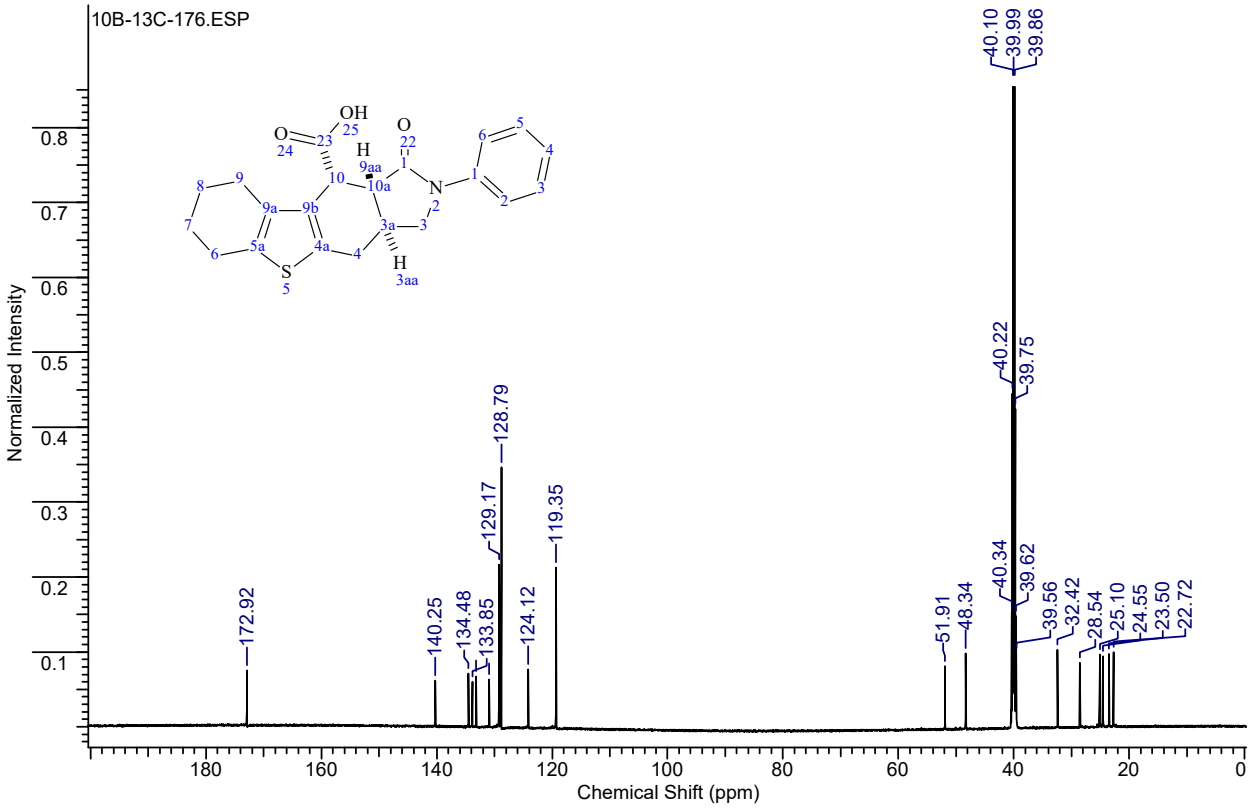
(3a*SR*,9*RS*,9a*RS*)-1-Oxo-2-phenyl-1,2,3,3a,4,6,7,8,9,9a-decahydrocyclopenta[4,5]thieno[2,3-*f*]isoindole-9-carboxylic acid (10a).



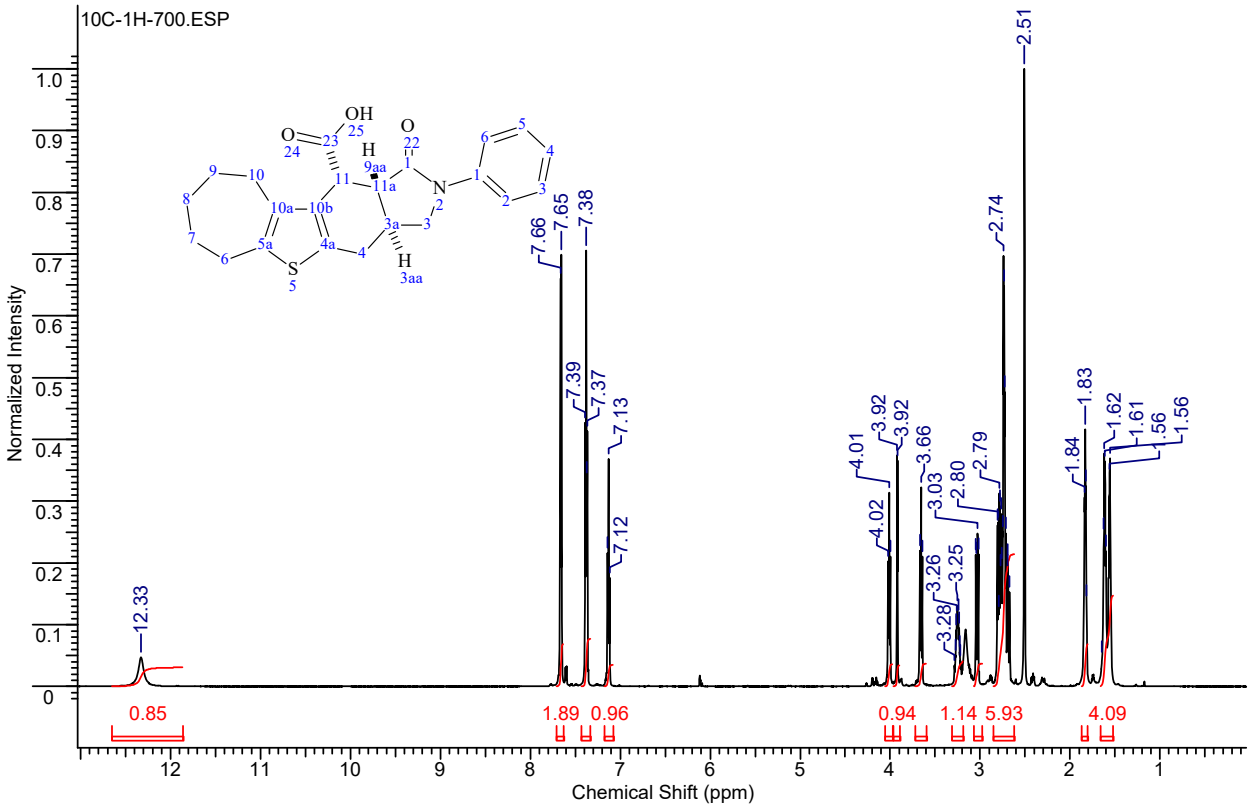


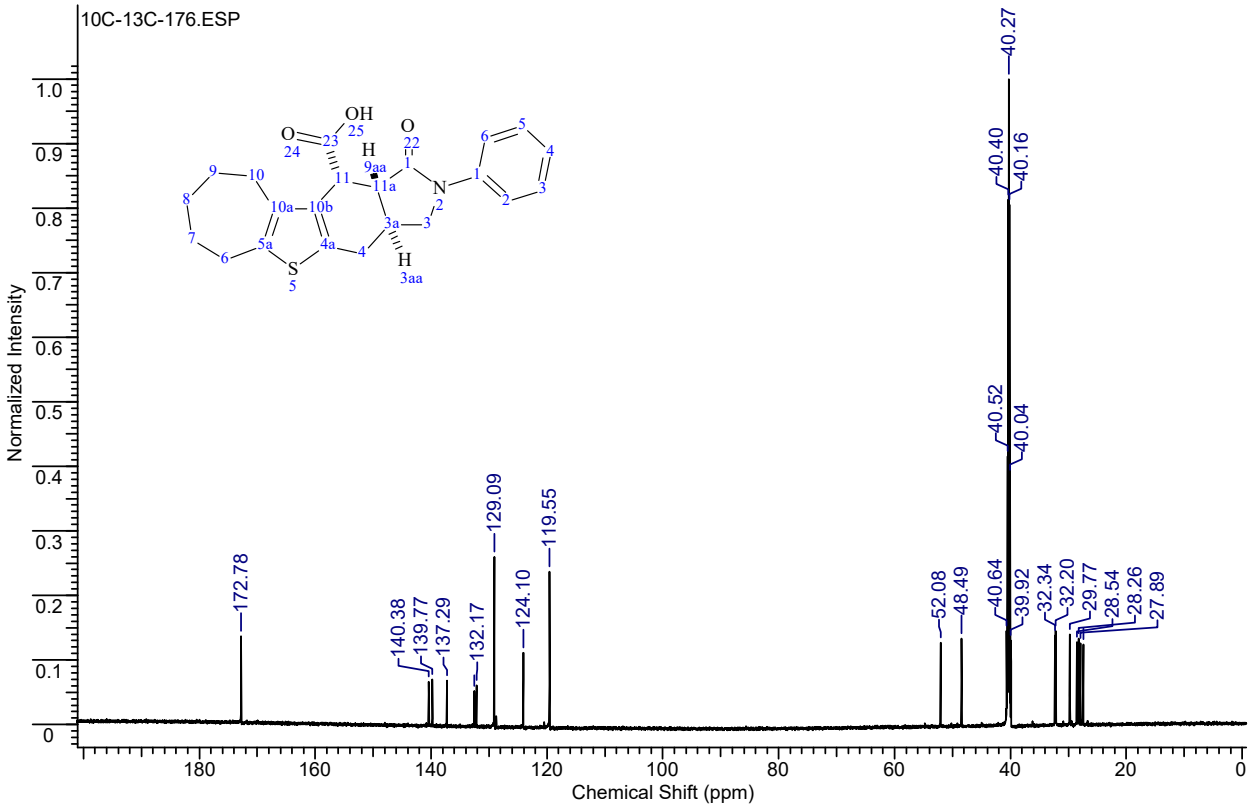
(3a*SR*,10*RS*,10a*RS*)-1-Oxo-2-phenyl-2,3,3a,4,6,7,8,9,10,10a-decahydro-1*H*-benzo[4,5]thieno[2,3-*f*]isoindole-10-carboxylic acid (10b). *Contains an impurity of benzene*



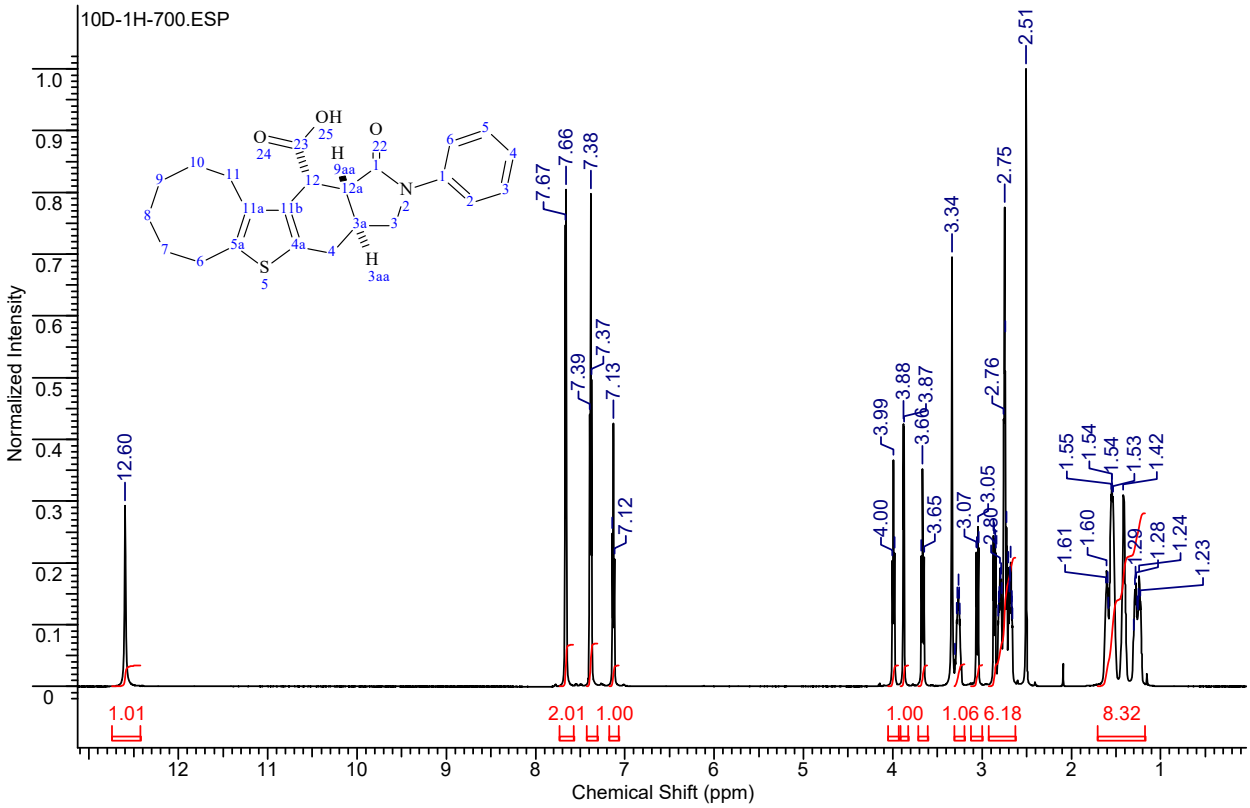


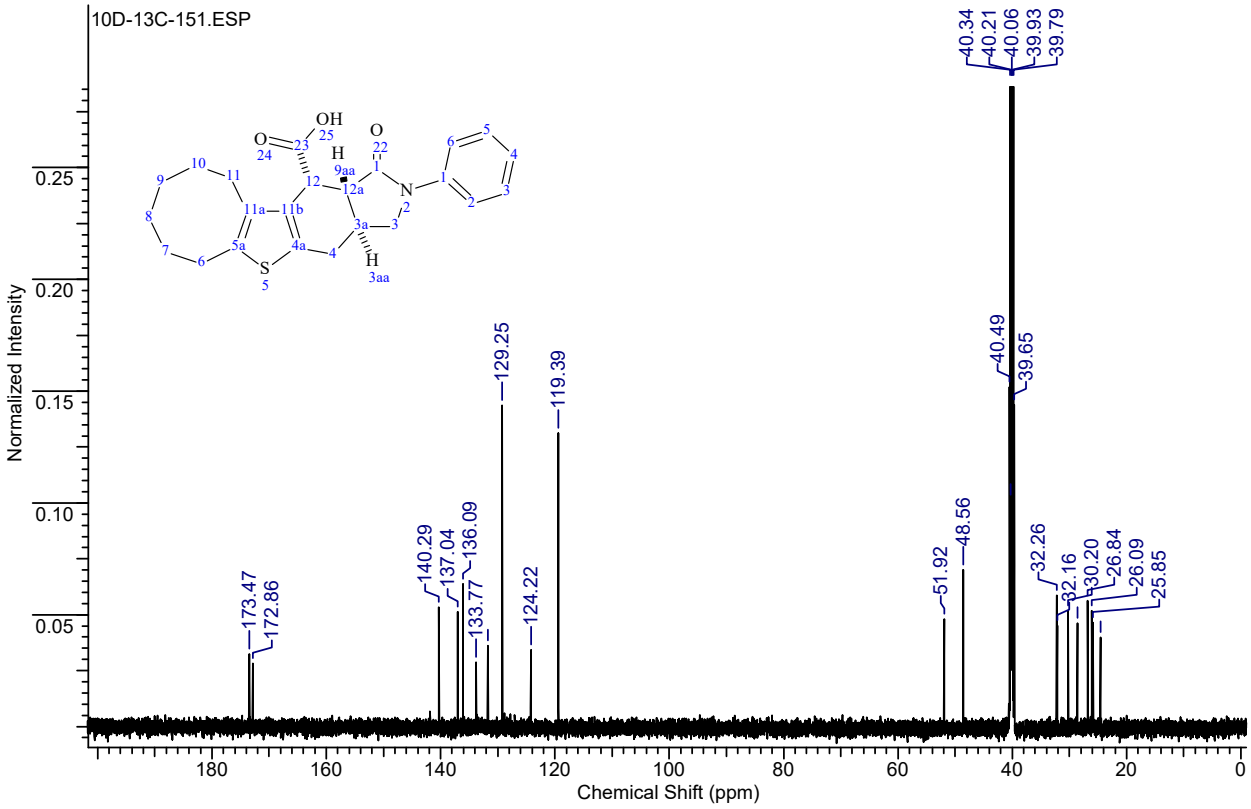
(3a*RS*,11*SR*,11a*SR*)-1-Oxo-2-phenyl-1,2,3,3a,4,6,7,8,9,10,11,11a-dodecahydrocyclohepta[4,5]thieno[2,3-*f*]isoindole-11-carboxylic acid (10c).



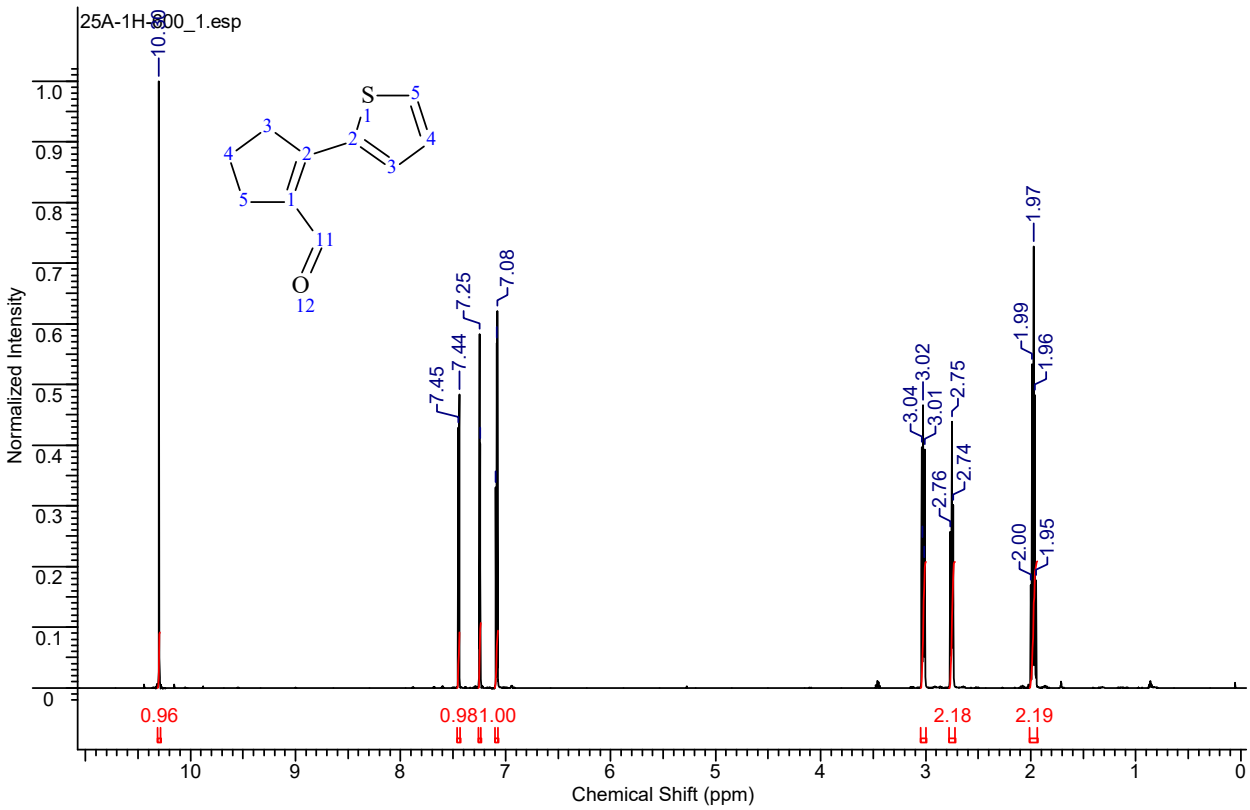


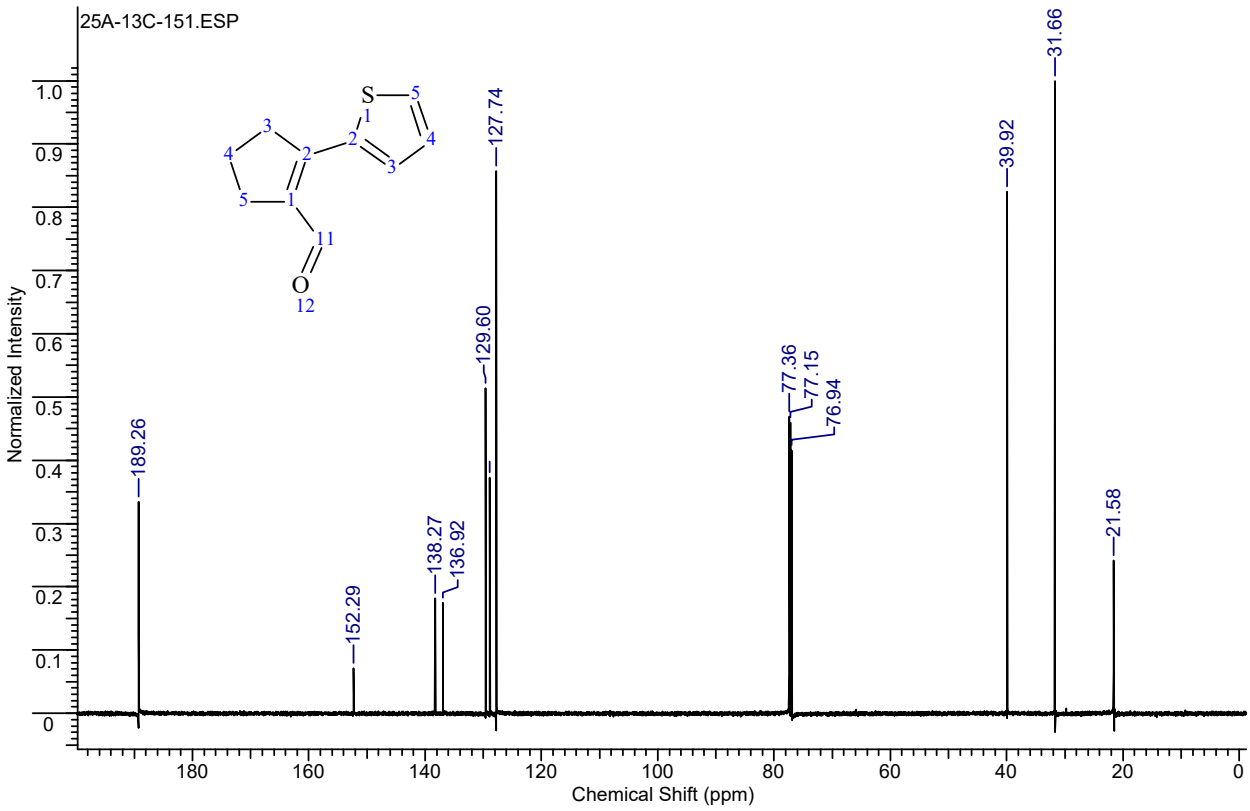
(3a*SR*,12*RS*,12a*RS*)-1-Oxo-2-phenyl-2,3,3a,4,6,7,8,9,10,11,12,12a-dodecahydro-1*H*-cycloocta[4,5]thieno[2,3-*f*]isoindole-12-carboxylic acid (10d).



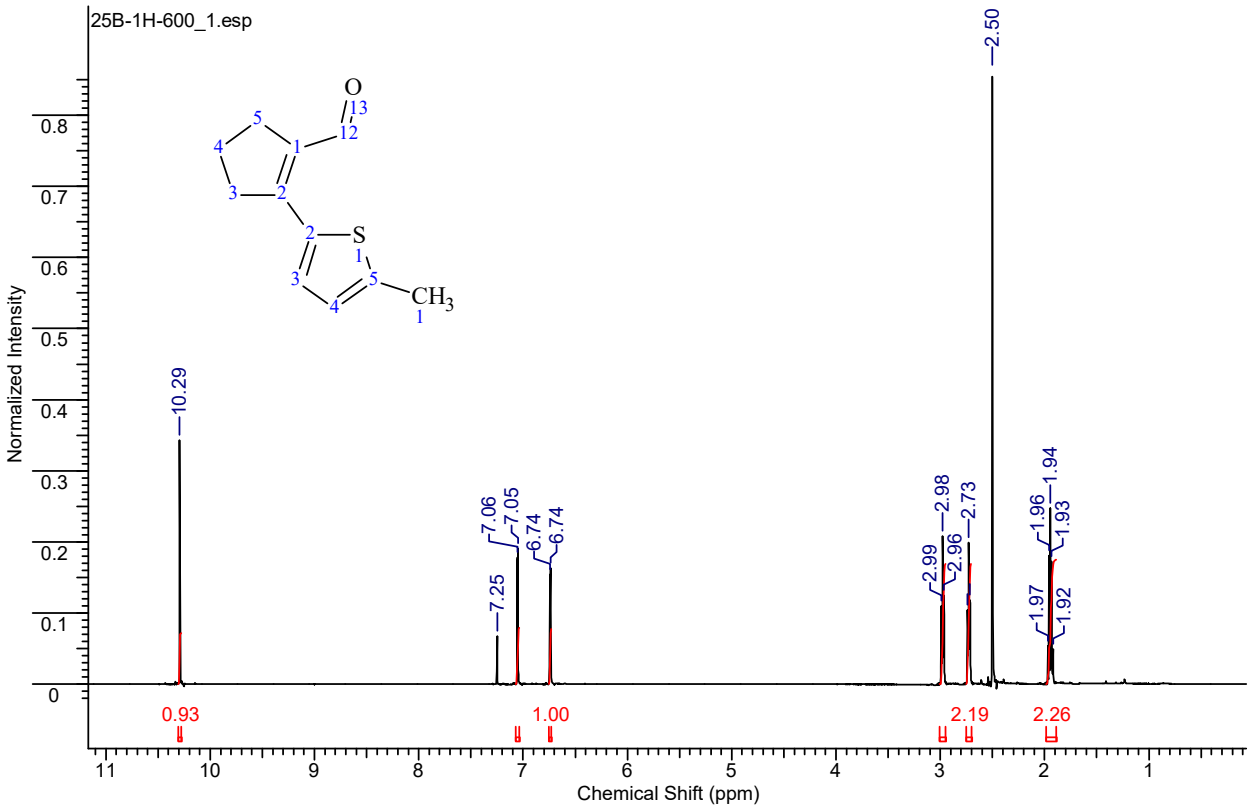


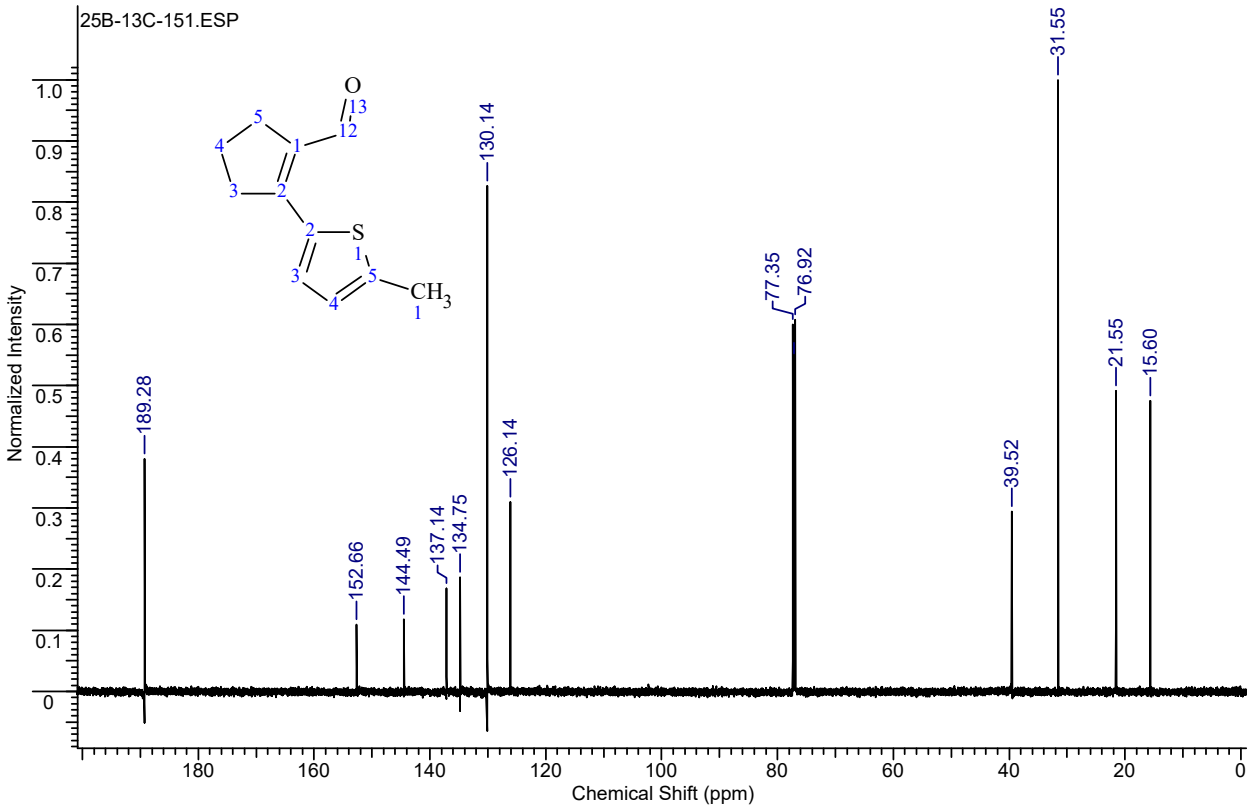
2-(Thiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25a).



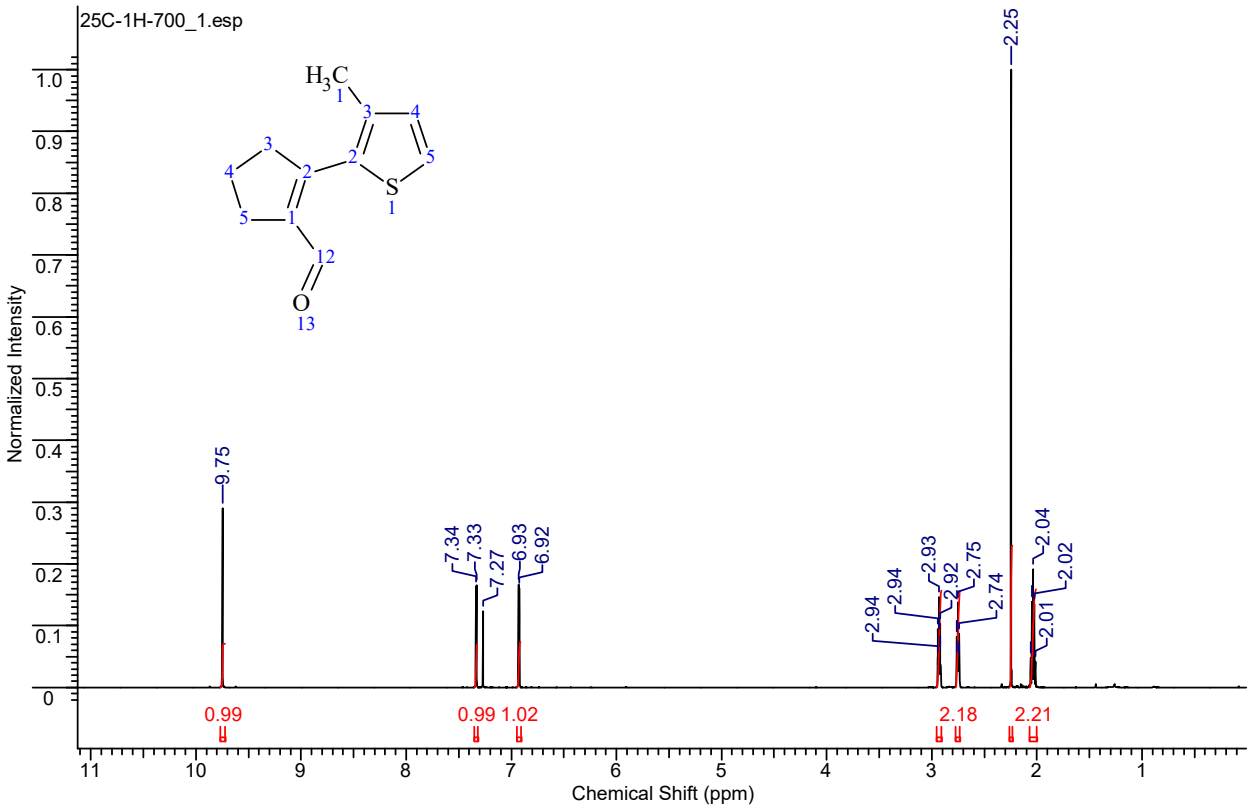


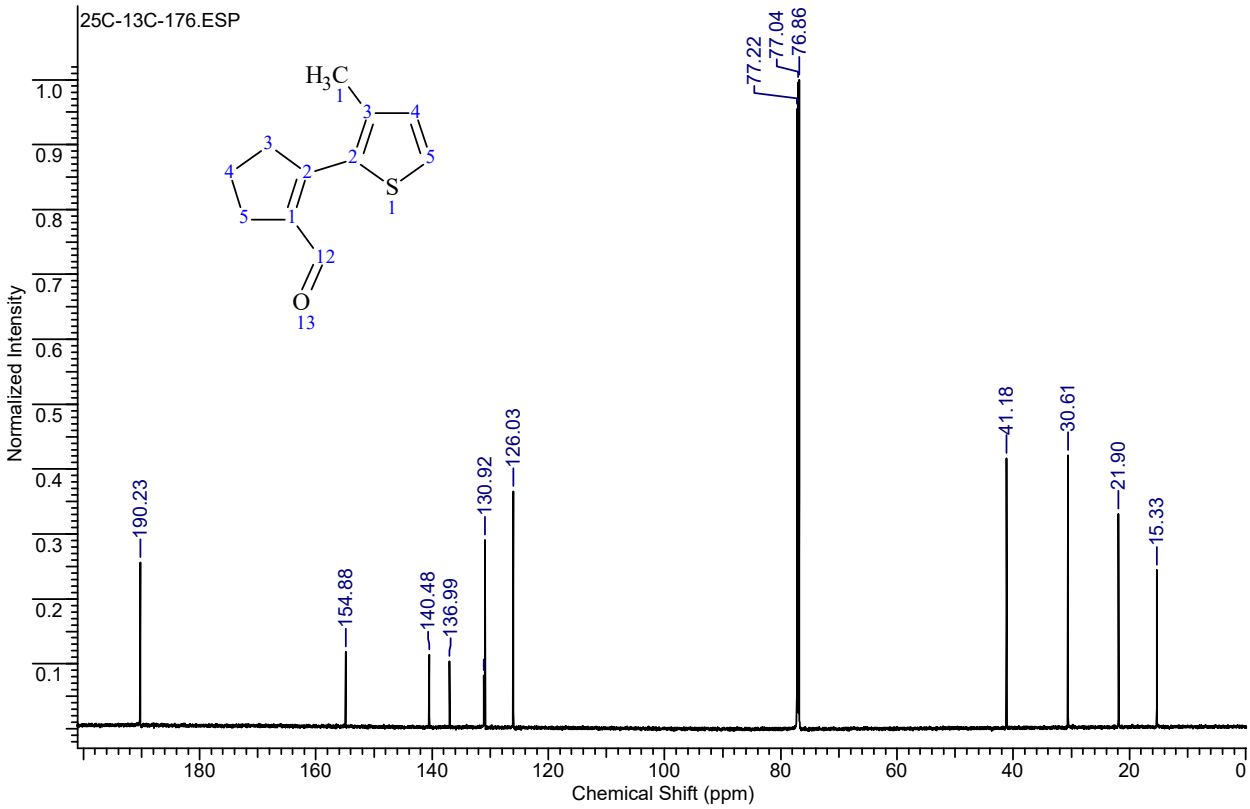
2-(5-Methylthiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25b).



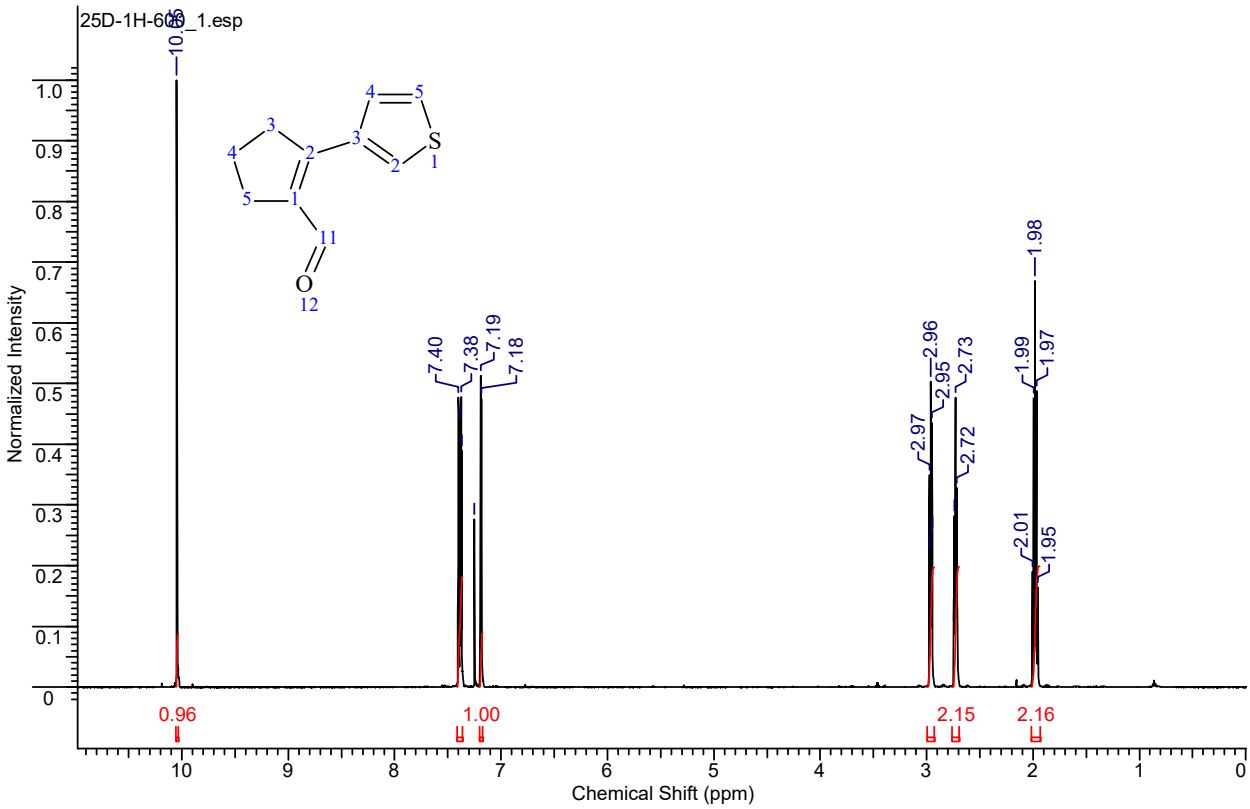


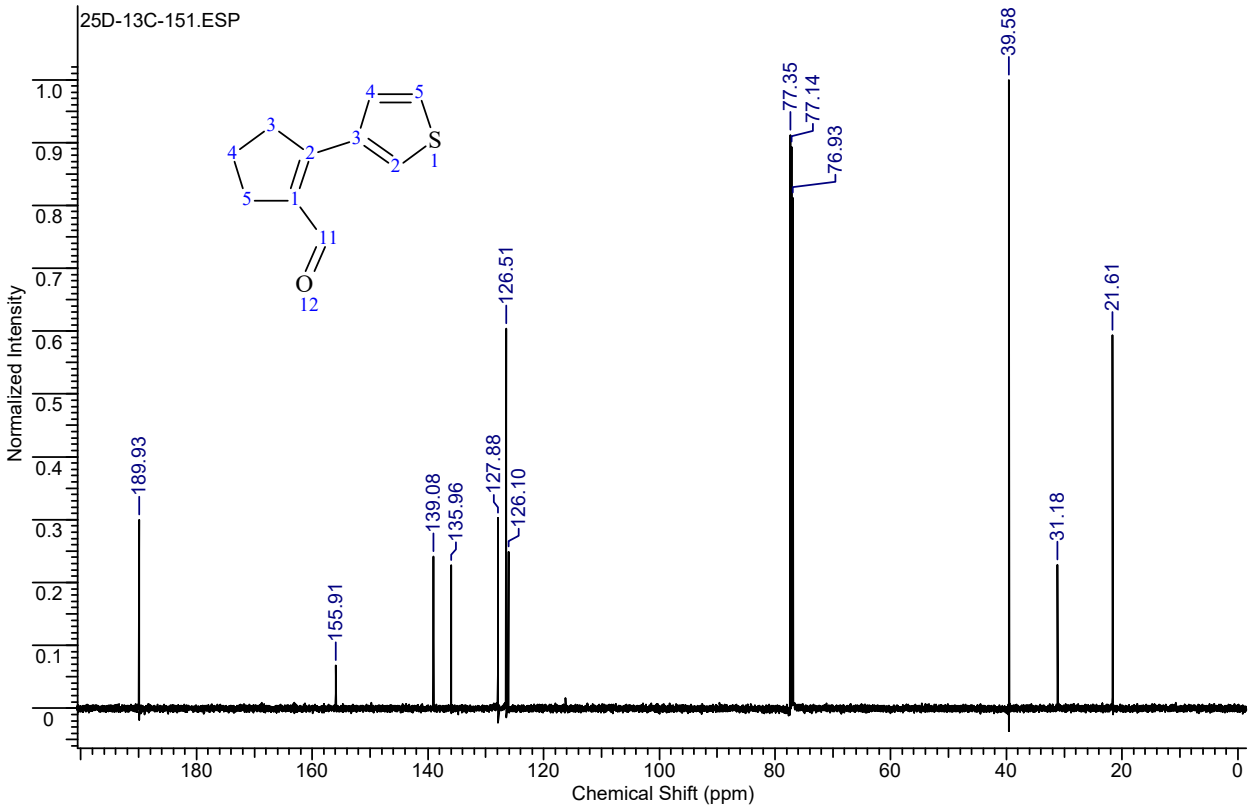
2-(3-Methylthiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25c).



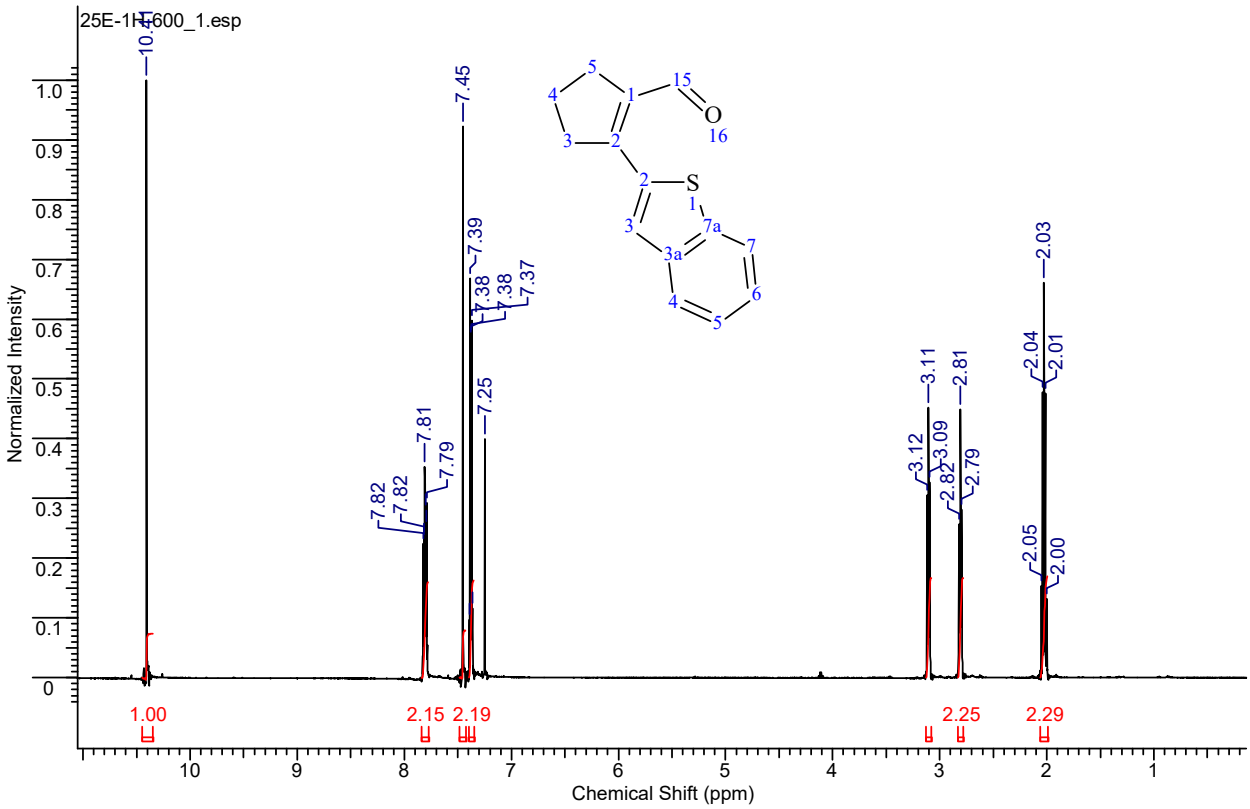


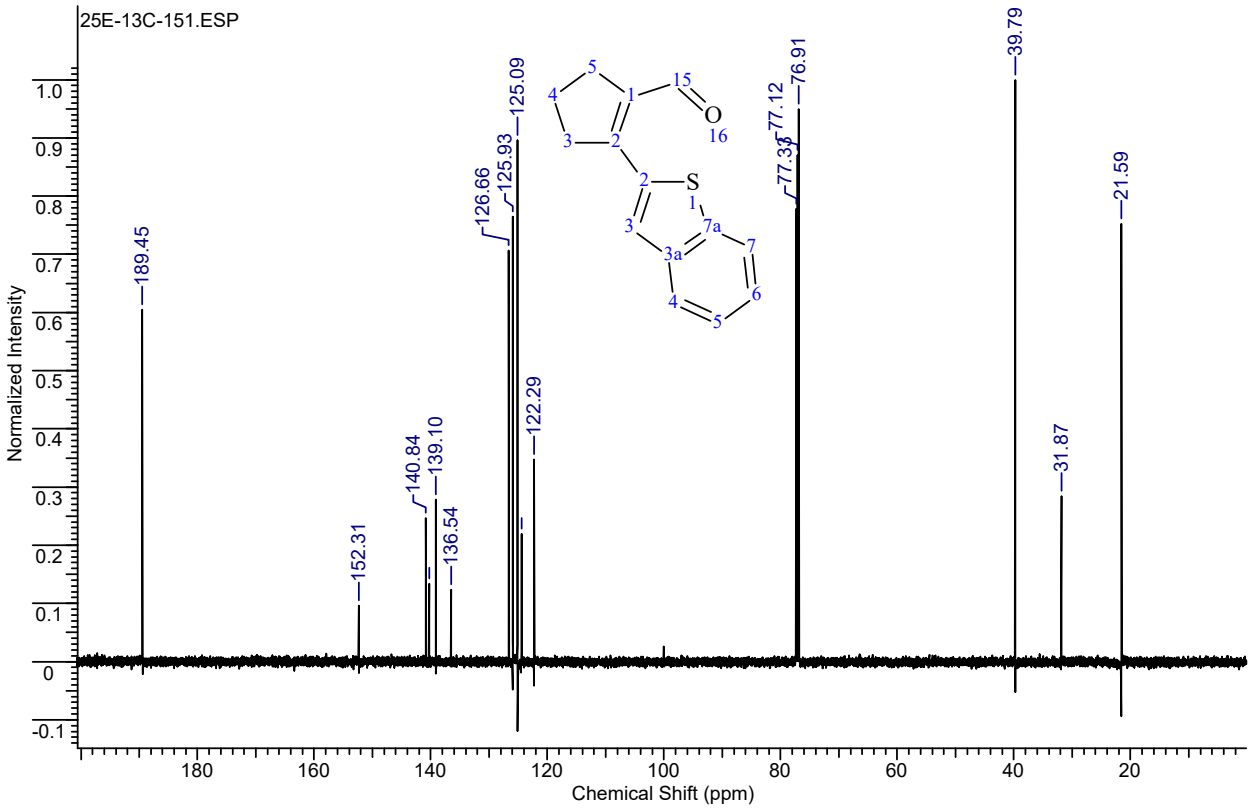
2-(Thiophen-3-yl)cyclopent-1-ene-1-carbaldehyde (25d).



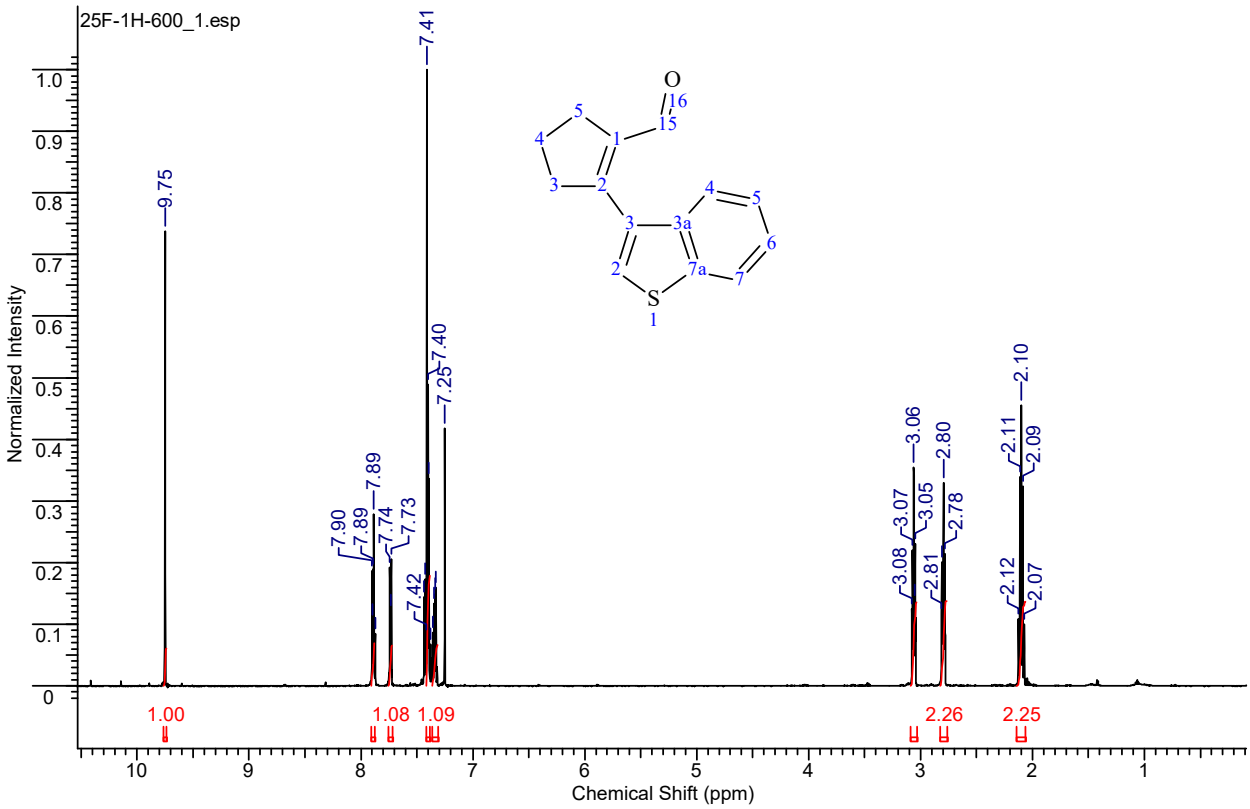


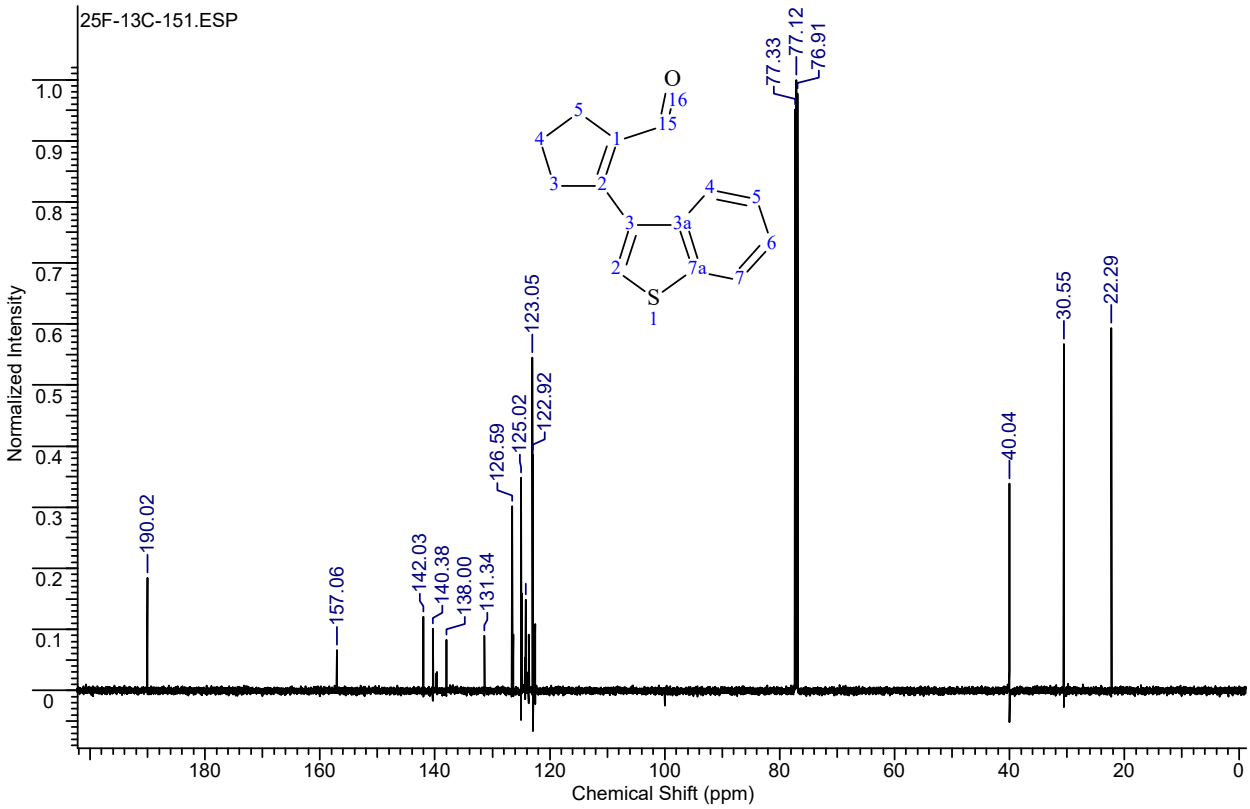
2-(Benzo[*b*]thiophen-2-yl)cyclopent-1-ene-1-carbaldehyde (25e).



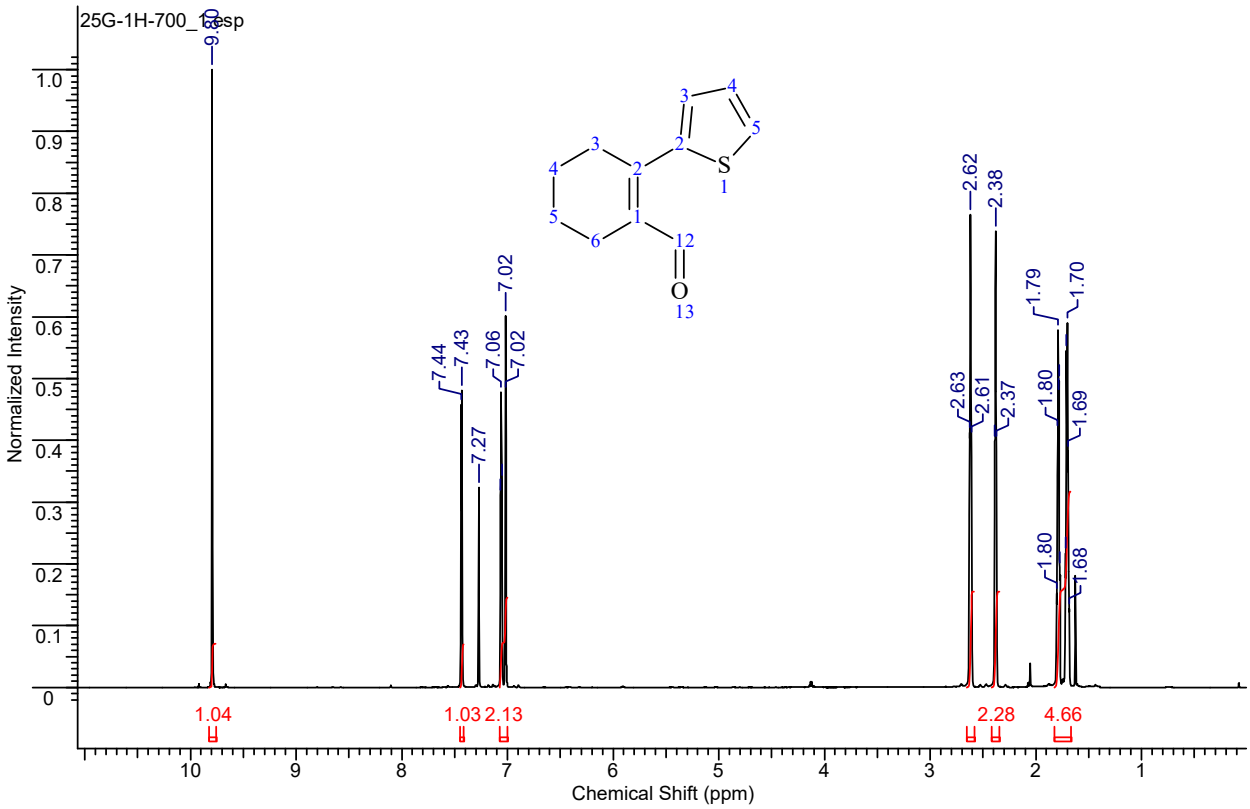


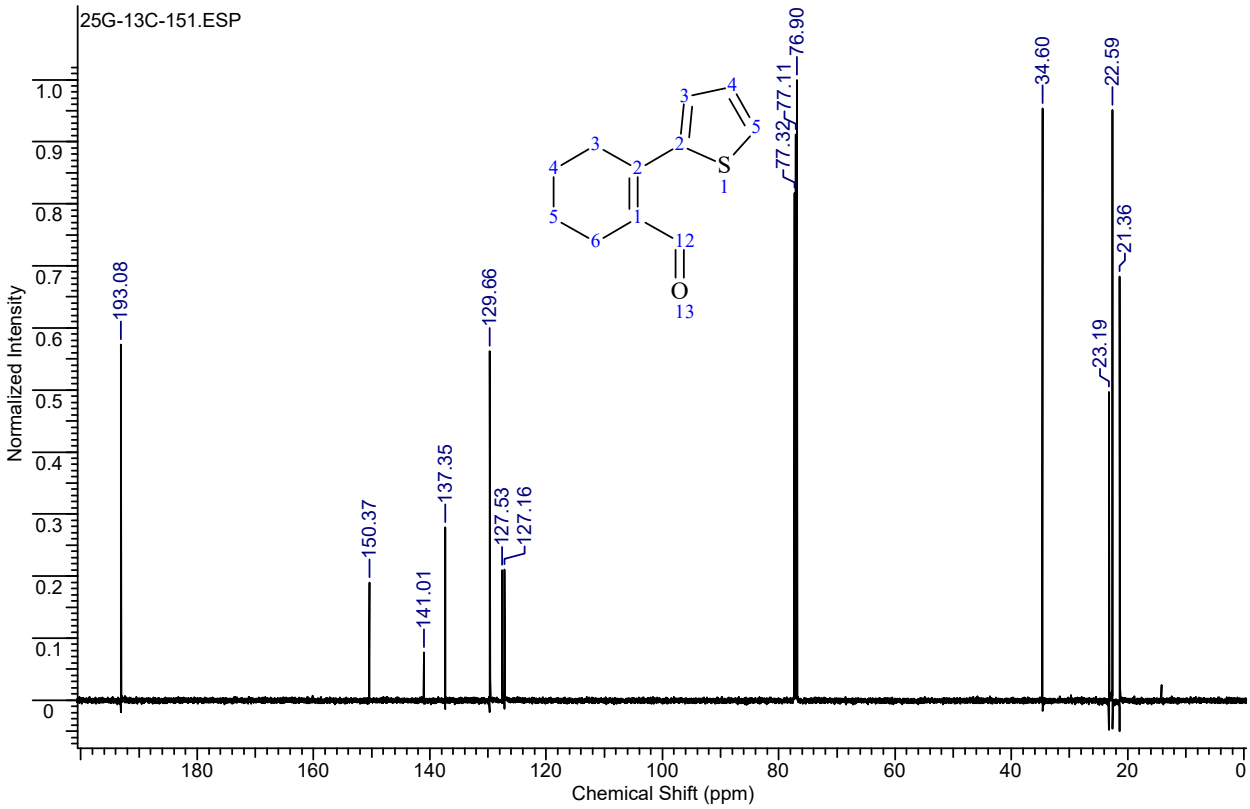
2-(Benzo[*b*]thiophen-3-yl)cyclopent-1-ene-1-carbaldehyde (25f).



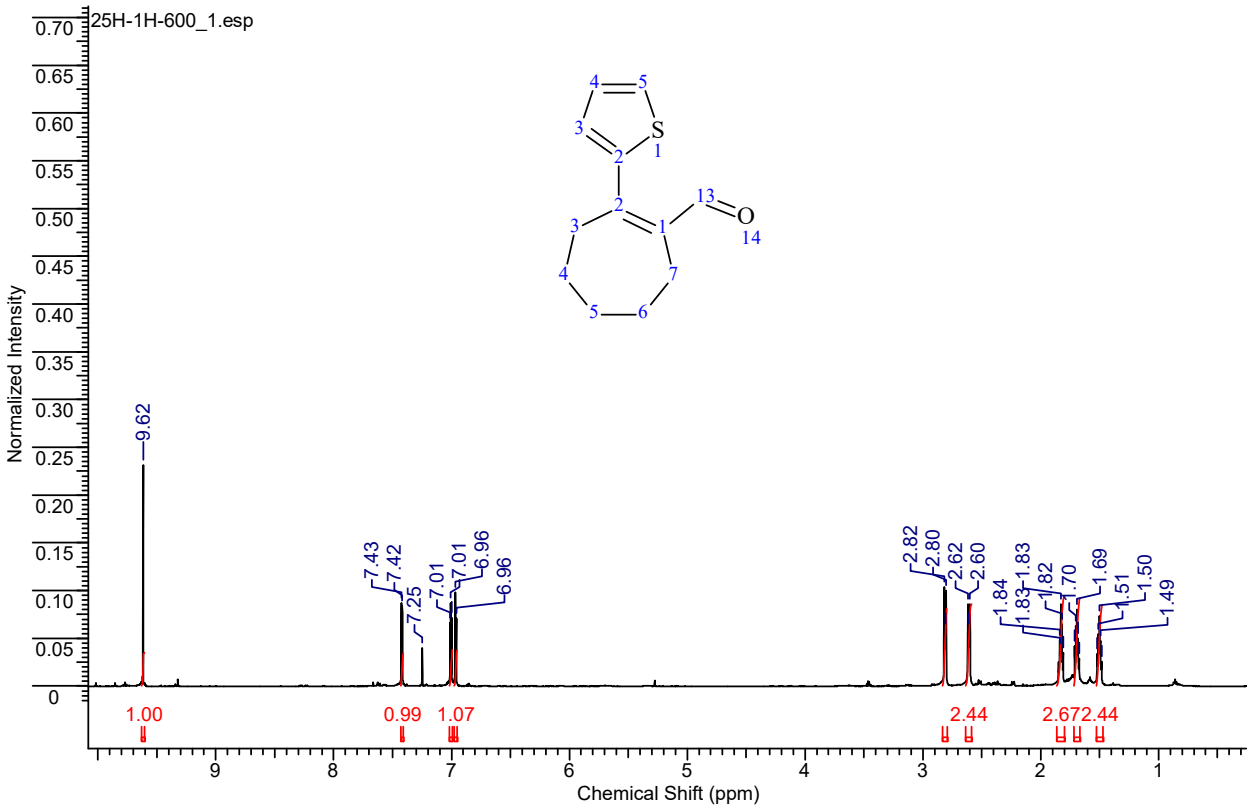


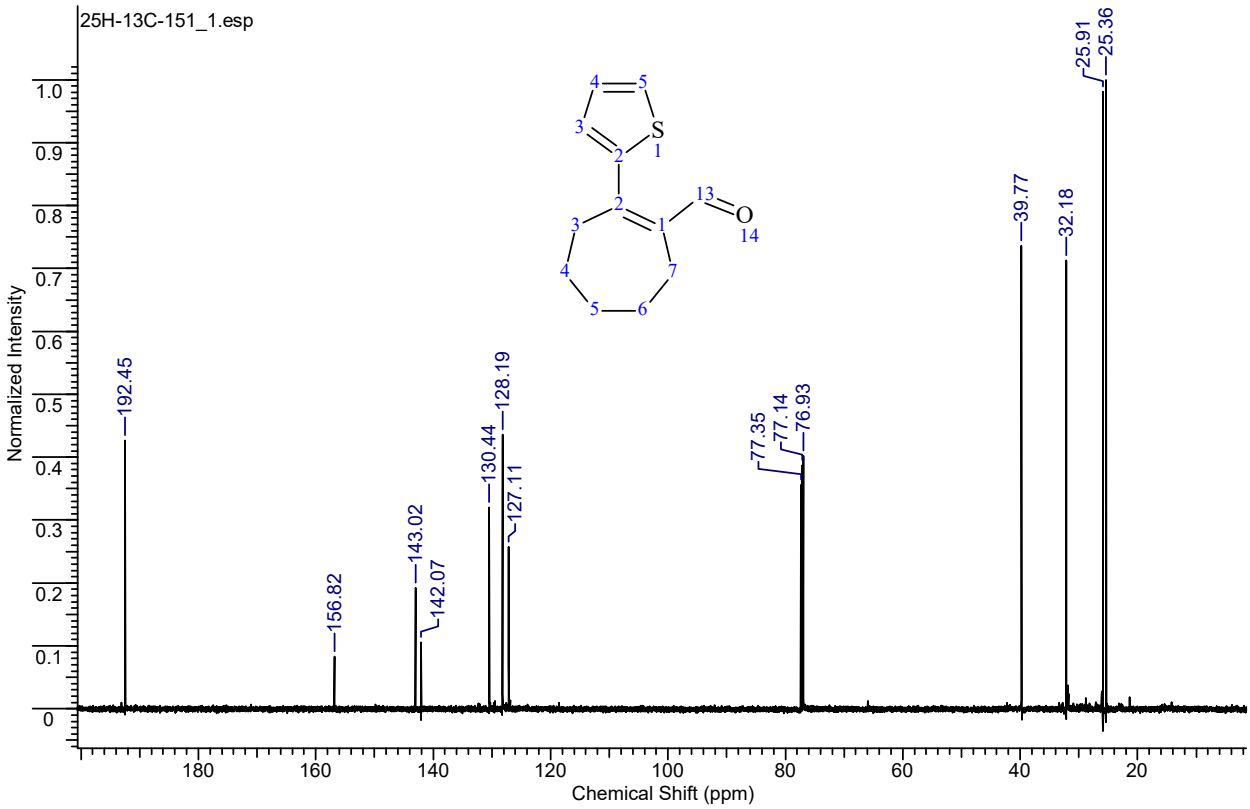
2-(Thiophen-2-yl)cyclohex-1-ene-1-carbaldehyde (25g).



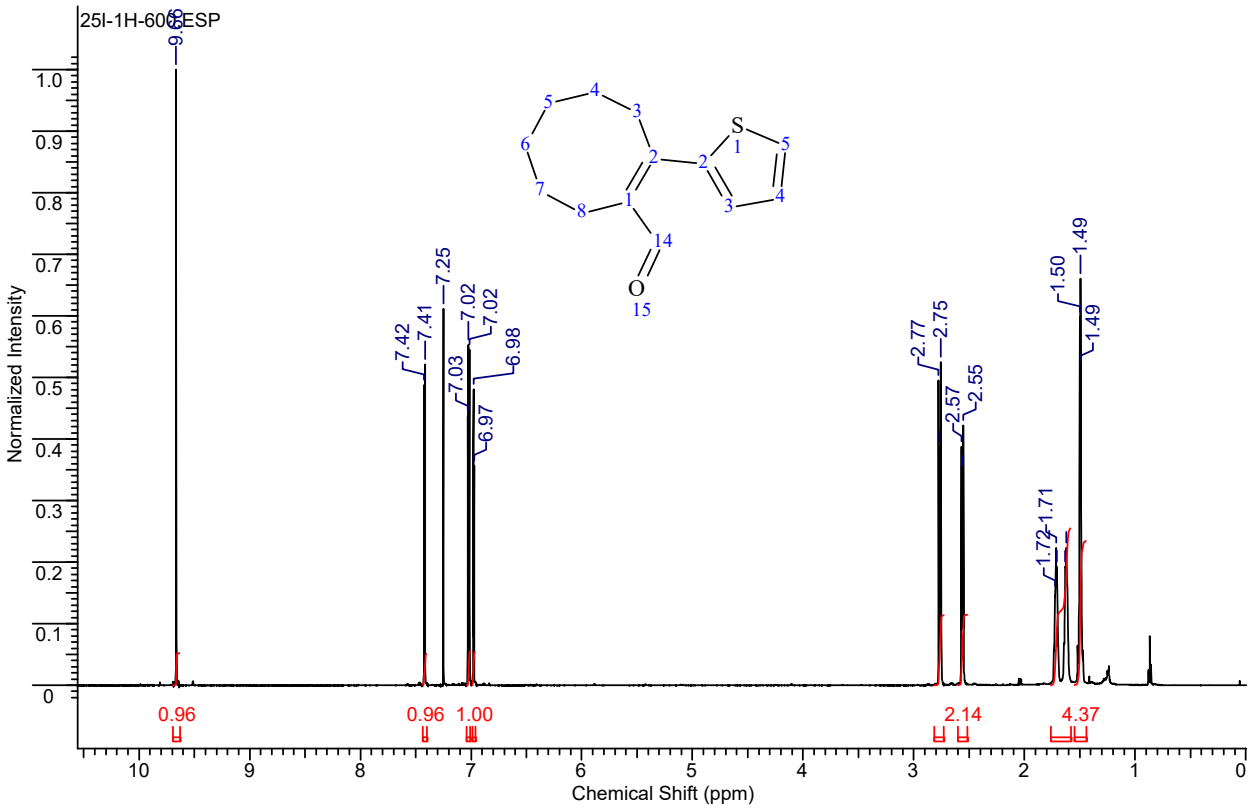


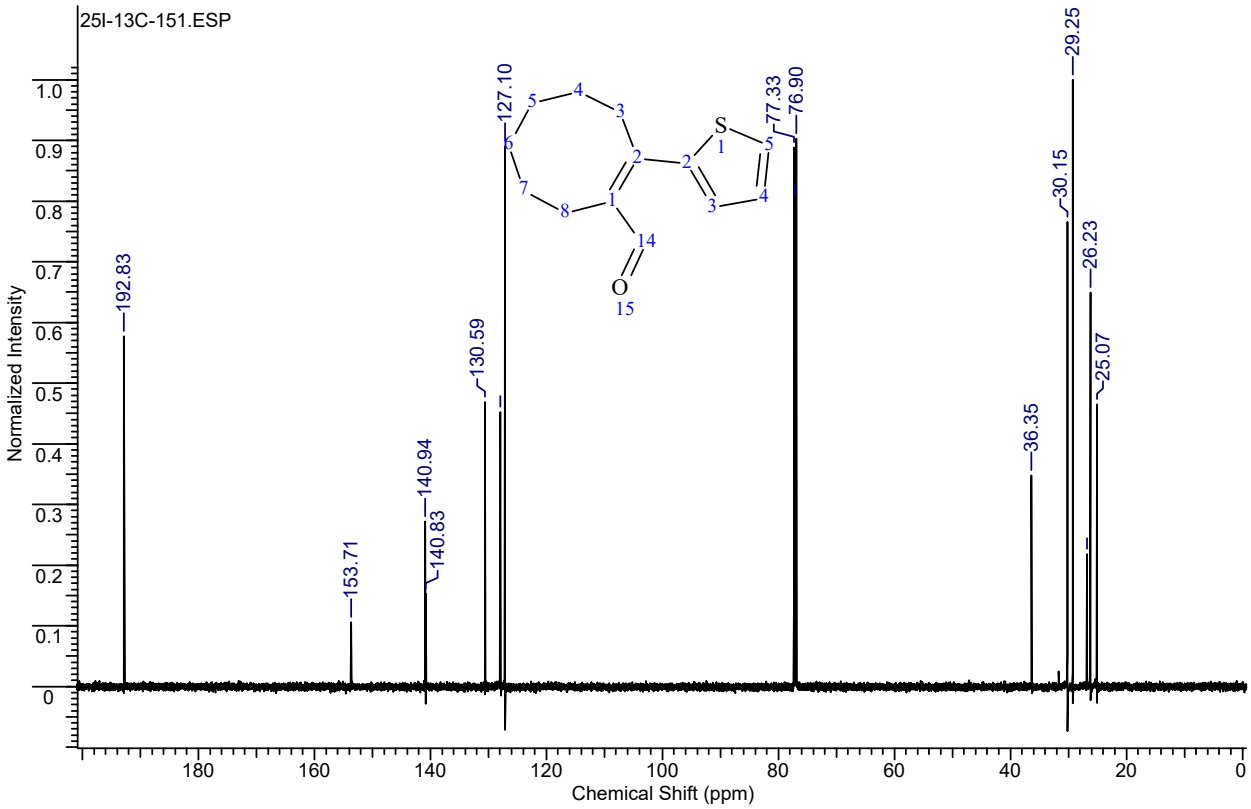
2-(Thiophen-2-yl)cyclohept-1-ene-1-carbaldehyde (25h).



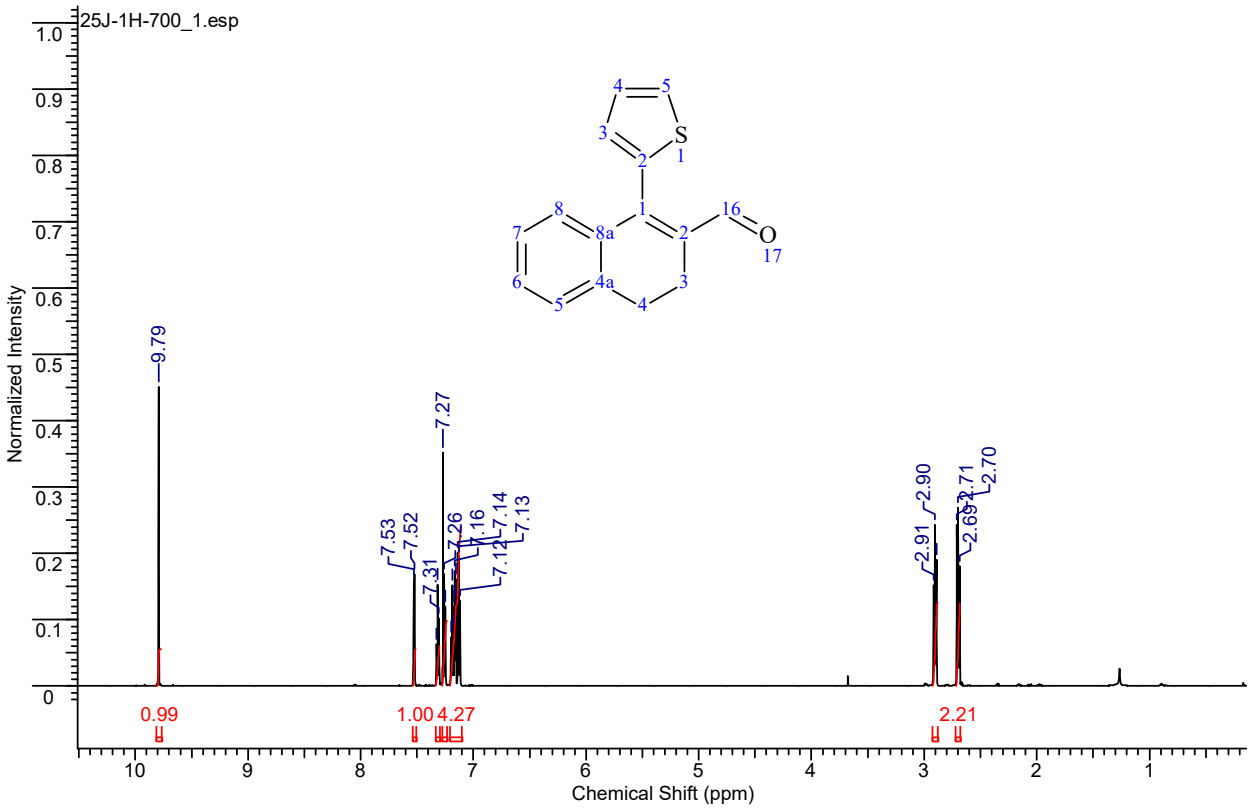


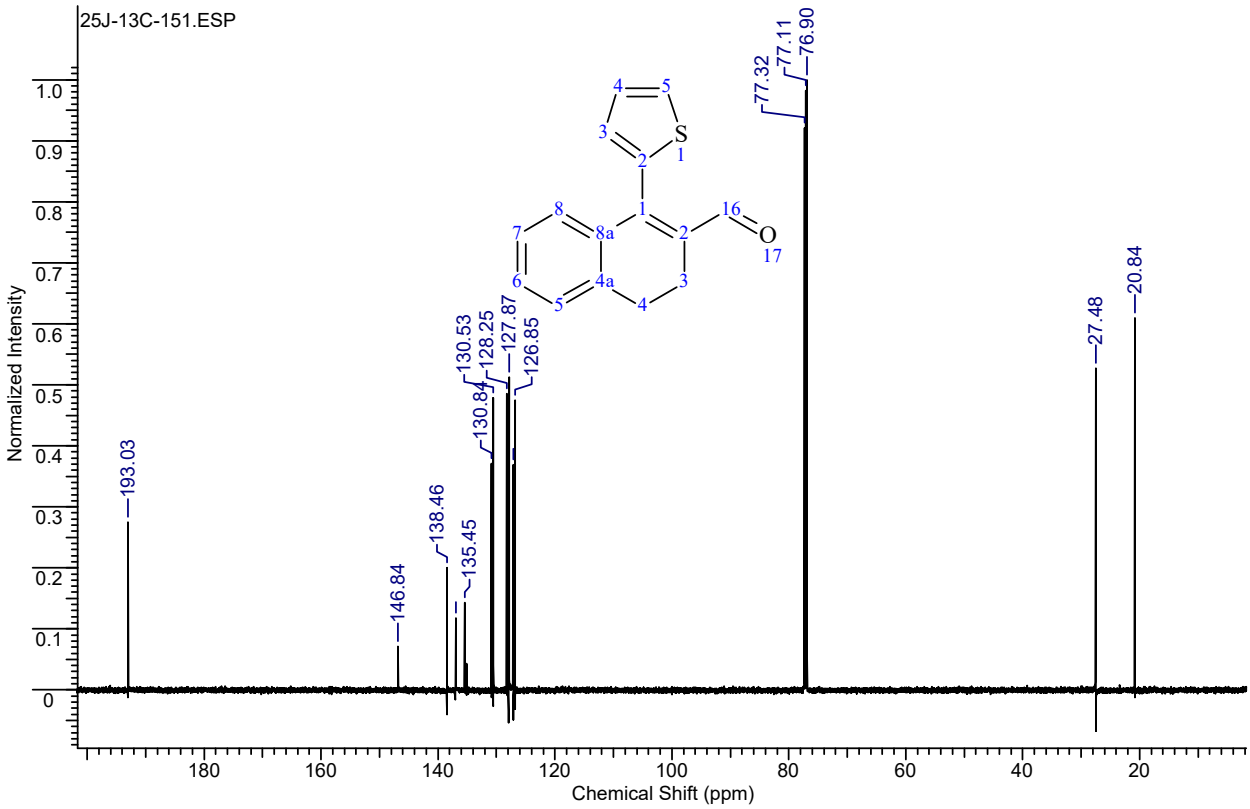
2-(Thiophen-2-yl)cyclooct-1-ene-1-carbaldehyde (25i).



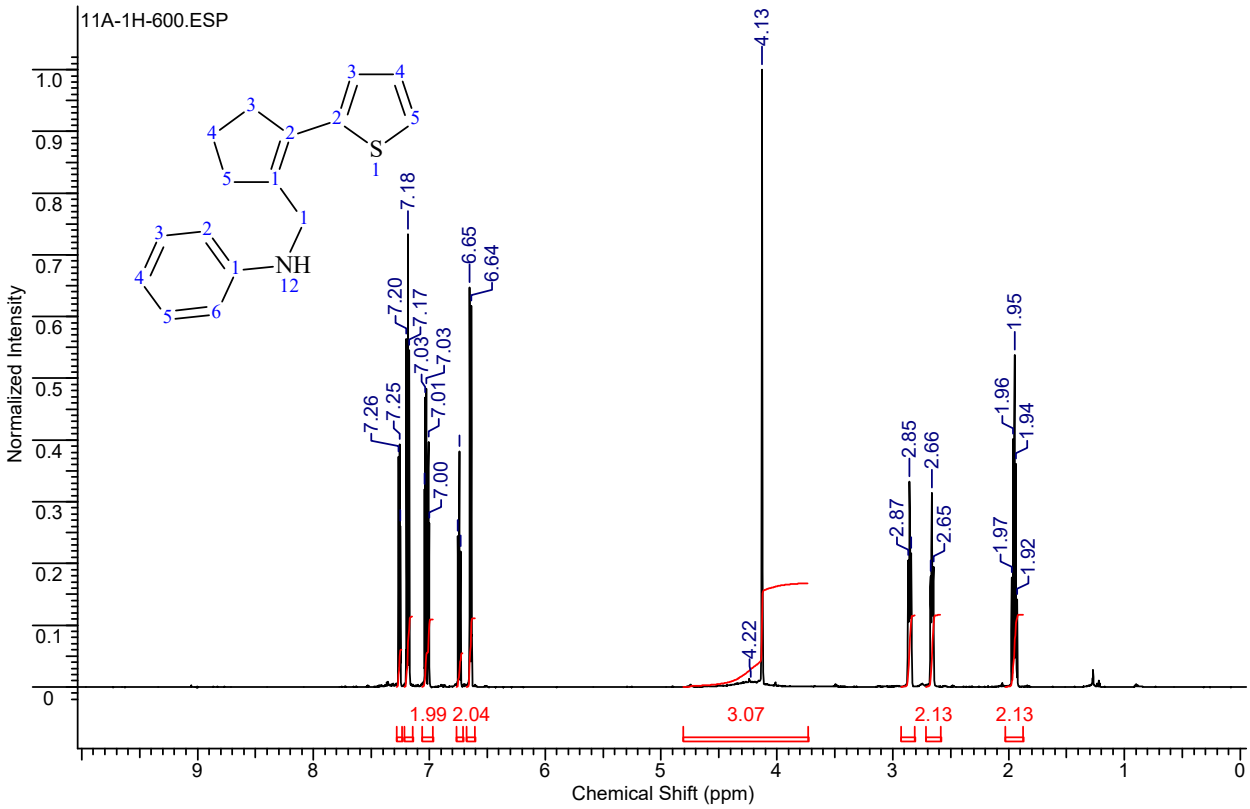


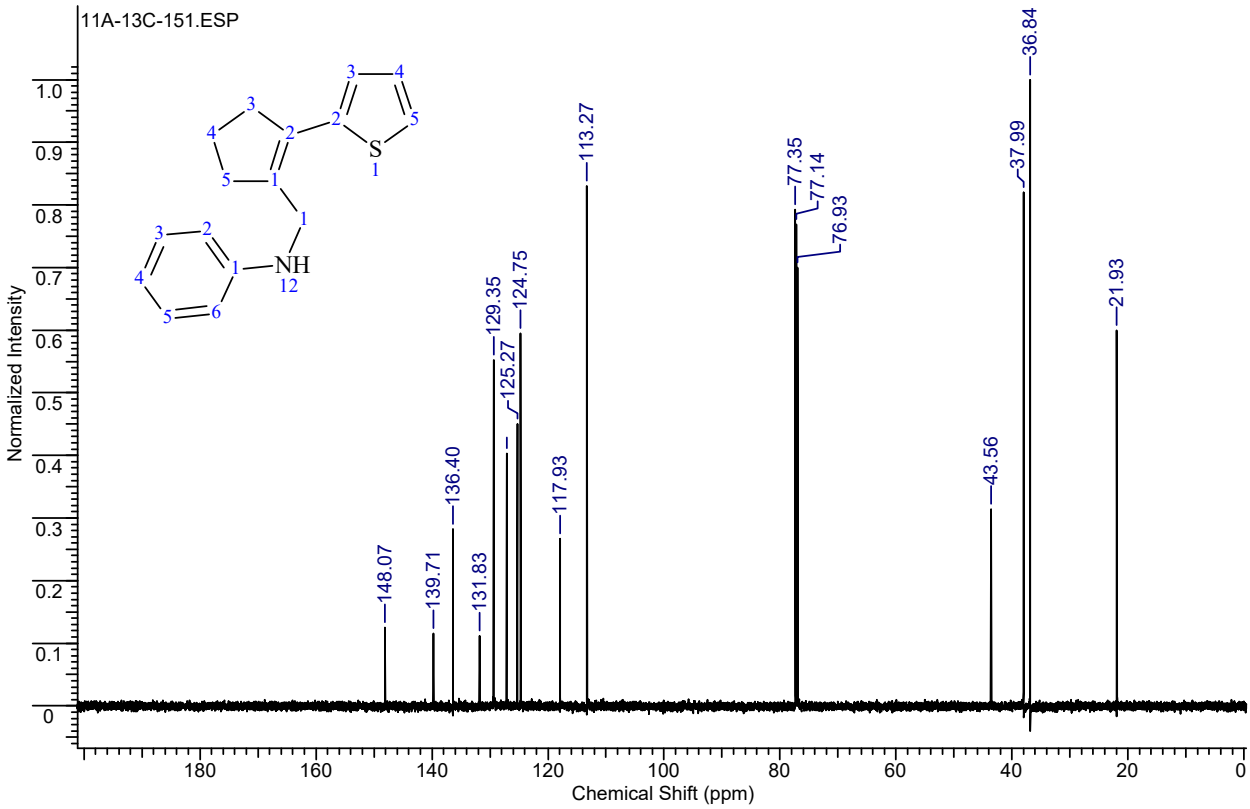
1-(Thiophen-2-yl)-3,4-dihydronaphthalene-2-carbaldehyde (25j).



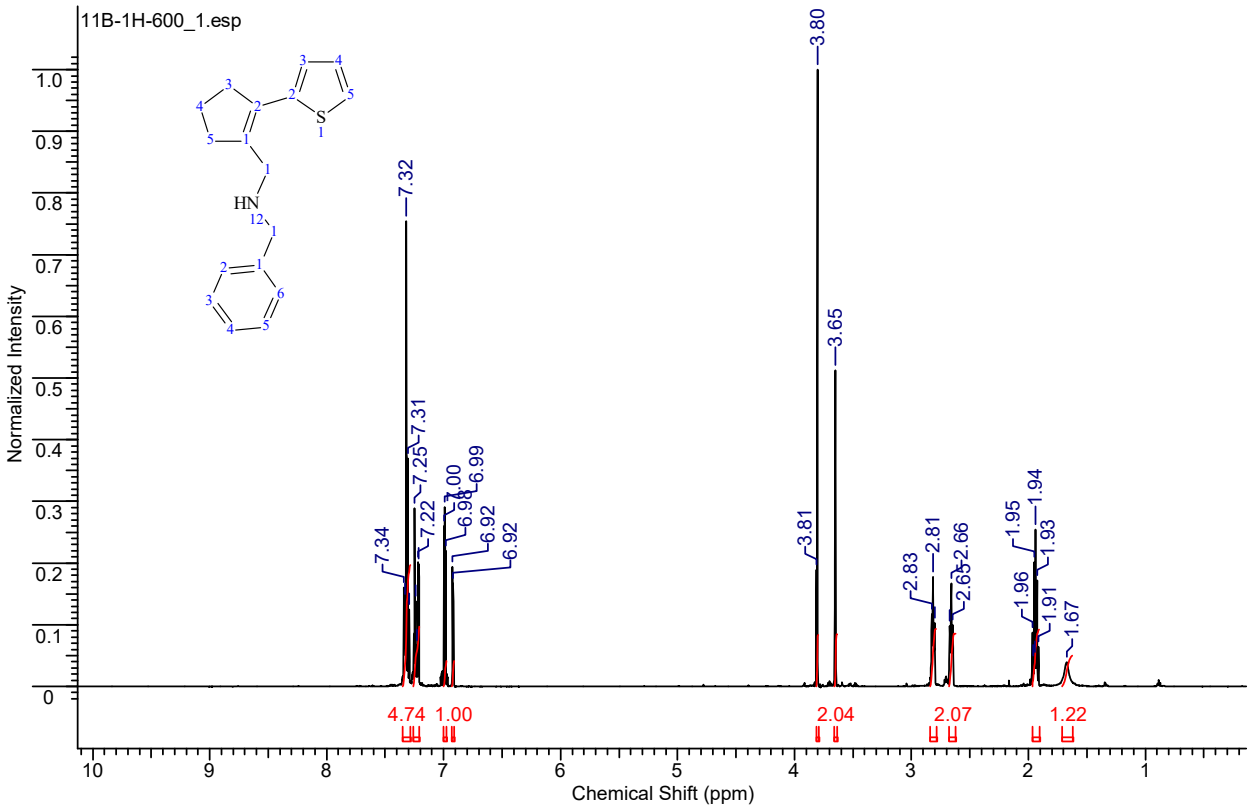


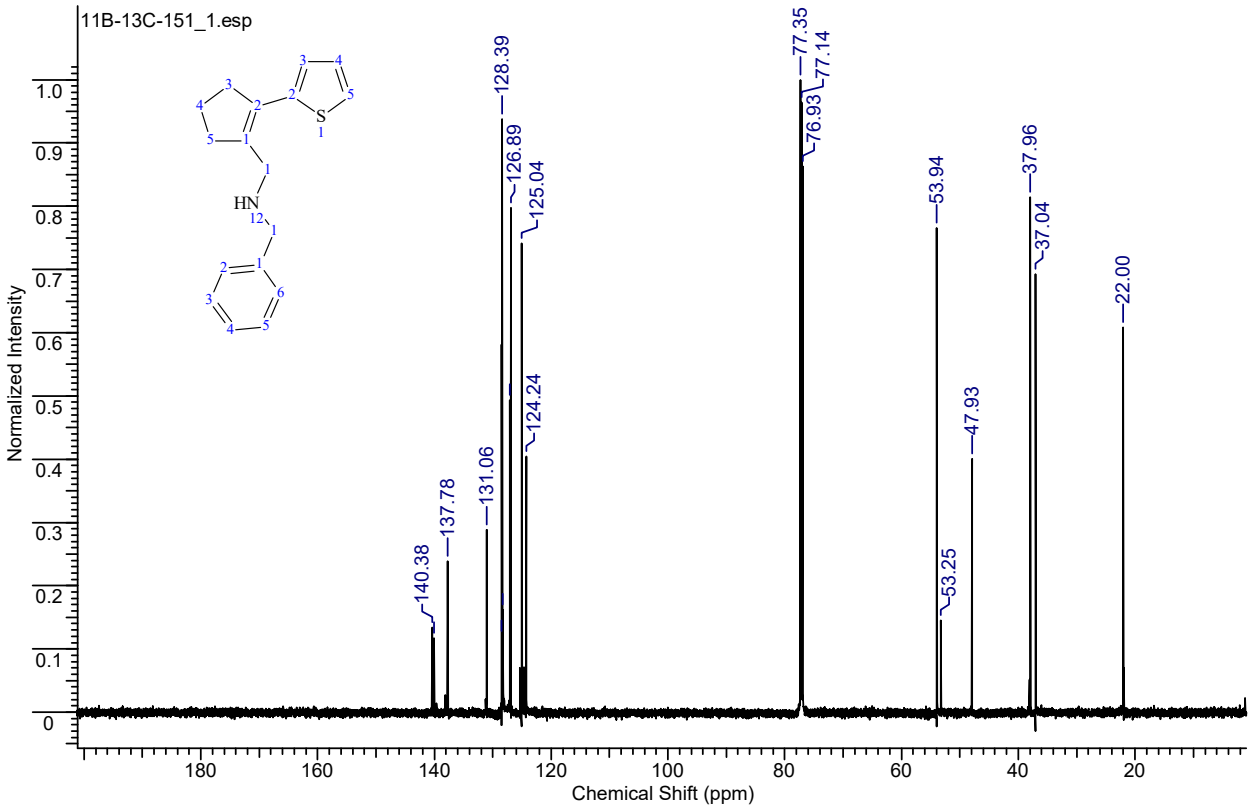
***N*-((2-(Thiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11a).**



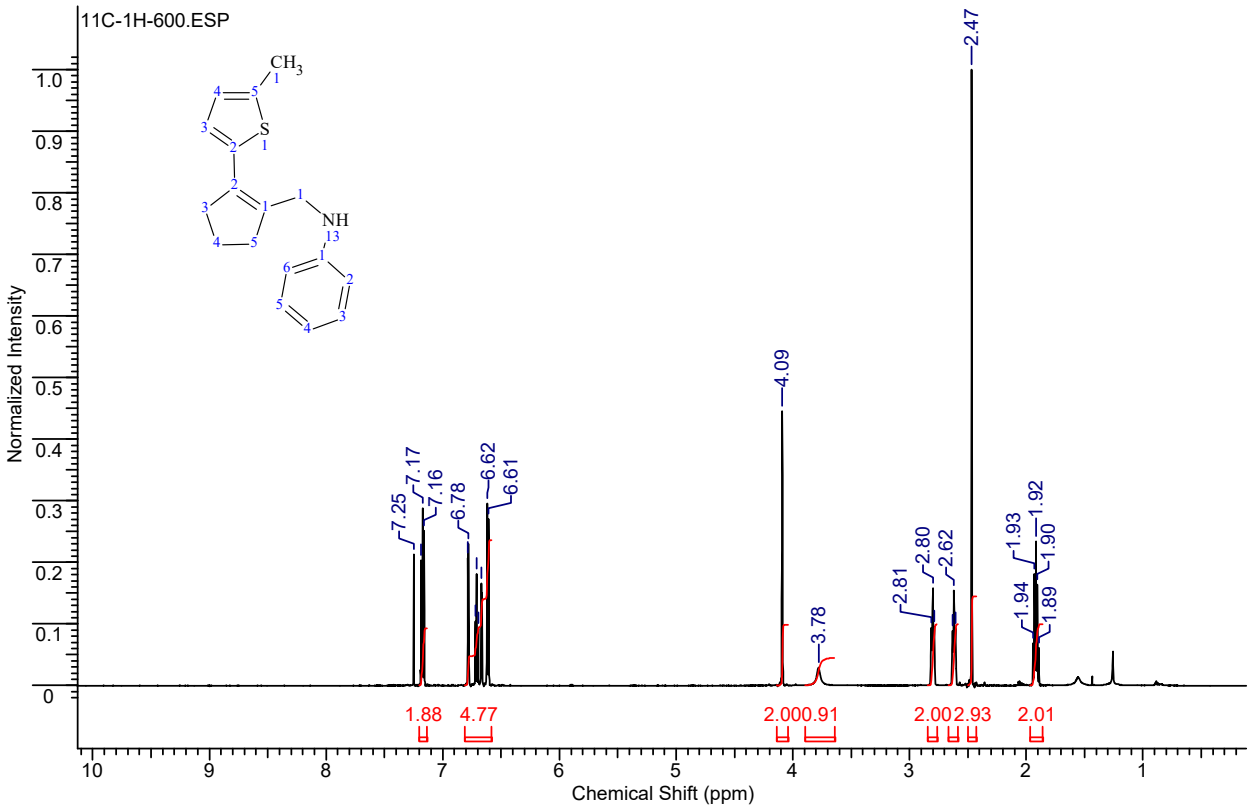


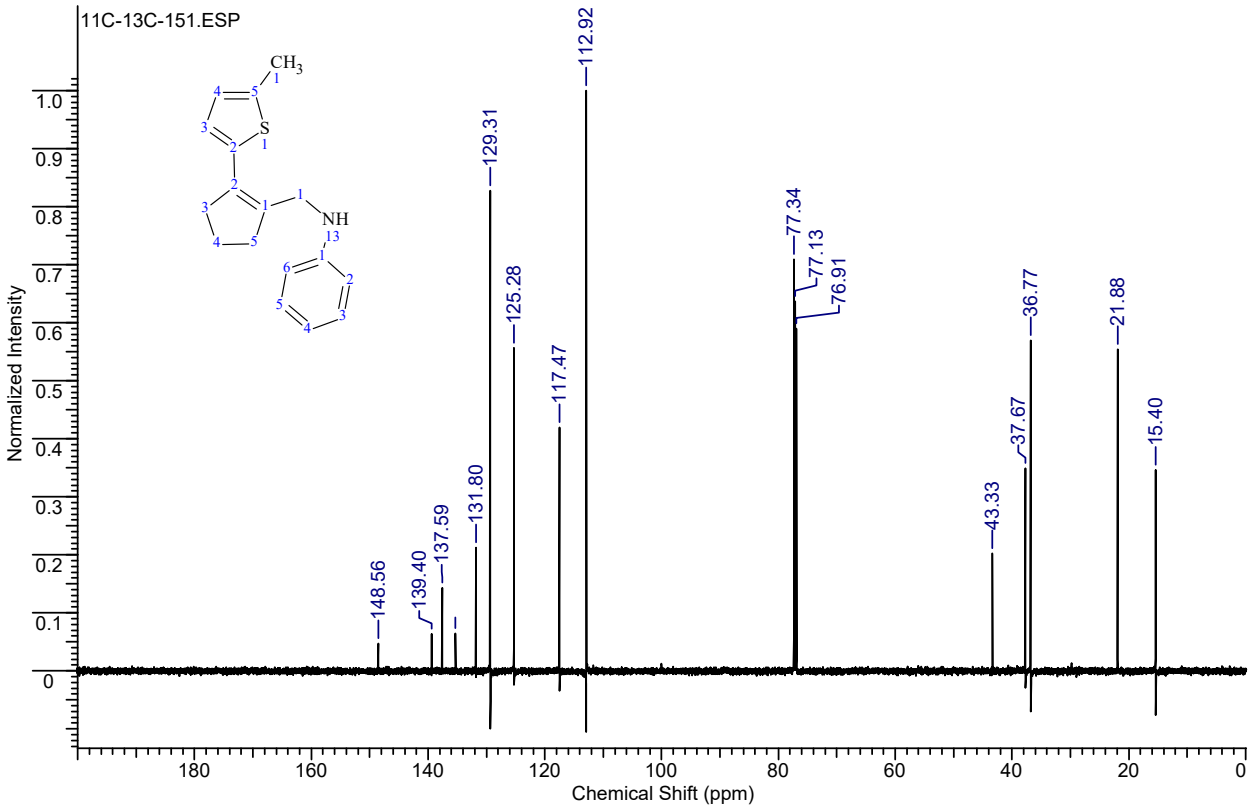
_N_-Benzyl-1-(2-(thiophen-2-yl)cyclopent-1-en-1-yl)methanamine (11b).



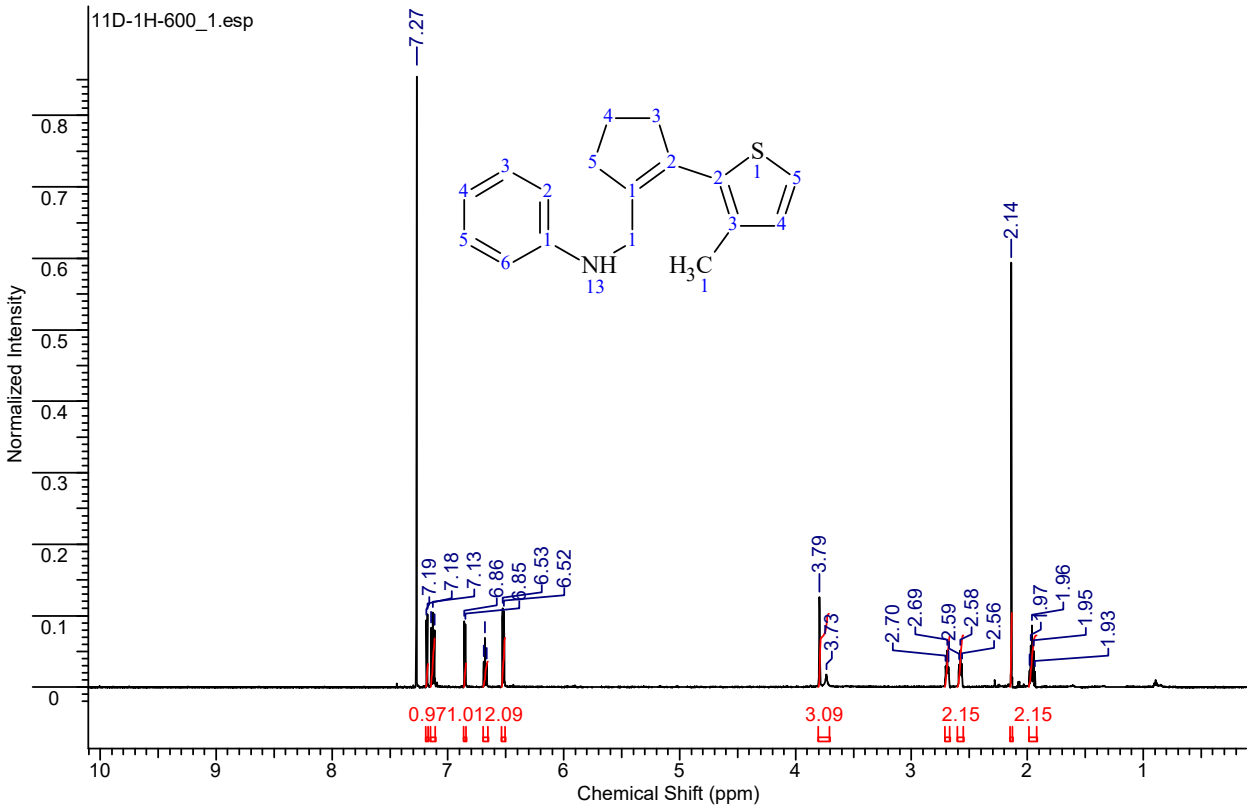


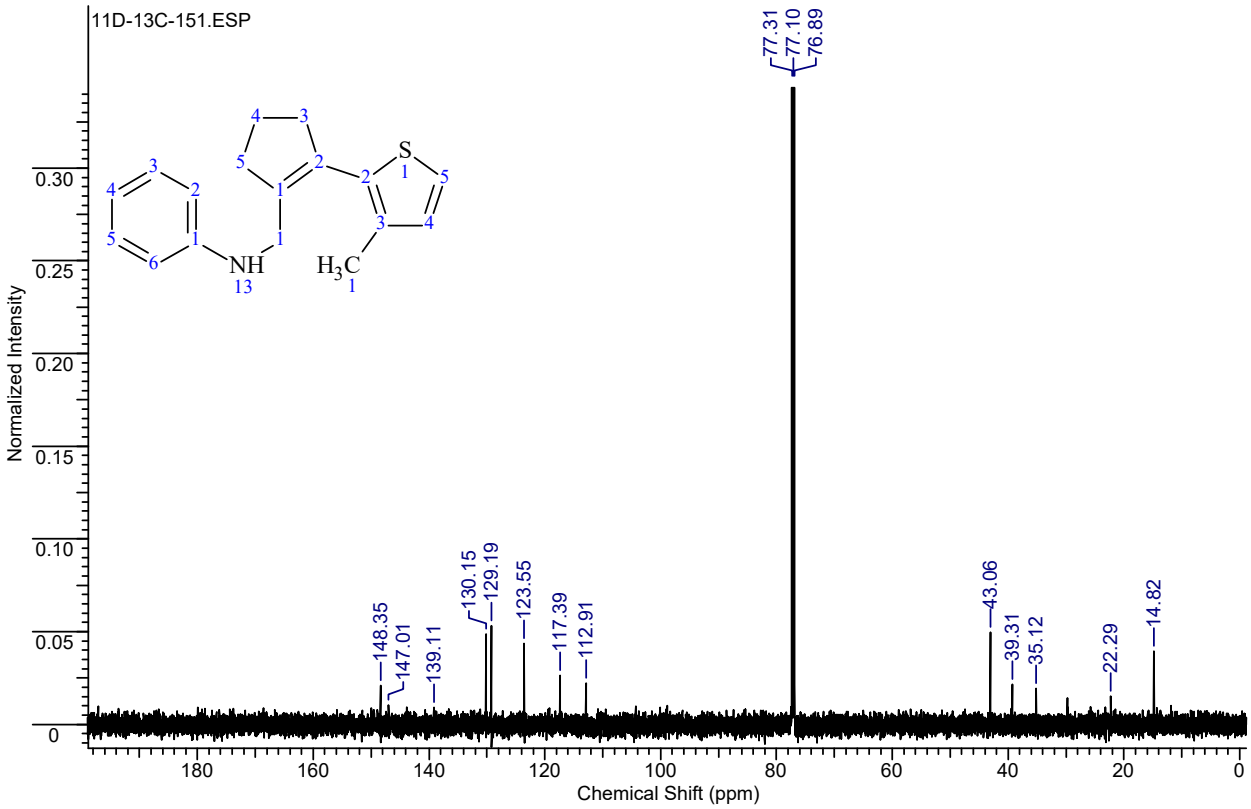
***N*-((2-(5-Methylthiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11c).**



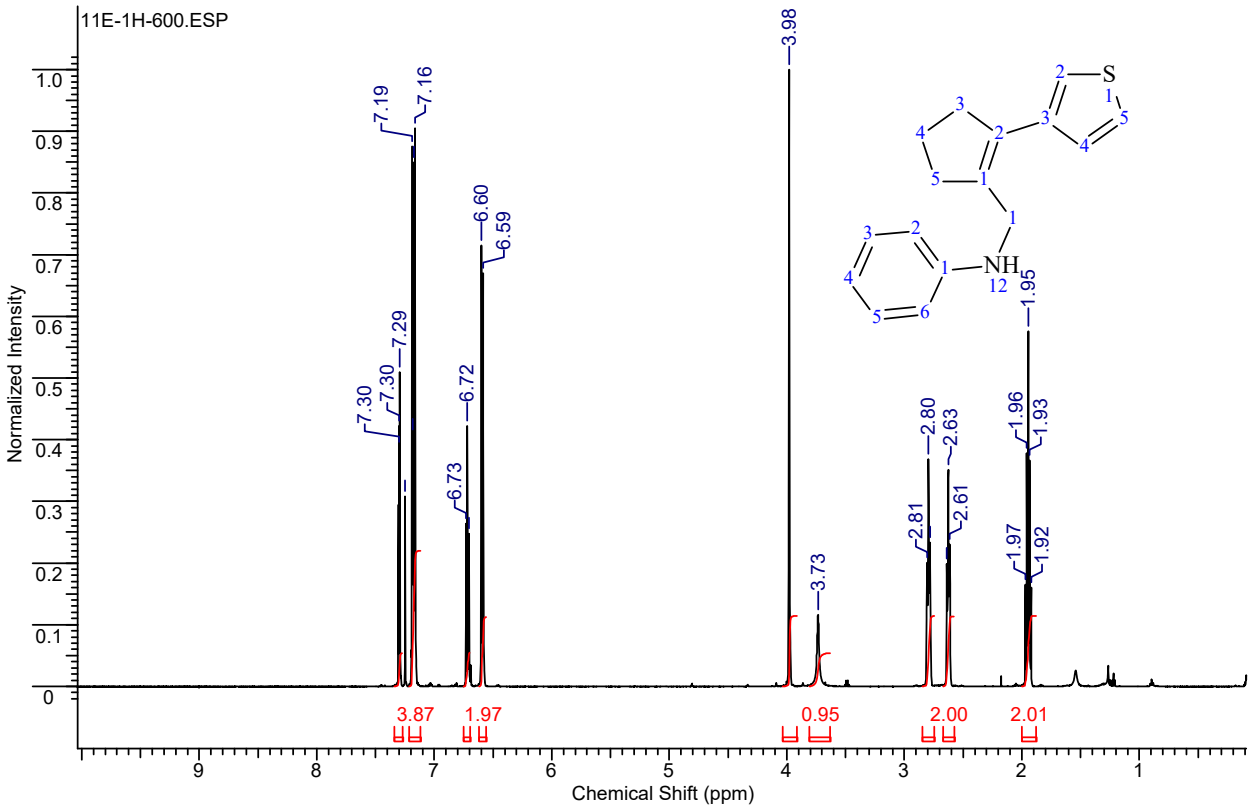


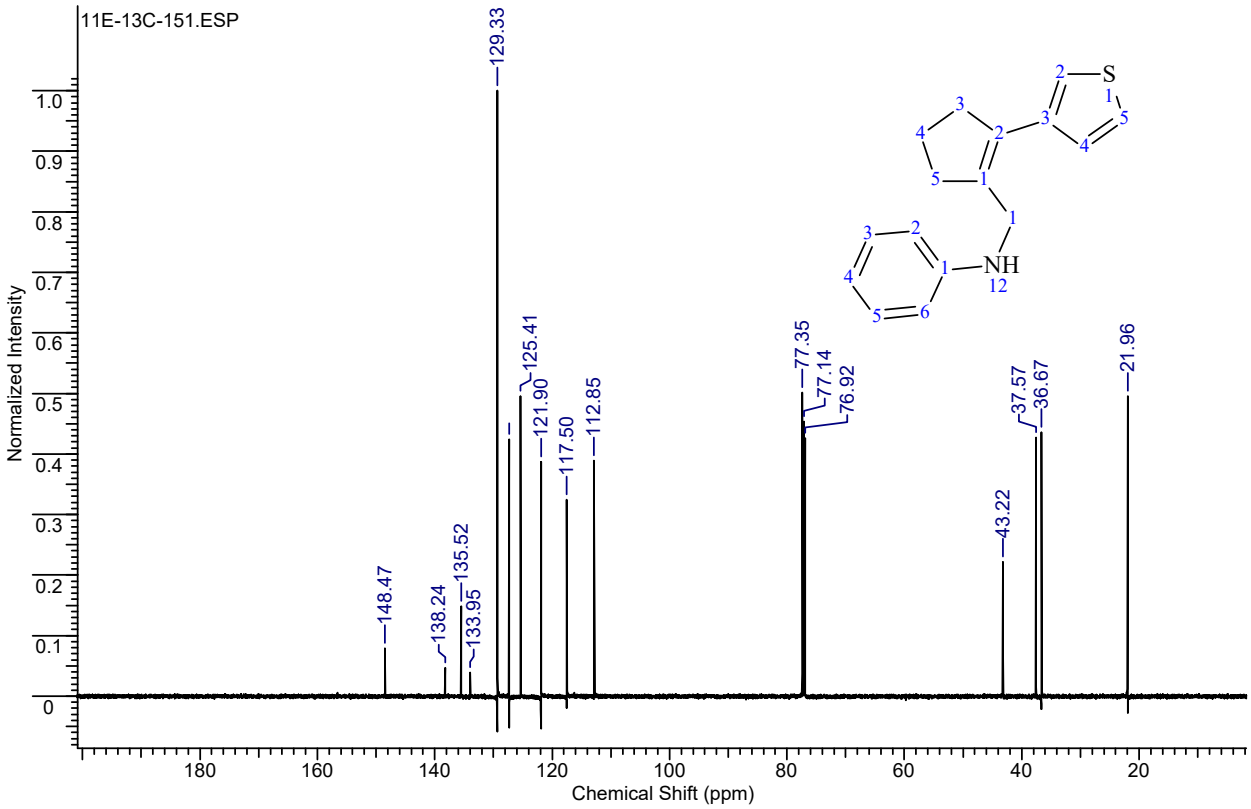
***N*-((2-(3-Methylthiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11d).**



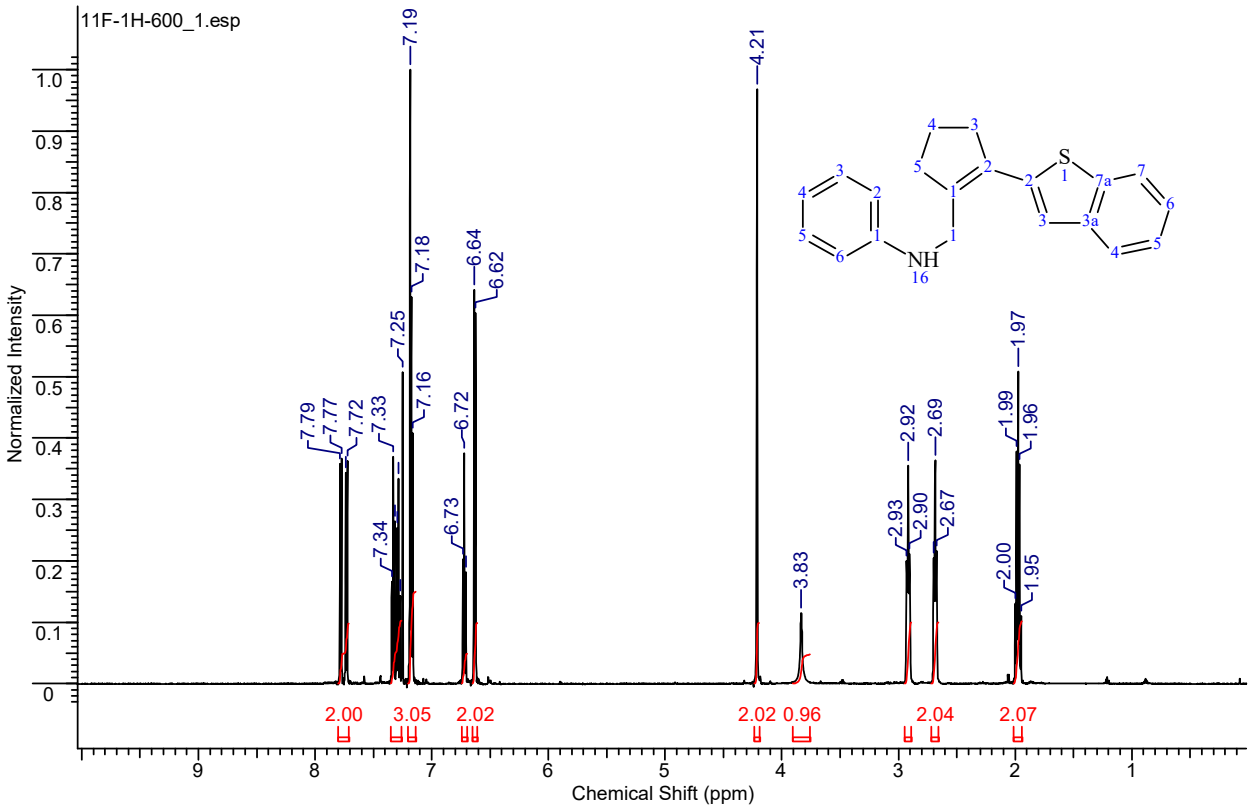


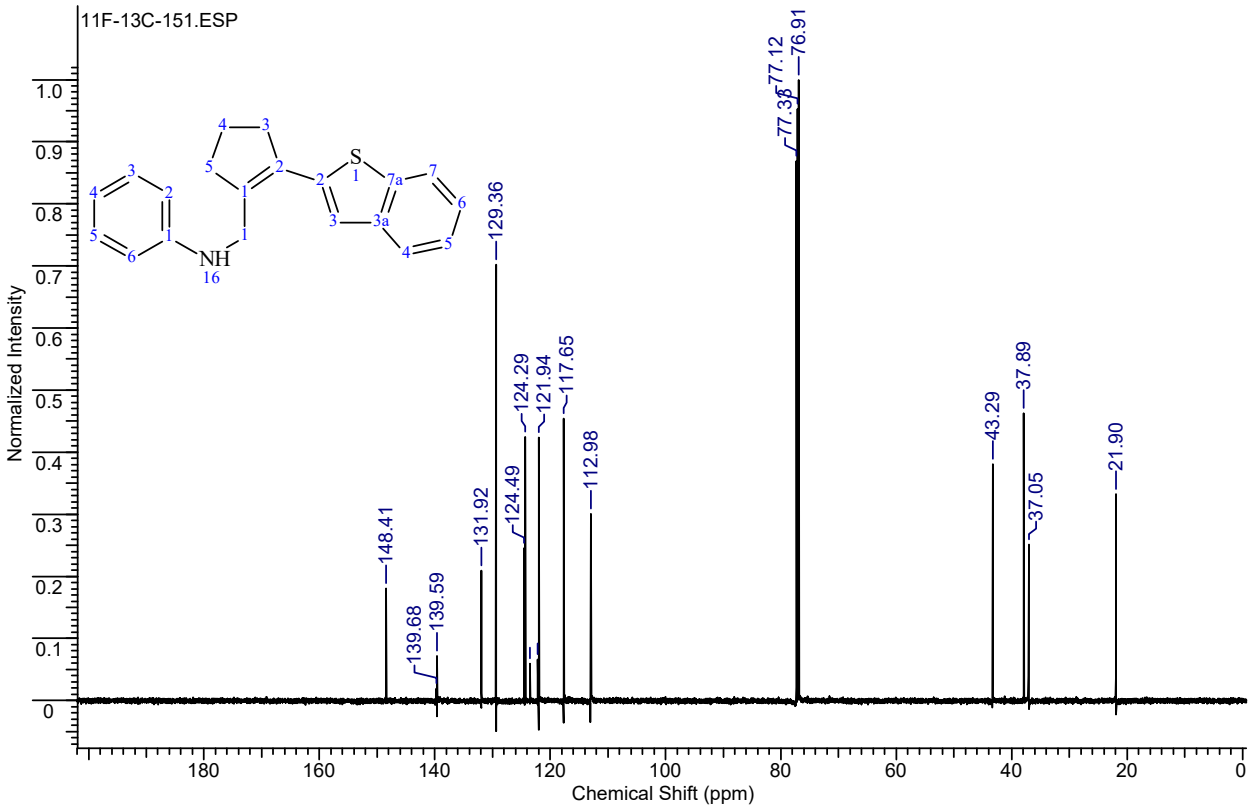
***N*-((2-(Thiophen-3-yl)cyclopent-1-en-1-yl)methyl)aniline (11e).**



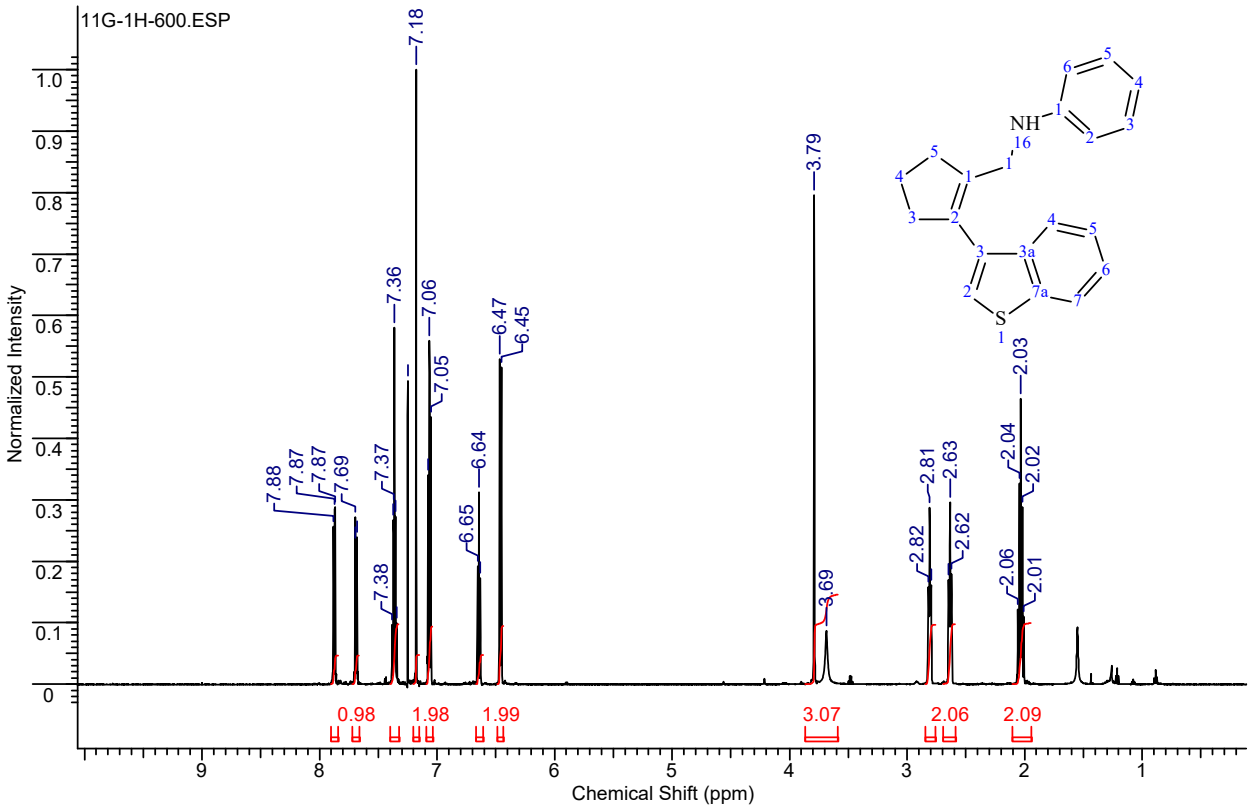


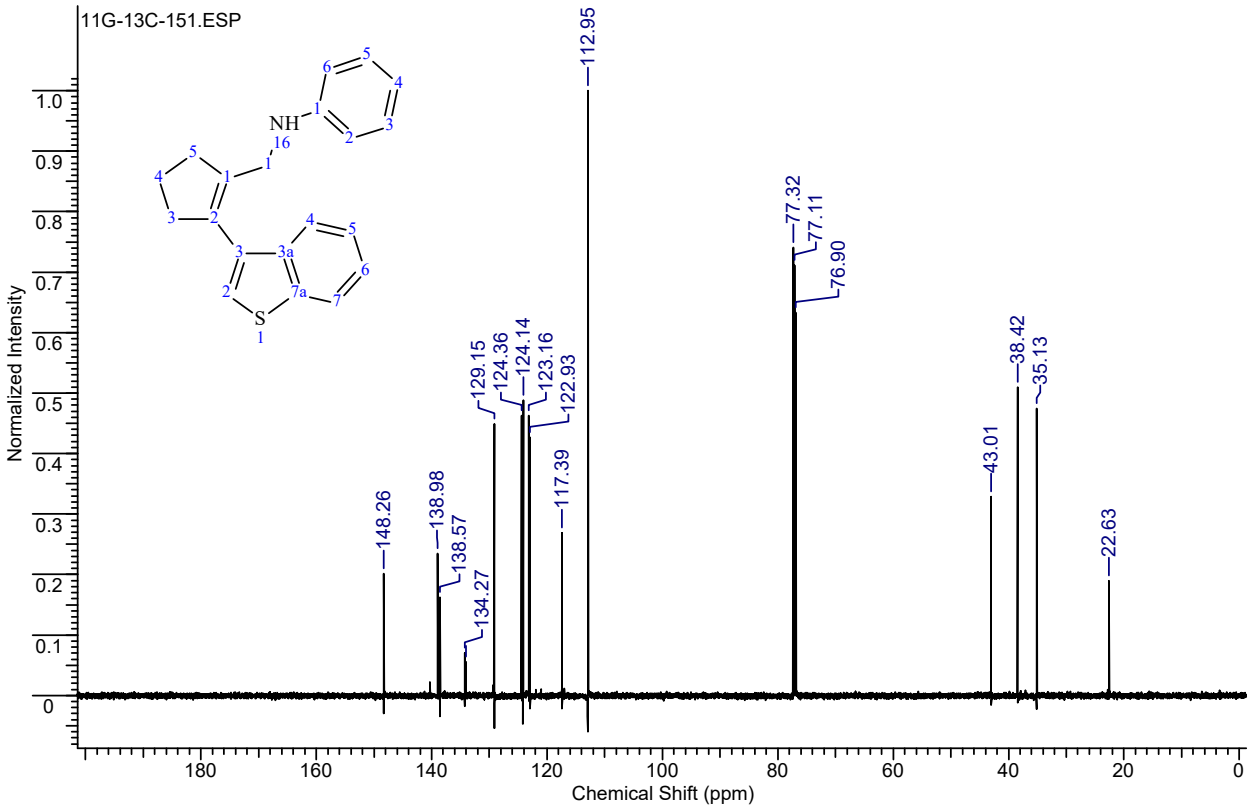
***N*-((2-(Benzo[*b*]thiophen-2-yl)cyclopent-1-en-1-yl)methyl)aniline (11f).**



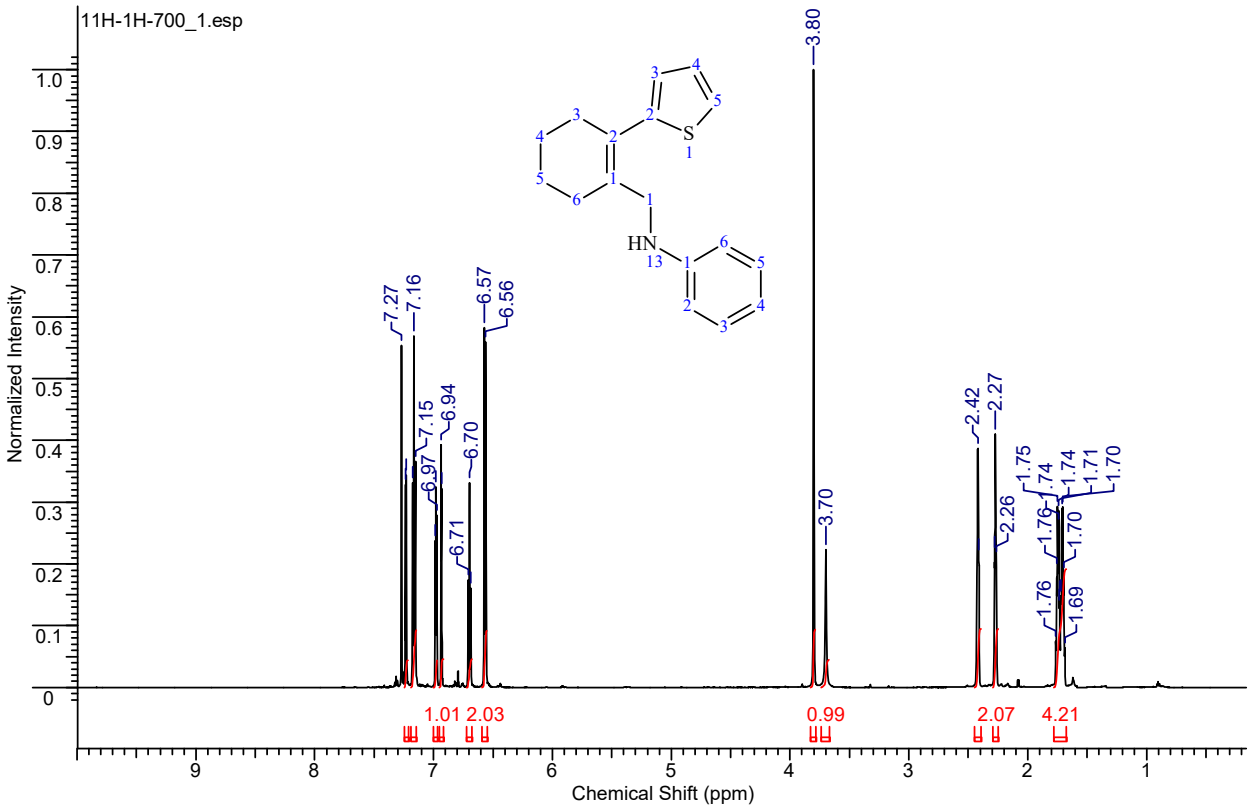


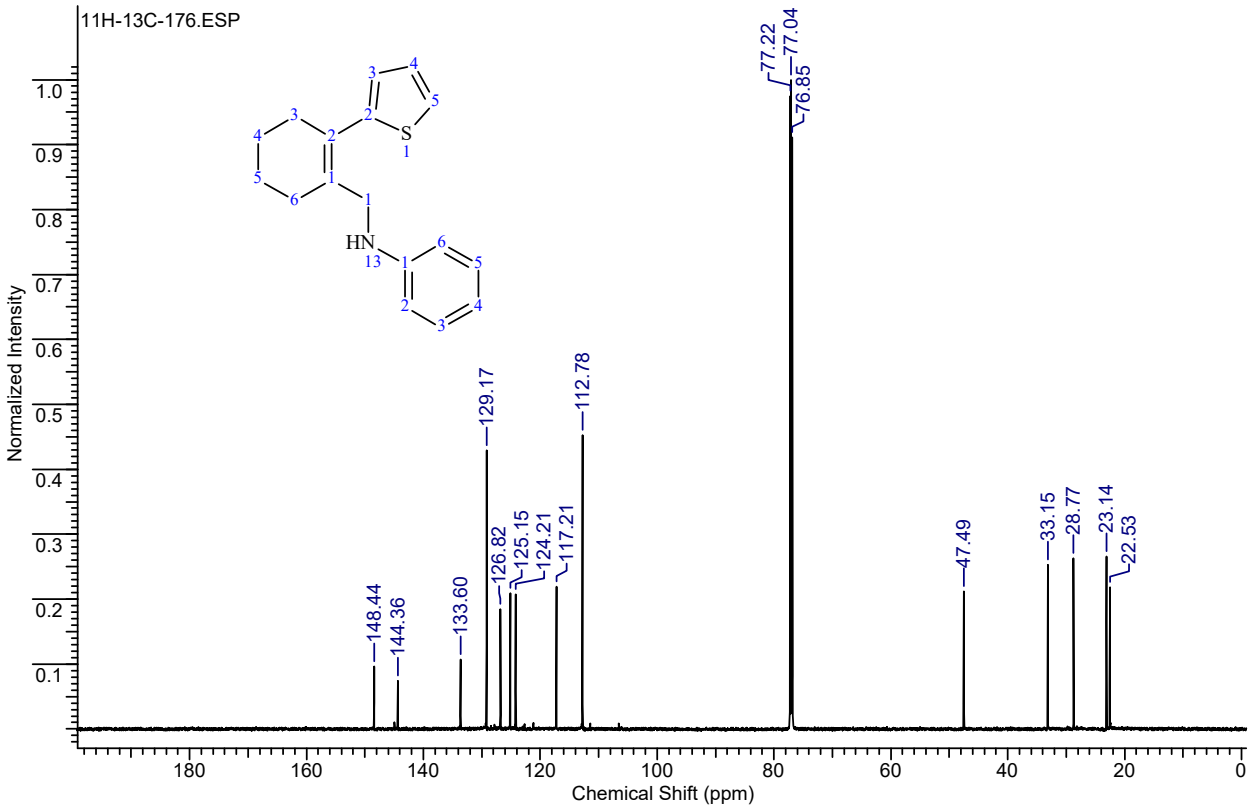
***N*-((2-(Benzo[*b*]thiophen-3-yl)cyclopent-1-en-1-yl)methyl)aniline (11g).**



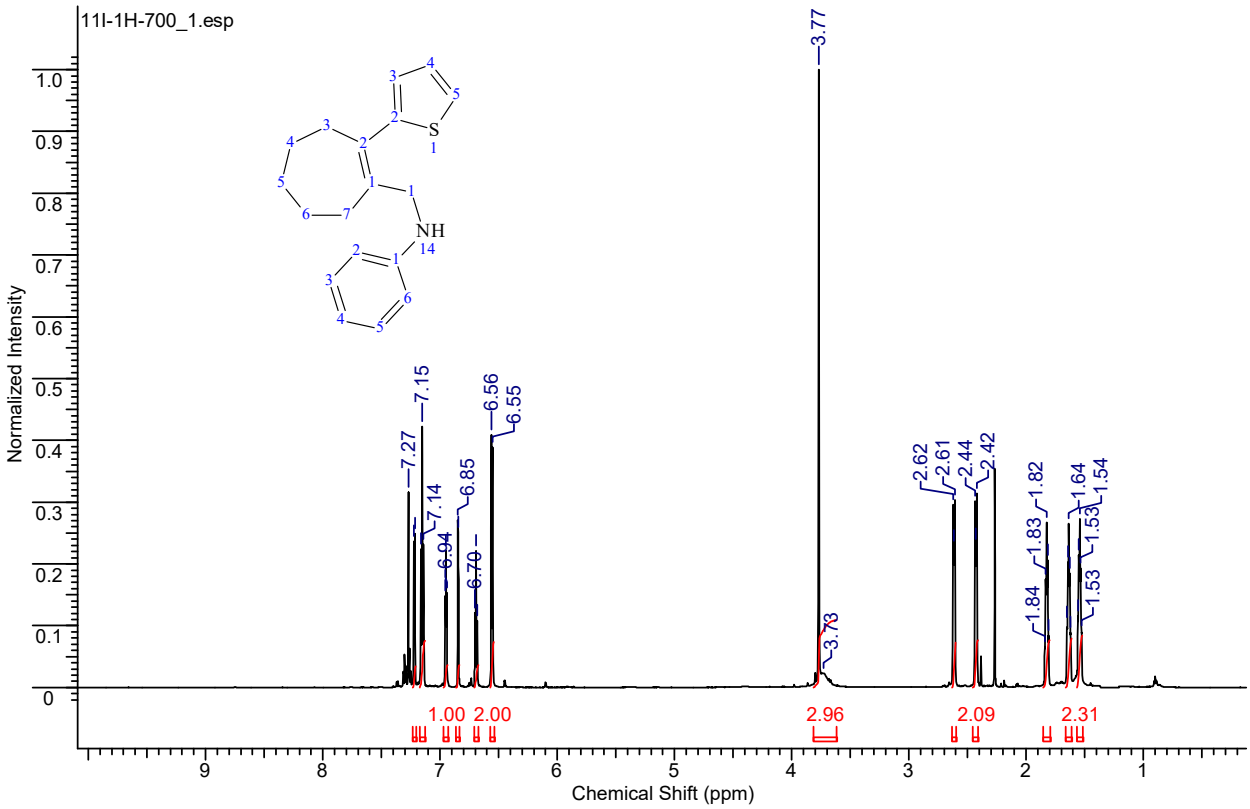


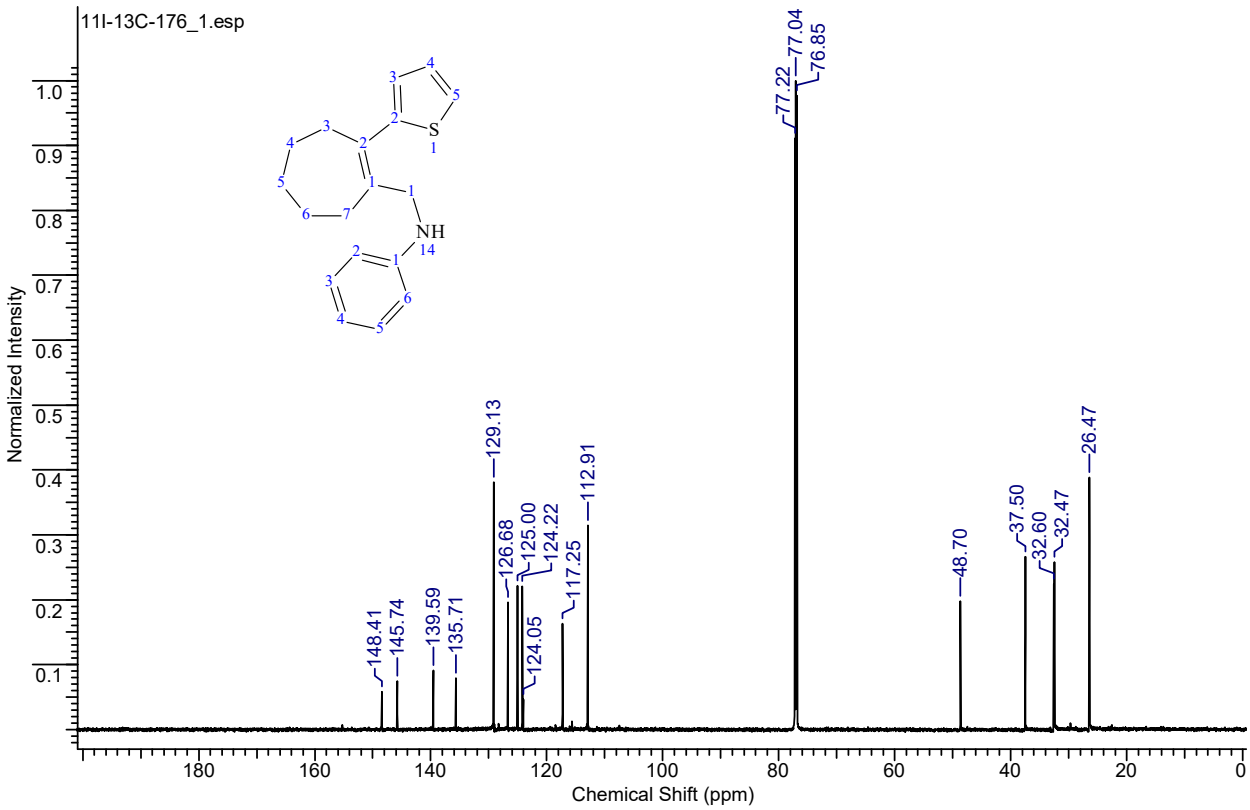
***N*-((2-(Thiophen-2-yl)cyclohex-1-en-1-yl)methyl)aniline (11h).**



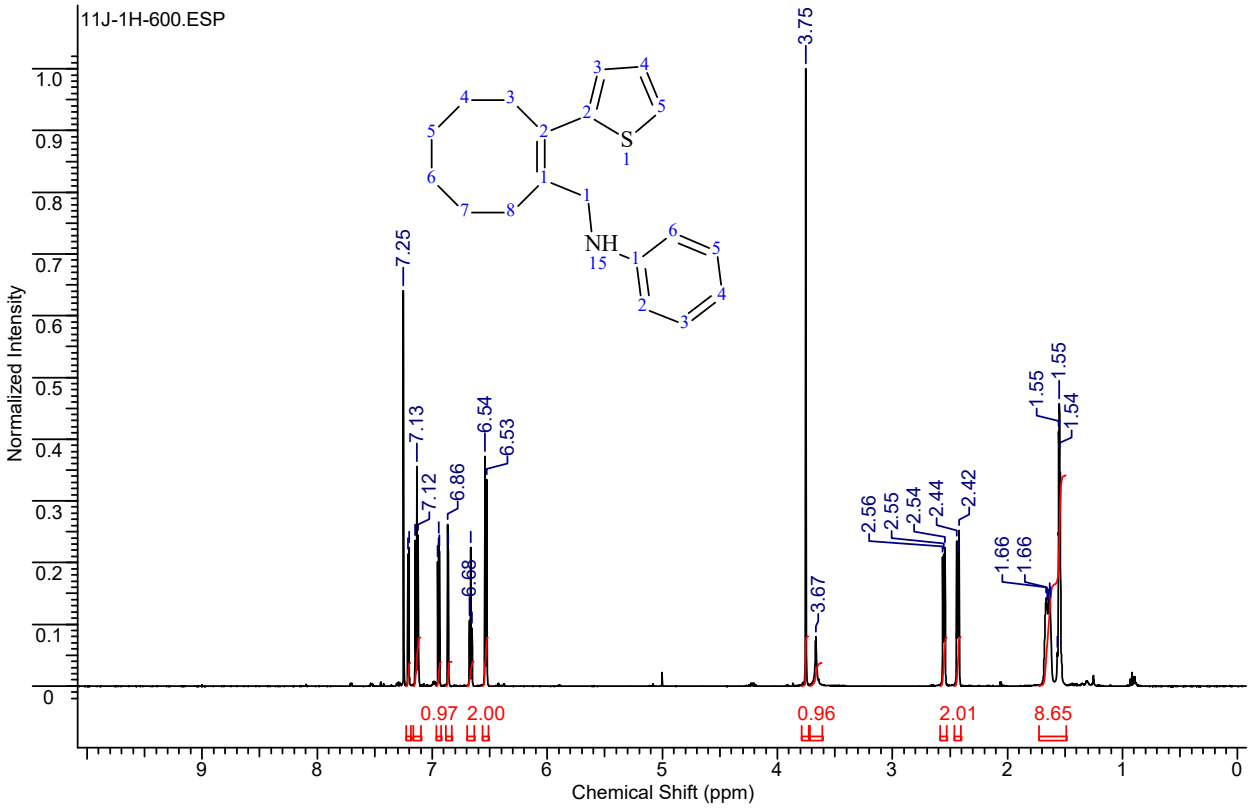


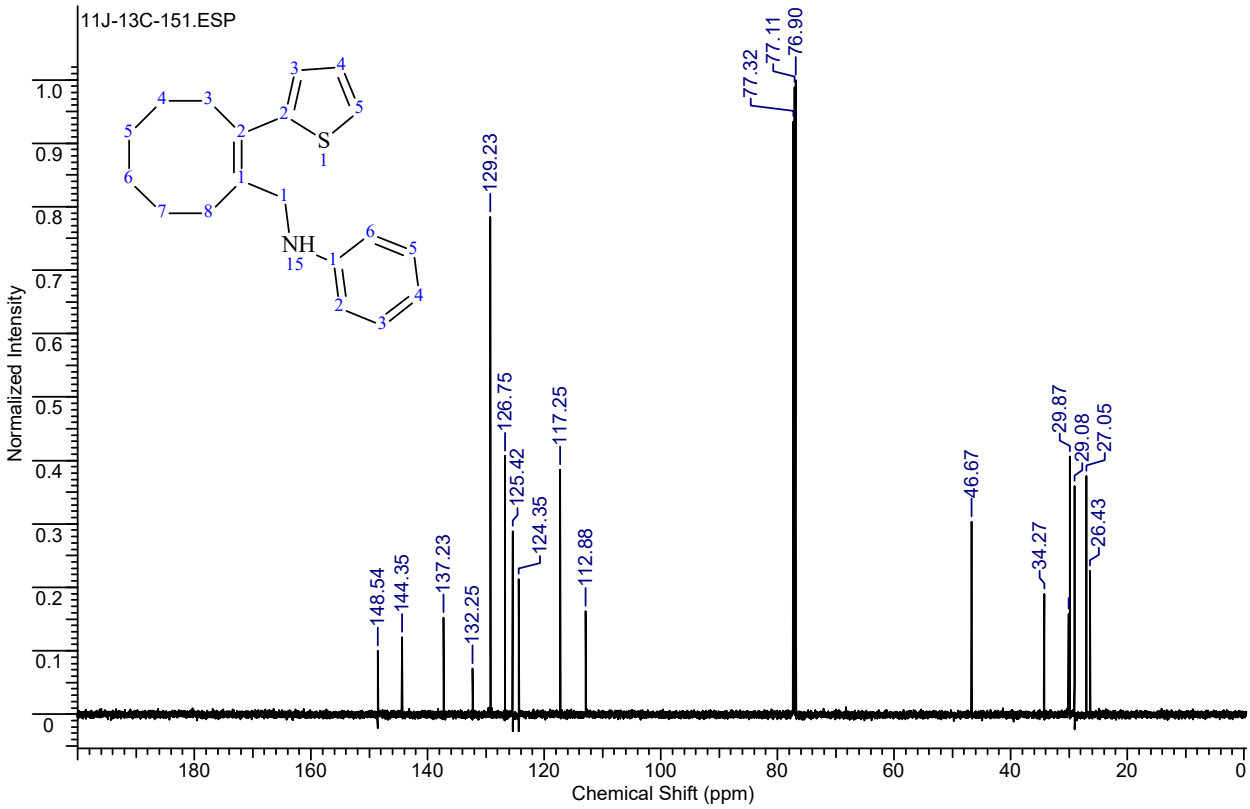
***N*-((2-(Thiophen-2-yl)cyclohept-1-en-1-yl)methyl)aniline (11i).**



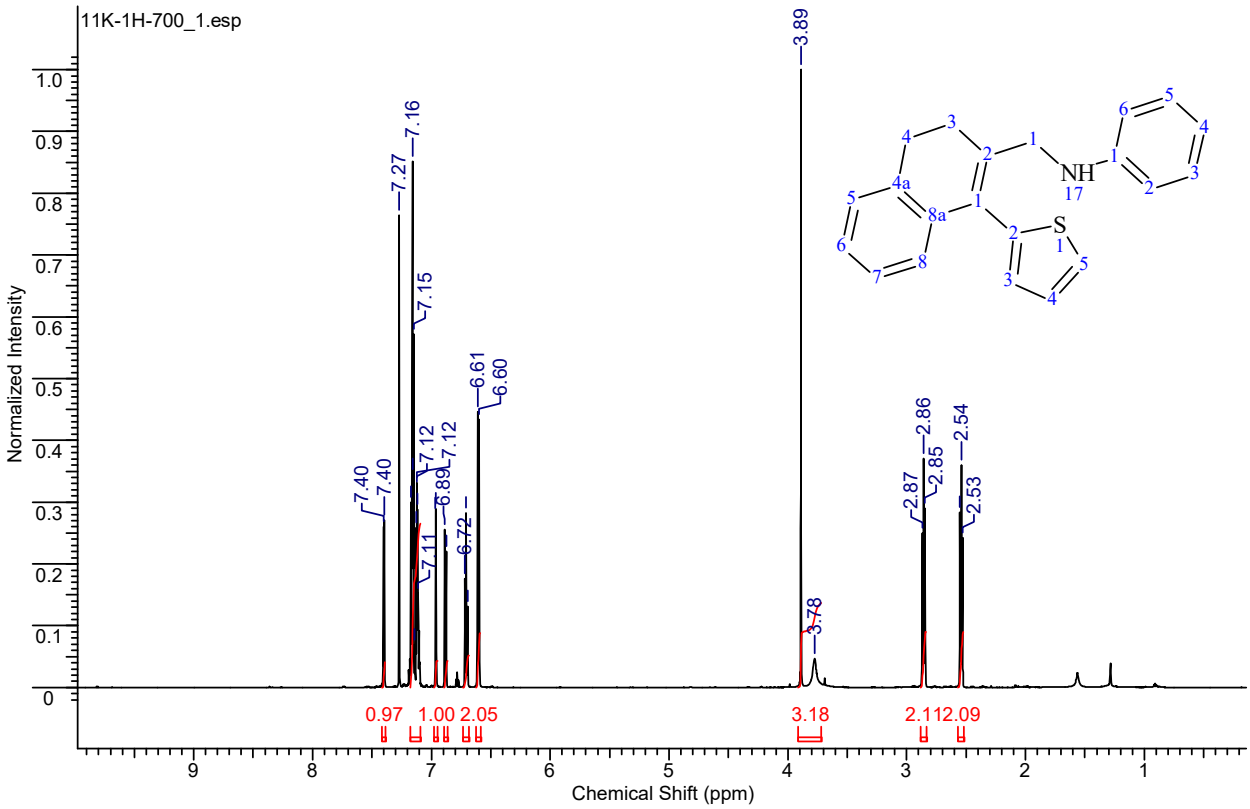


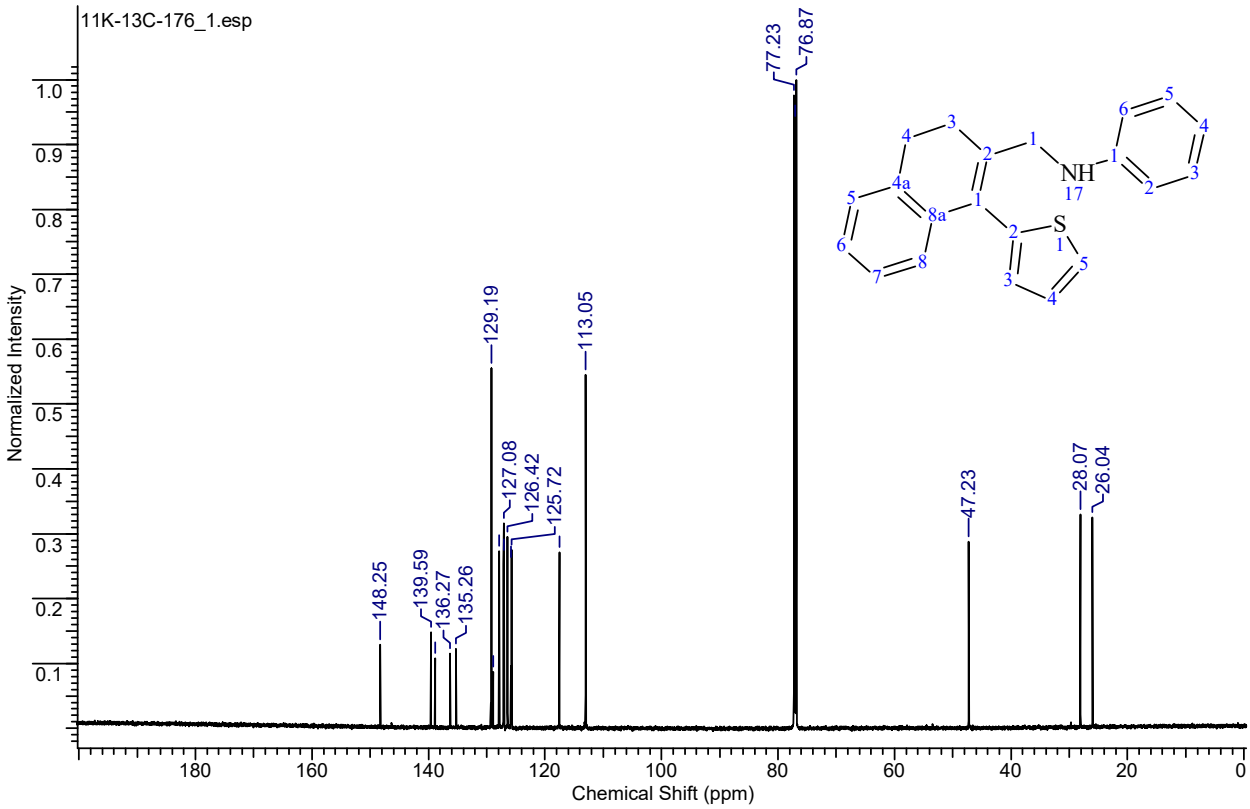
***N*-((2-(Thiophen-2-yl)cyclooct-1-en-1-yl)methyl)aniline (11j).**



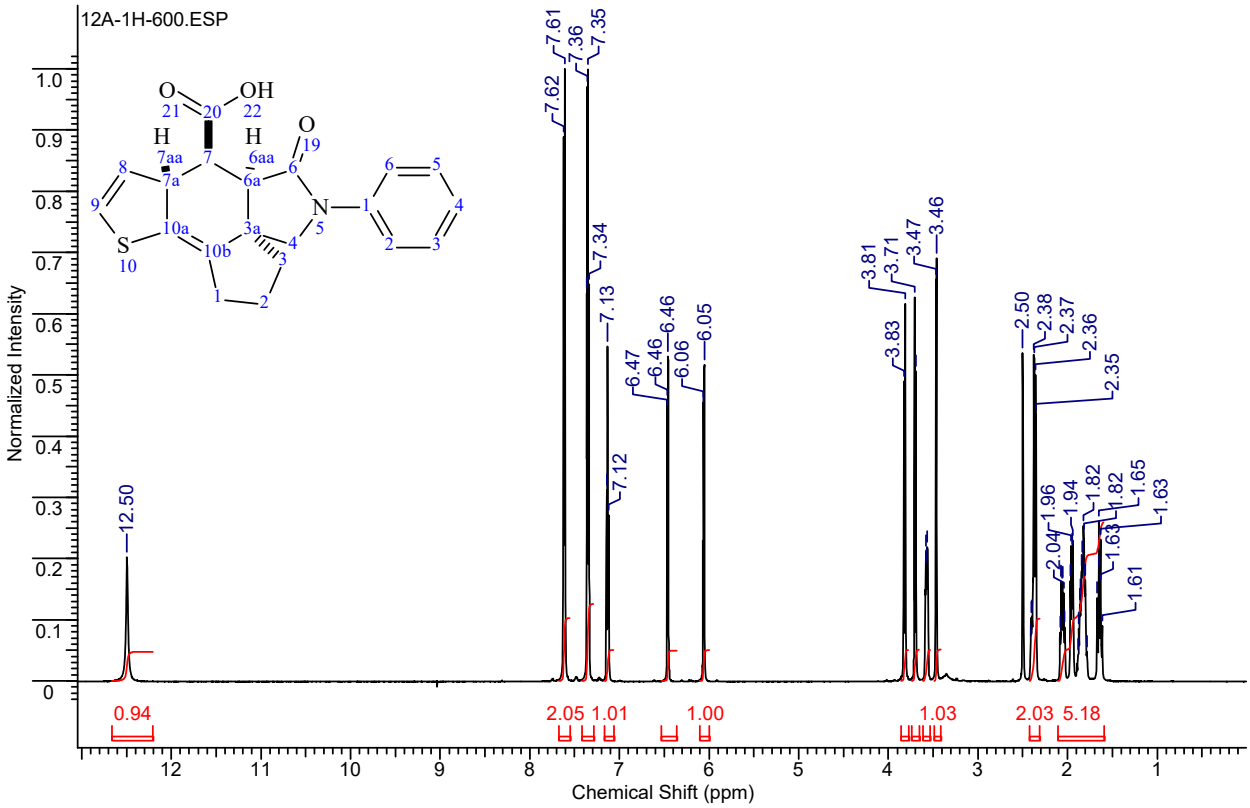


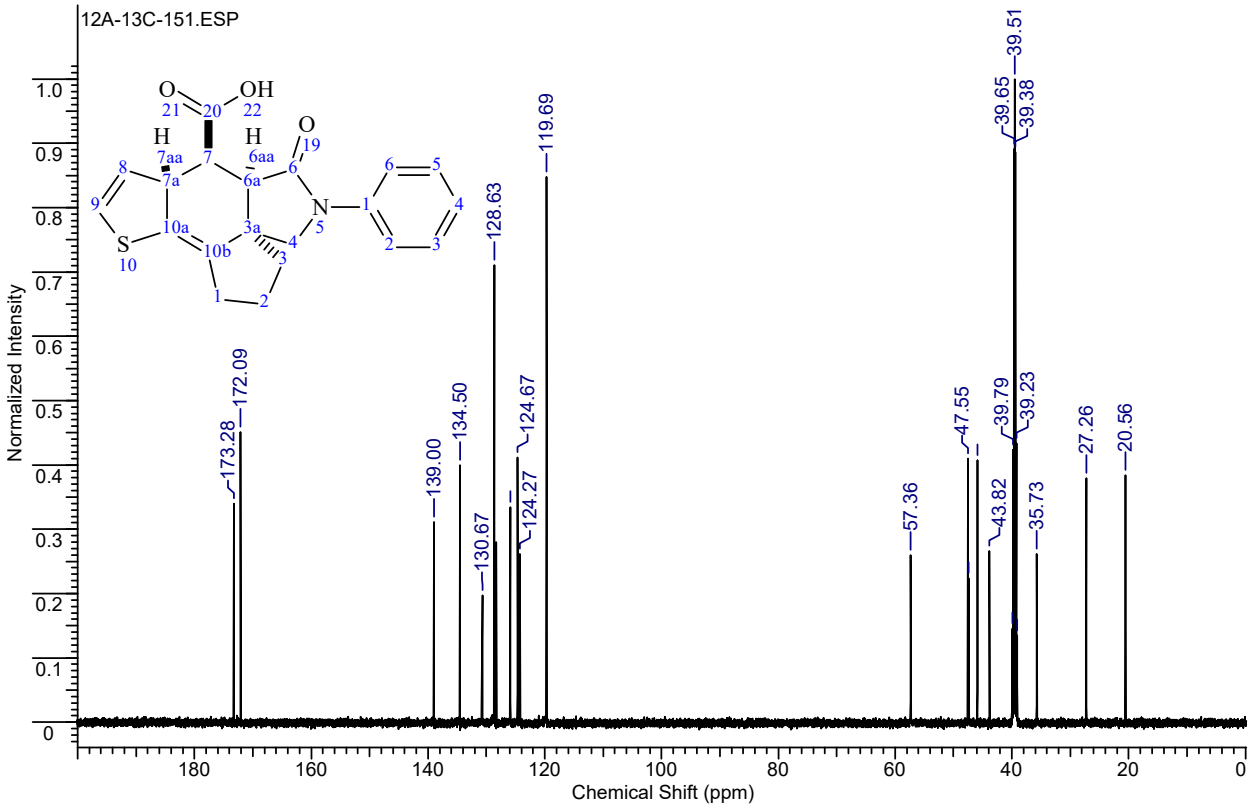
***N*-((1-(Thiophen-2-yl)-3,4-dihydronaphthalen-2-yl)methyl)aniline (11k).**

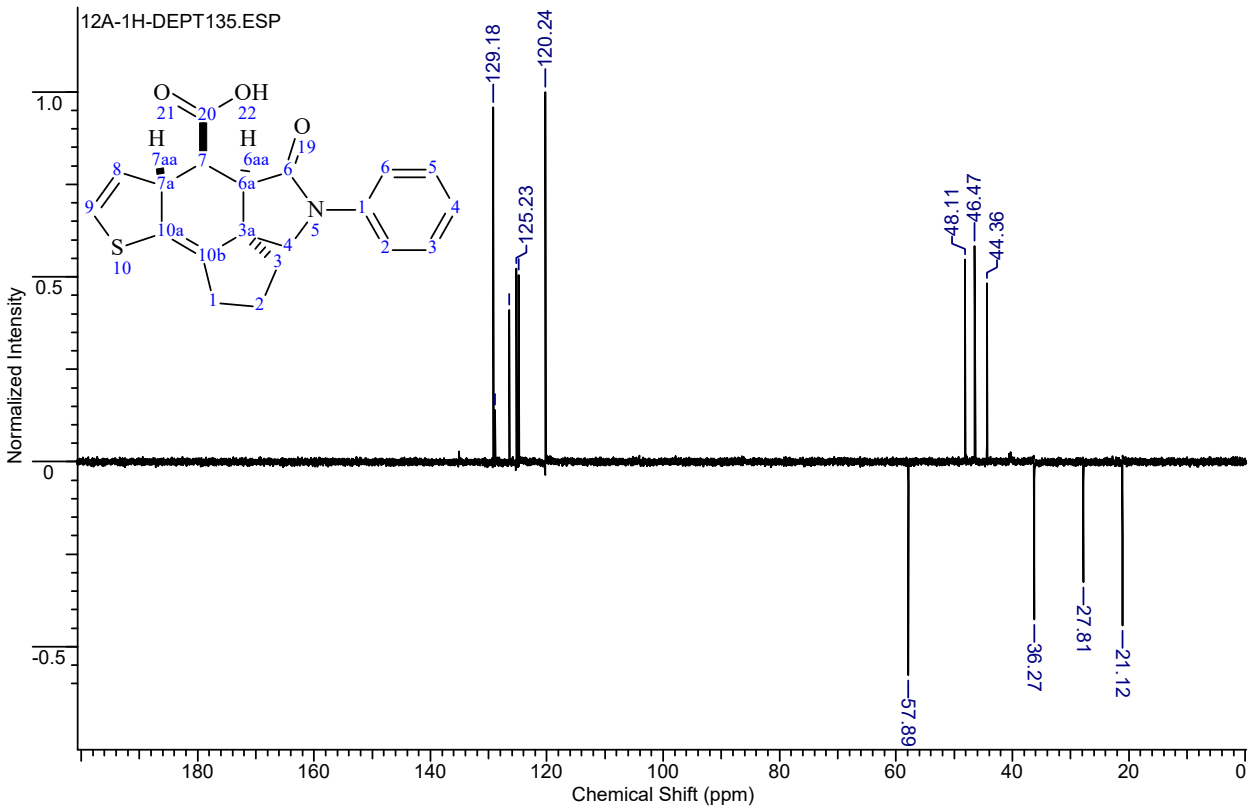




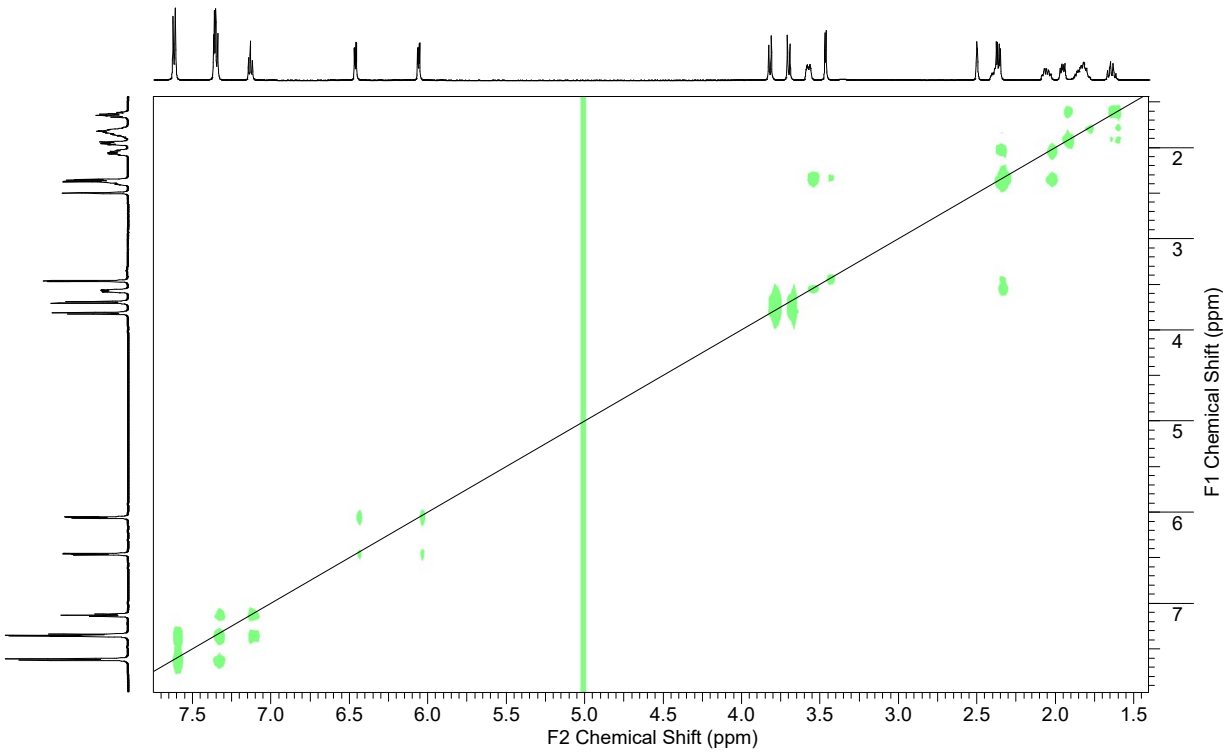
(3a*RS*,6a*RS*,7*SR*,7a*SR*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12a).

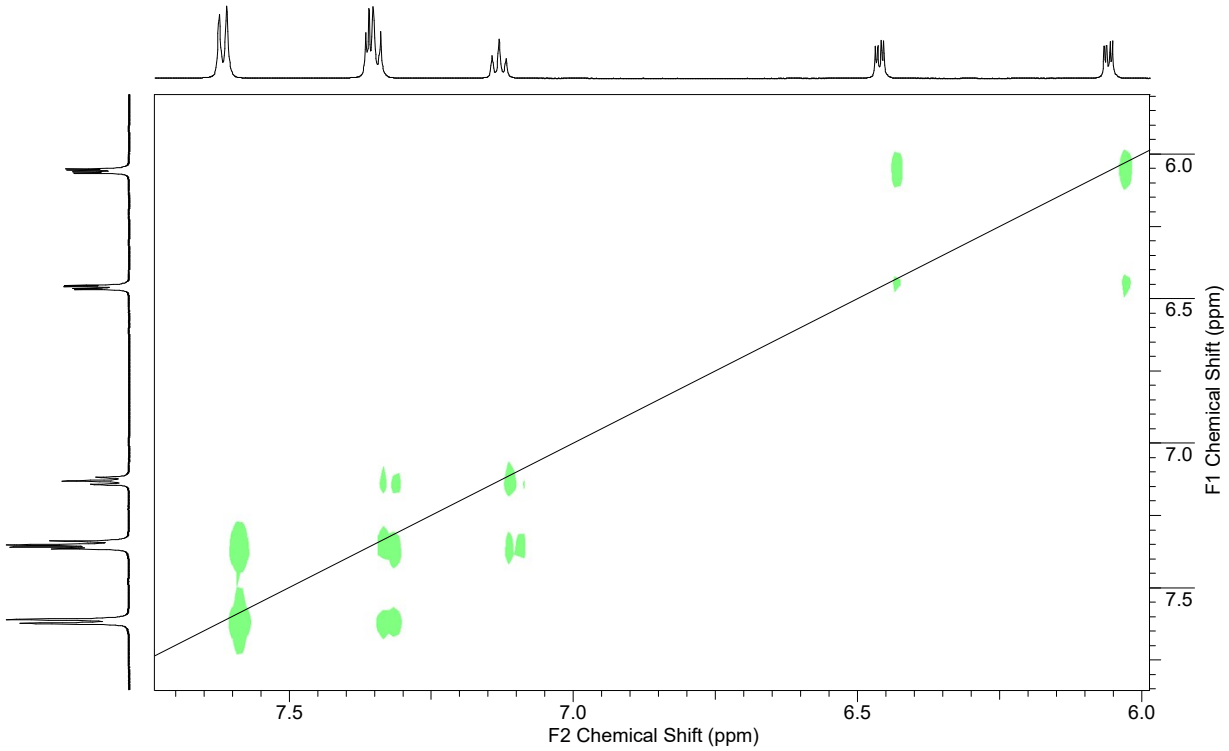


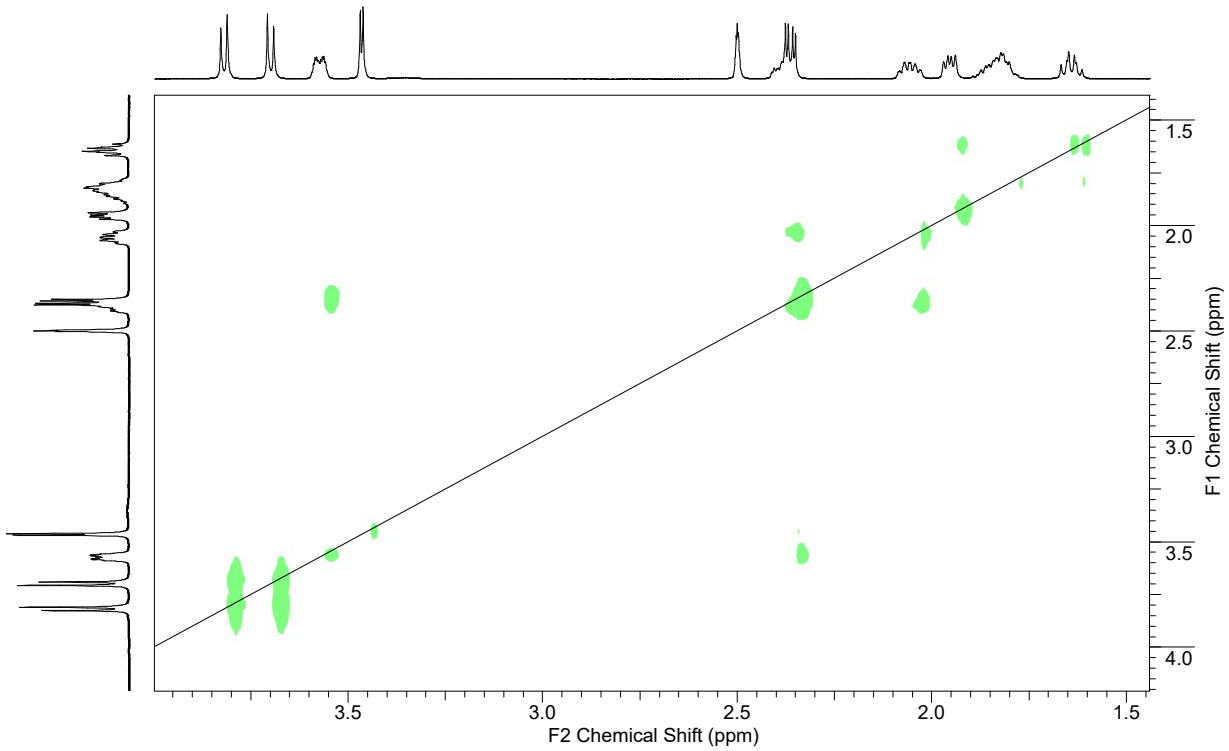



12A-1H-DEPT135.ESP
Normalized Intensity
Chemical Shift (ppm)
129.18
120.24
125.23
48.11
46.47
44.36
57.89
36.27
27.81
21.12

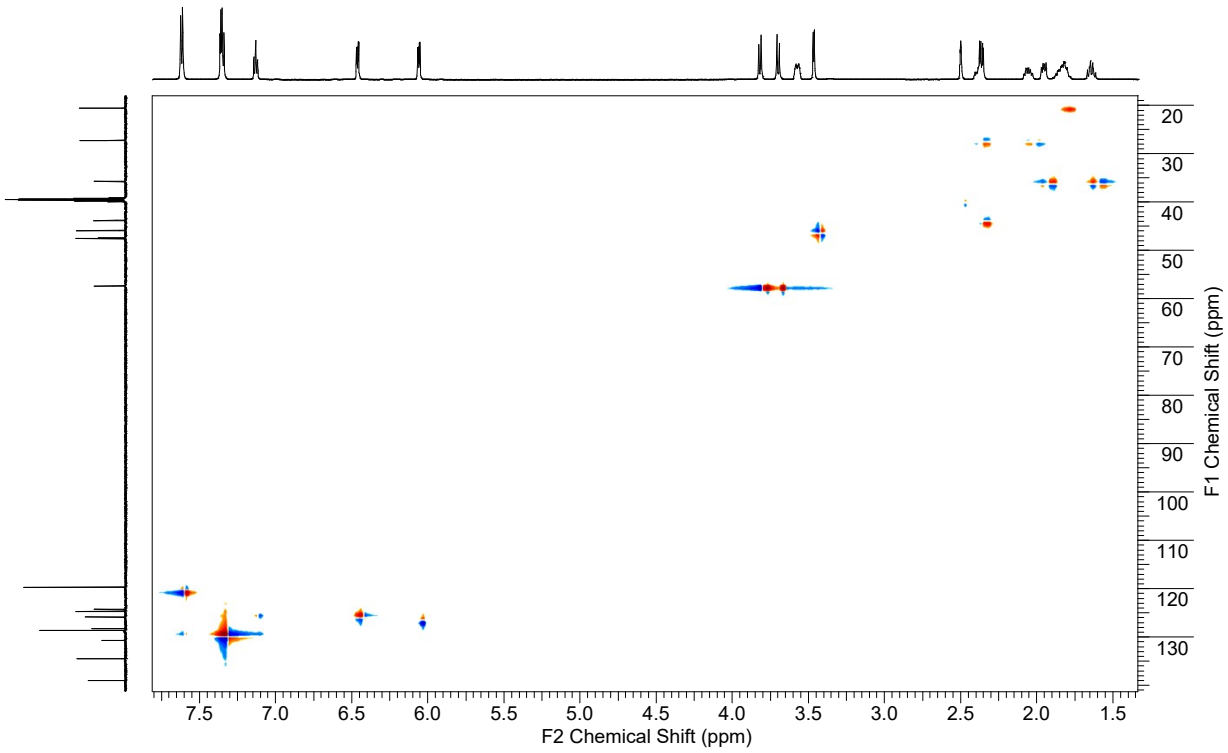
COSY of **12a**


F2 Chemical Shift (ppm)
F1 Chemical Shift (ppm)

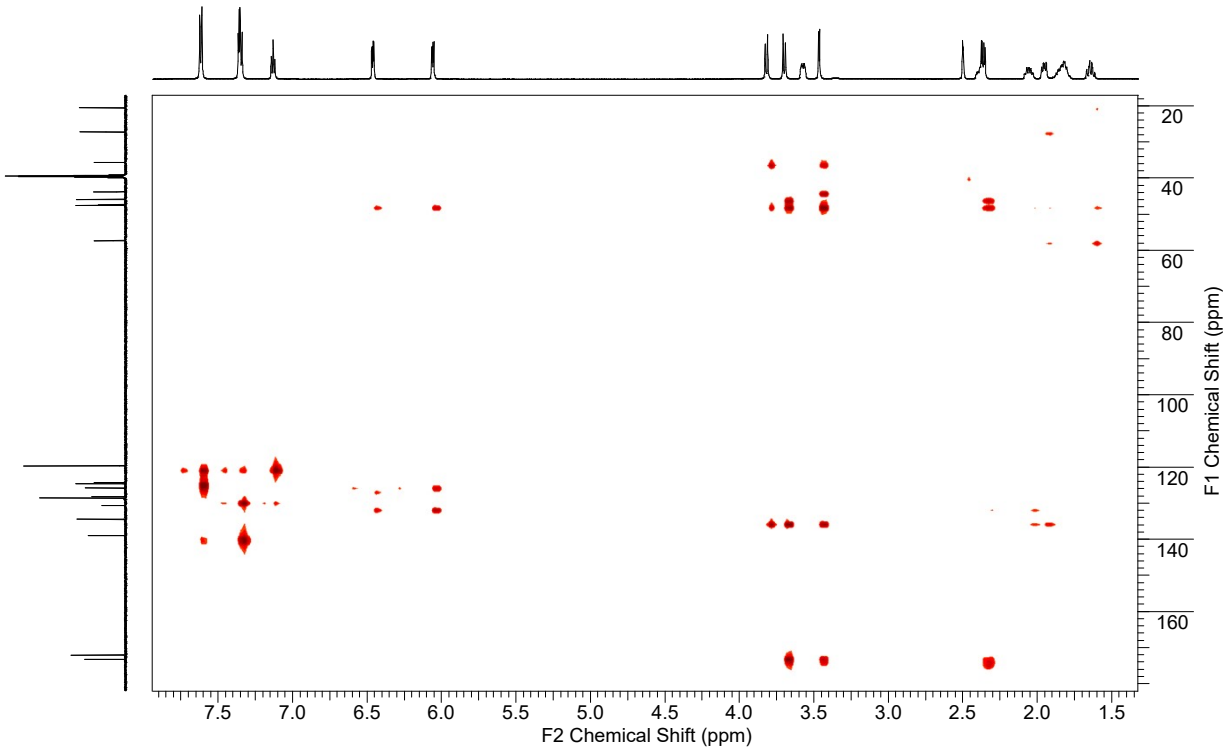

6.0
6.5
7.0
7.5
F1 Chemical Shift (ppm)
7.5
7.0
6.5
6.0
F2 Chemical Shift (ppm)


1.5
2.0
2.5
3.0
3.5
4.0
F1 Chemical Shift (ppm)
3.5
3.0
2.5
2.0
1.5
F2 Chemical Shift (ppm)

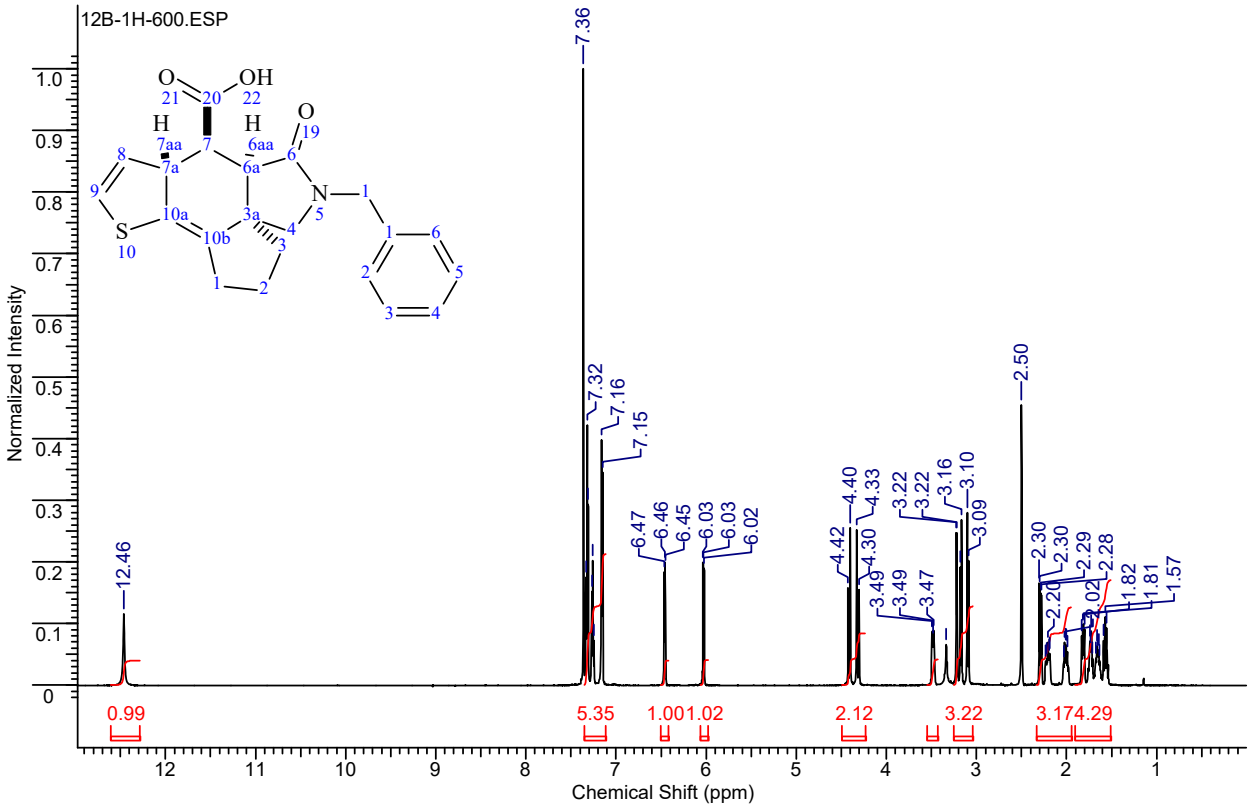
HSQC of **12a**

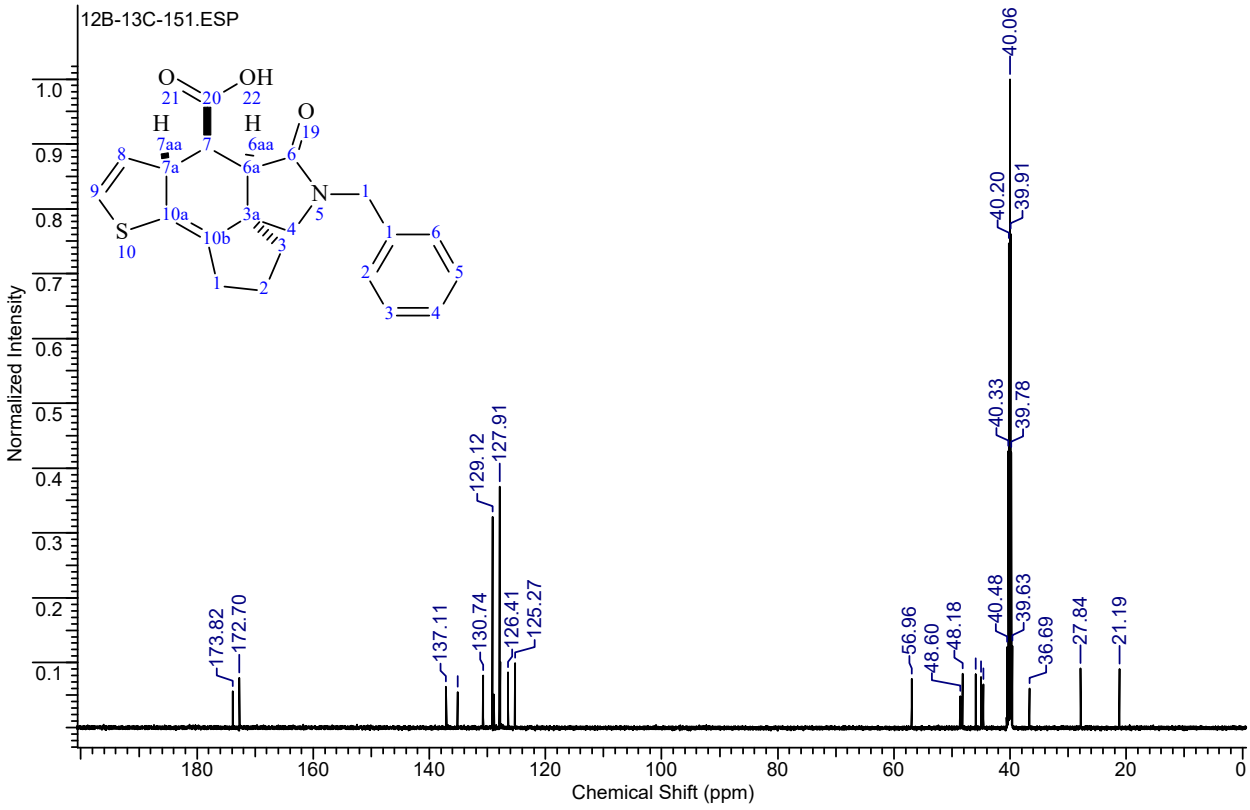


HMBC *of* **12a**

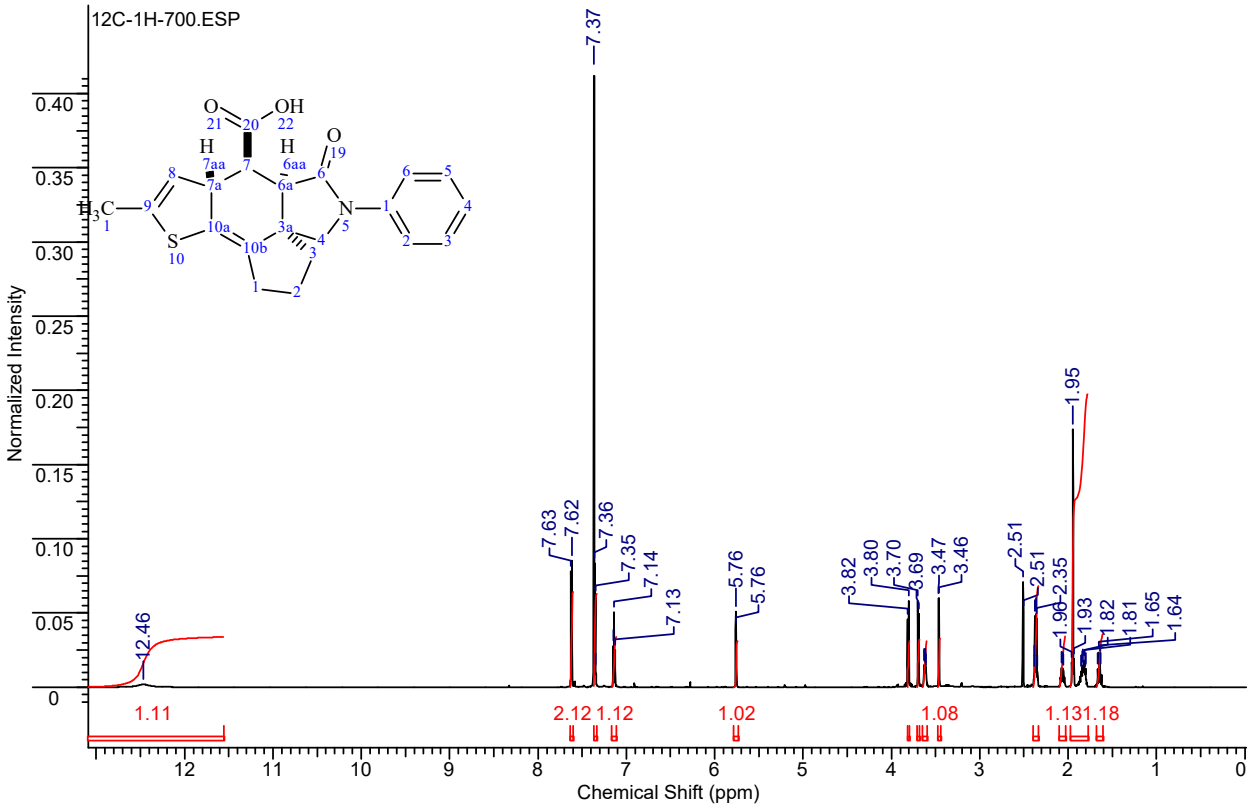


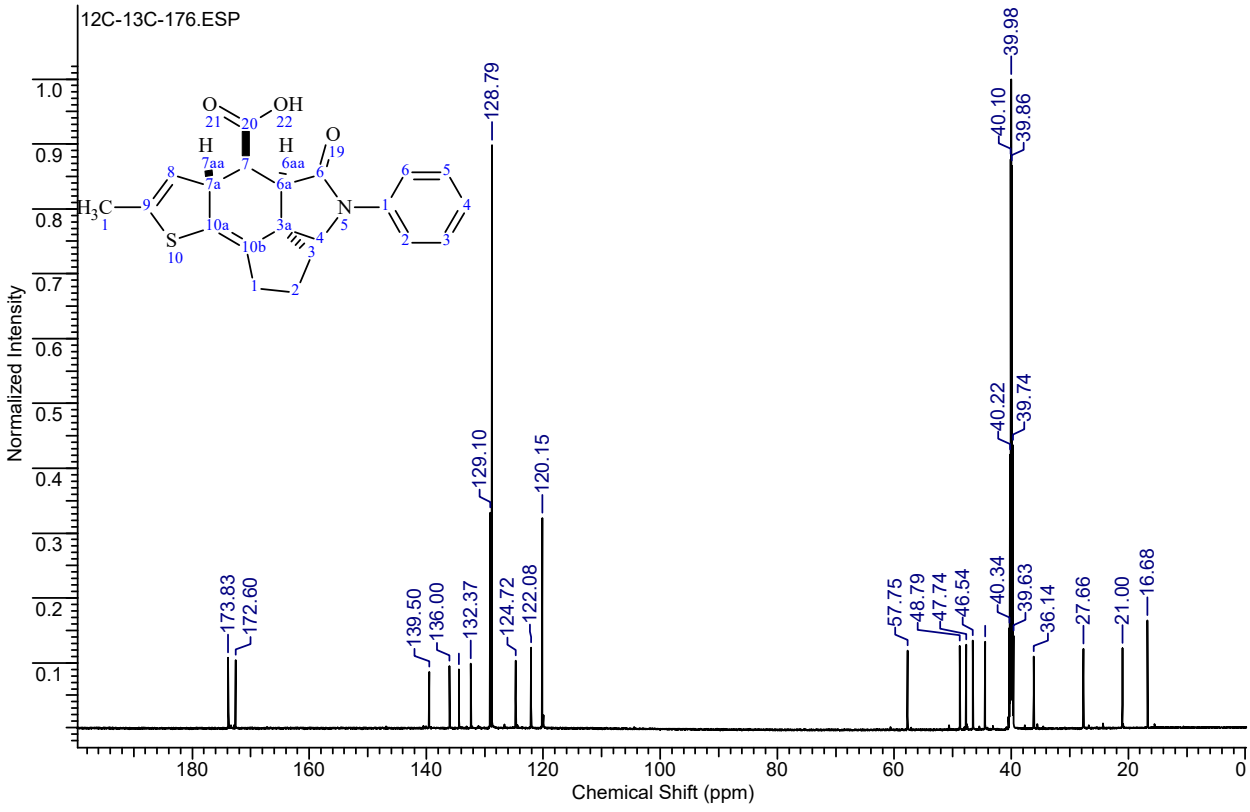
(3a*RS*,6a*RS*,7*SR*,7a*SR*)-5-Benzyl-6-oxo-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12b).



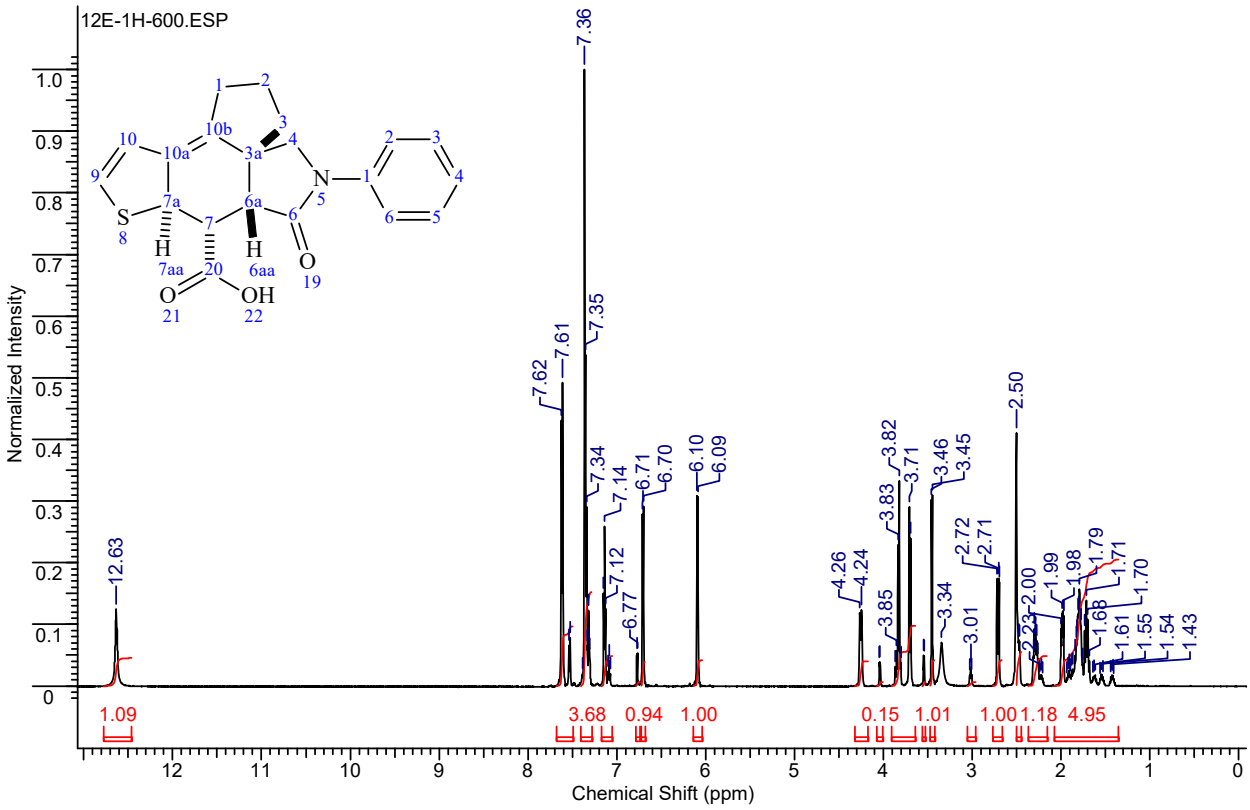


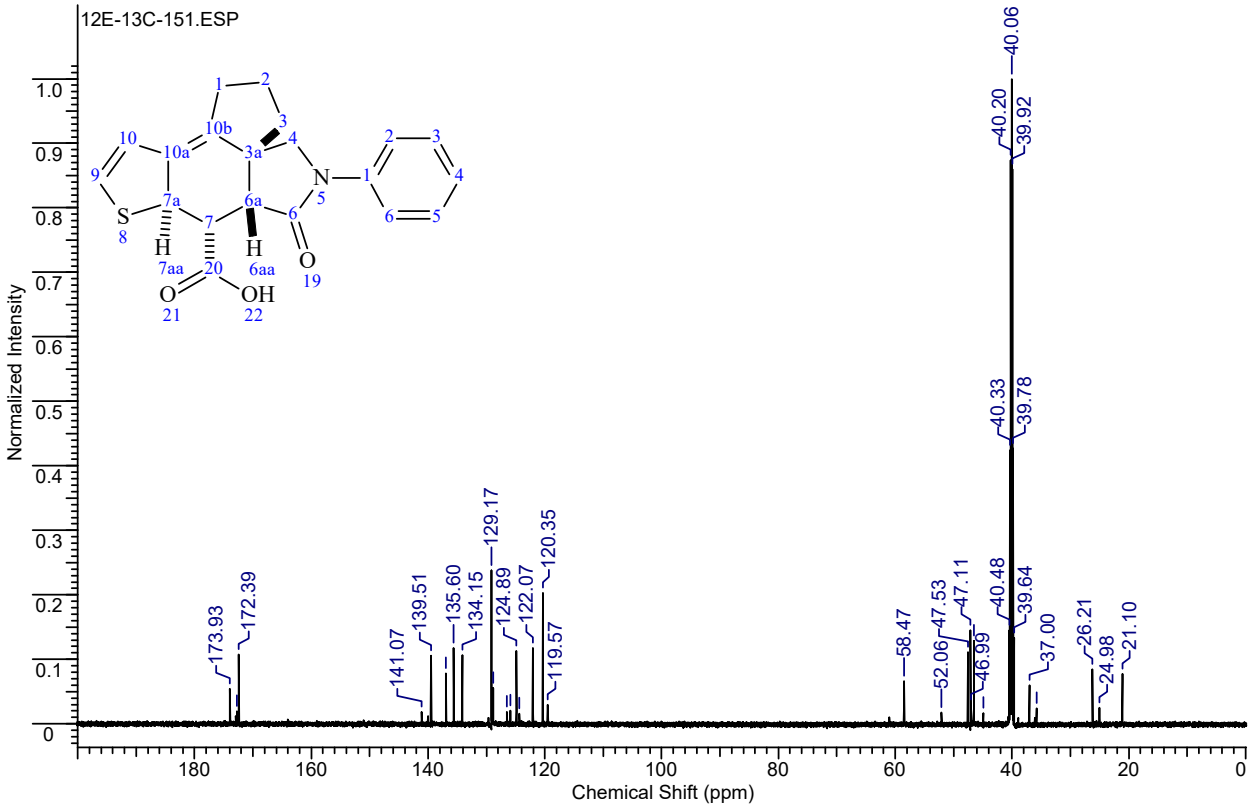
(3a*RS*,6a*RS*,7*SR*,7a*SR*)-9-Methyl-6-oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[2,3-*f*]isoindole-7-carboxylic acid (12c). *Contains an impurity of benzene*



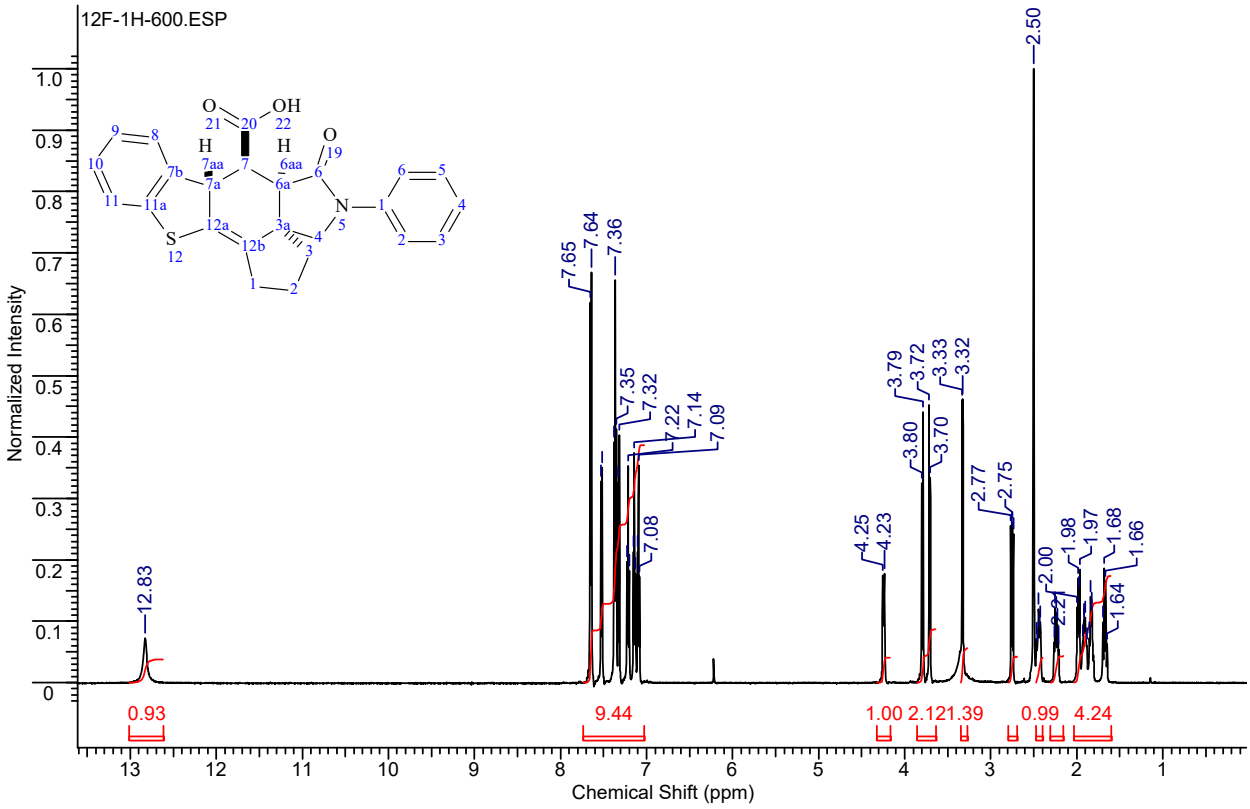


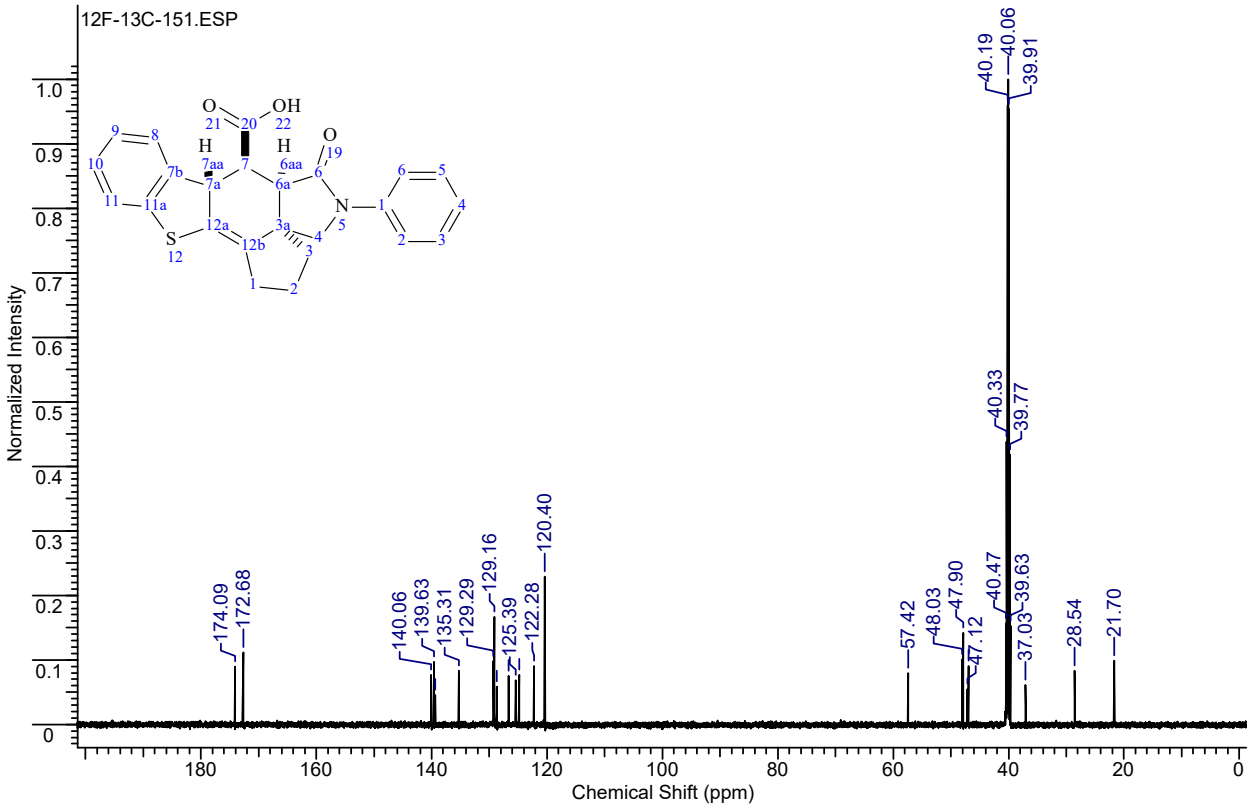
(3a*RS*,6a*RS*,7*RS*,7a*RS*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-cyclopenta[*d*]thieno[3,2-*f*]isoindole-7-carboxylic acid (12e). *Contains around 13% on an impurity of "aromatic" isomer.*



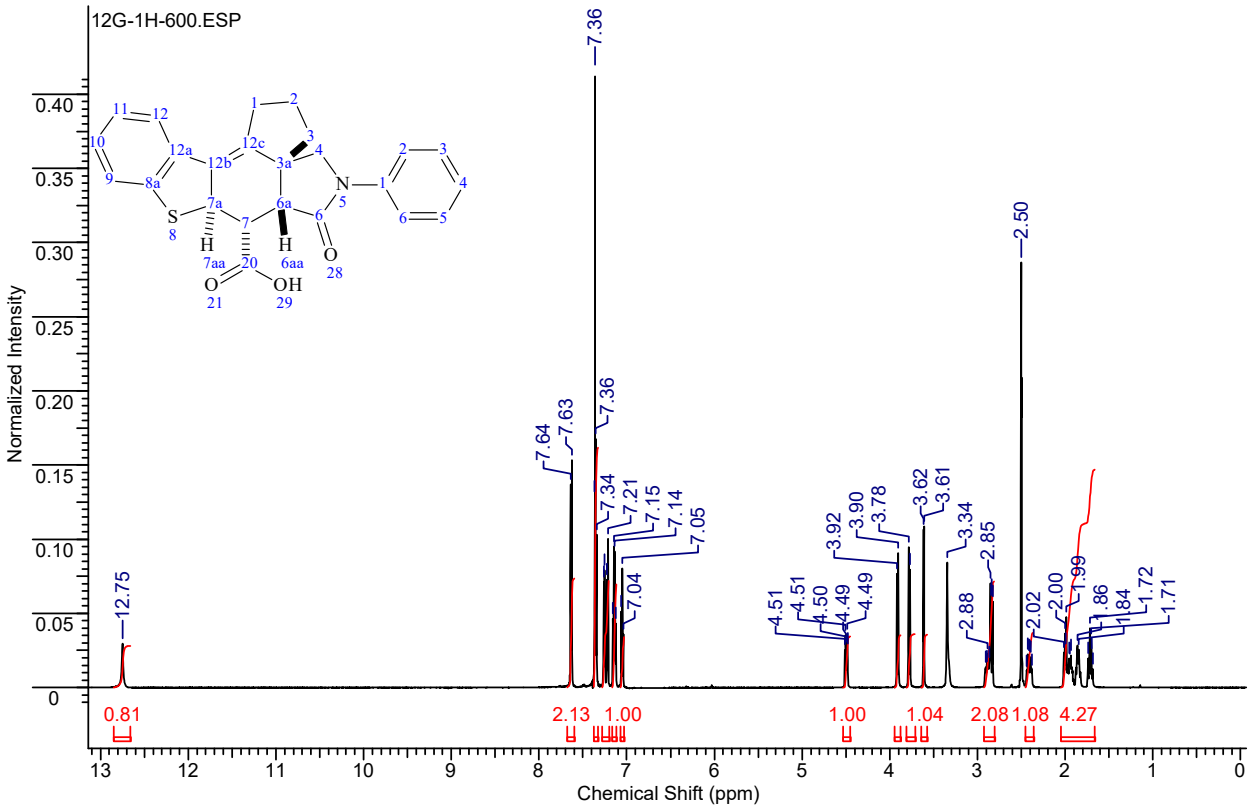


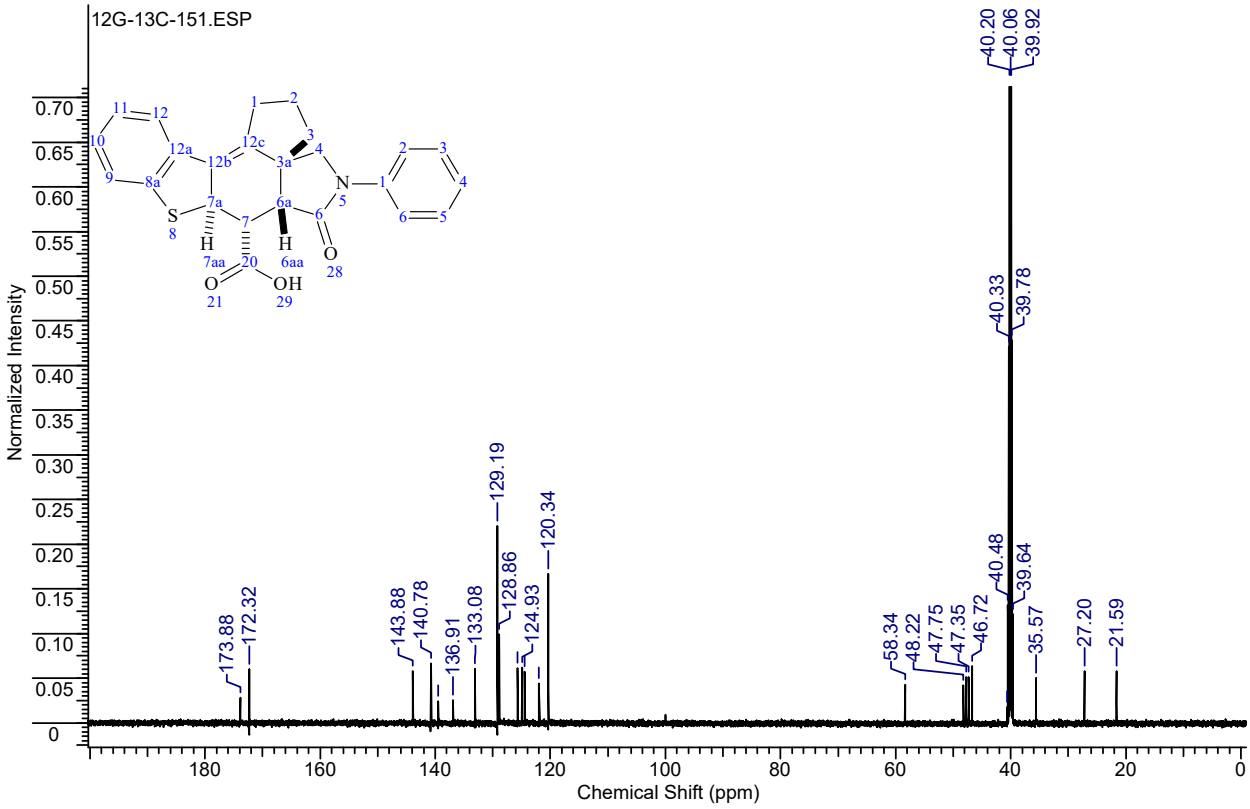
(3a*RS*,6a*RS*,7*SR*,7a*SR*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-benzo[4,5]thieno[2,3-*f*]cyclopenta[*d*]isoindole-7-carboxylic acid (12f).



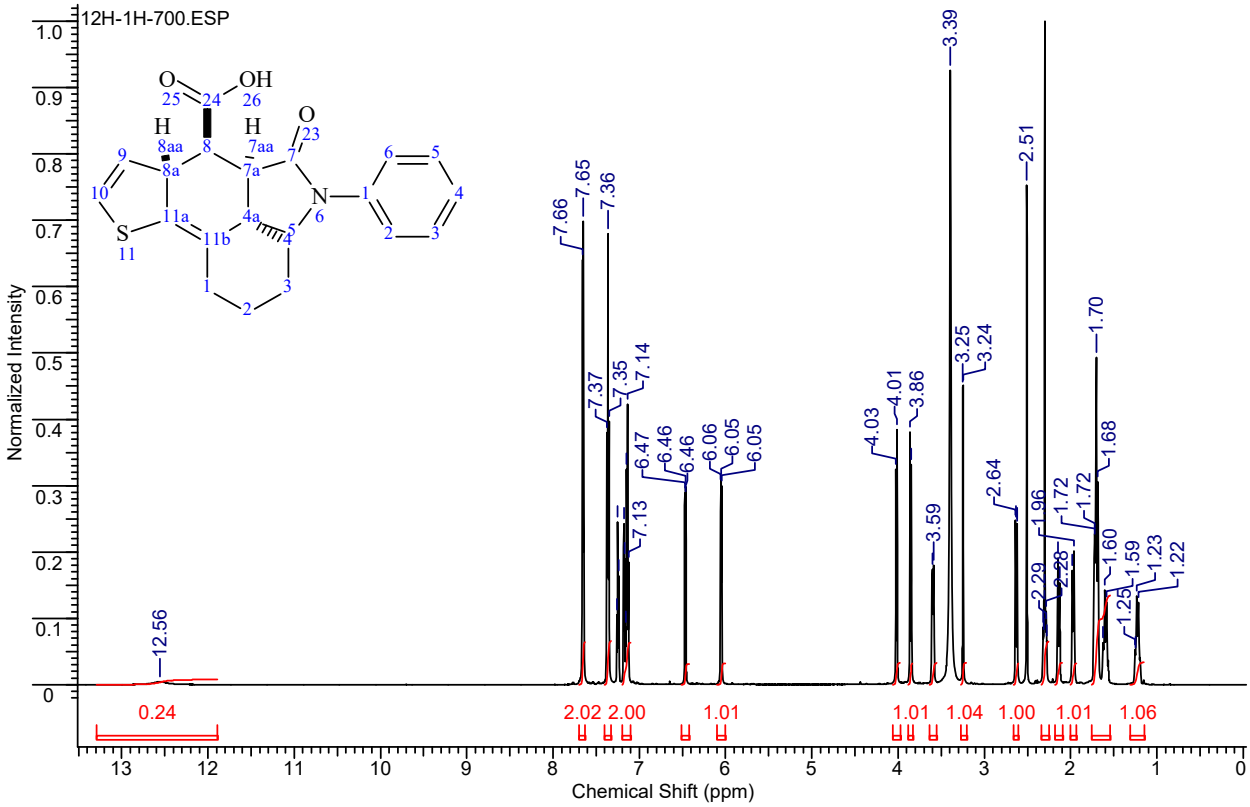


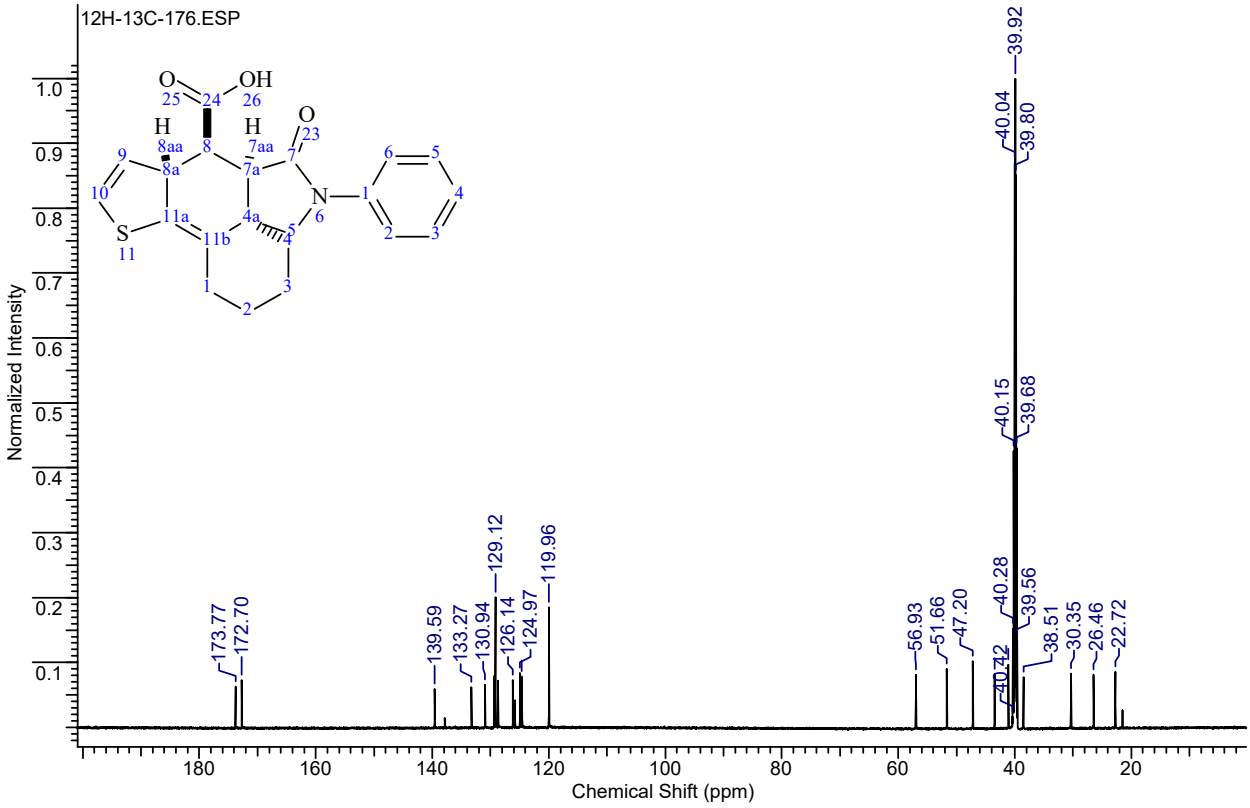
(3a*RS*,6a*RS*,7*RS*,7a*RS*)-6-Oxo-5-phenyl-2,3,4,5,6,6a,7,7a-octahydro-1*H*-benzo[4,5]thieno[3,2-*f*]cyclopenta[*d*]isoindole-7-carboxylic acid (12g). *Contains an impurity of benzene*



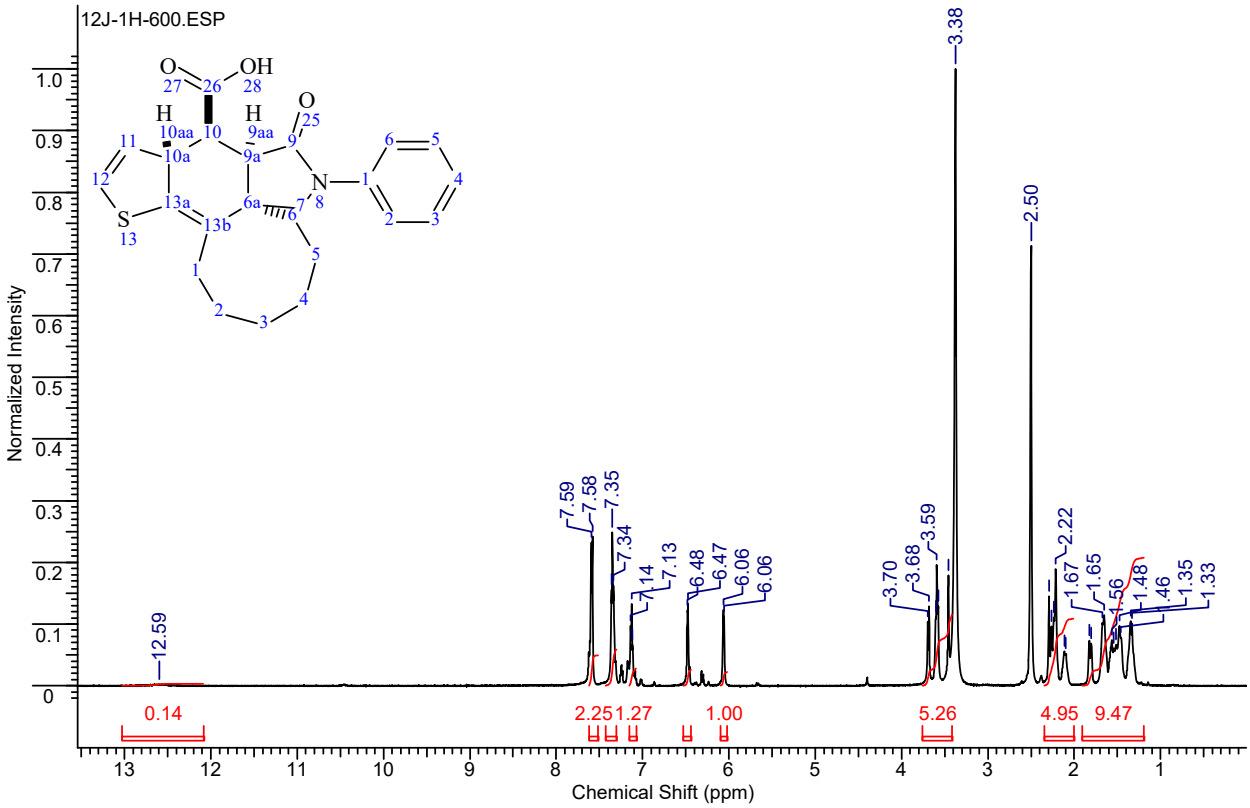


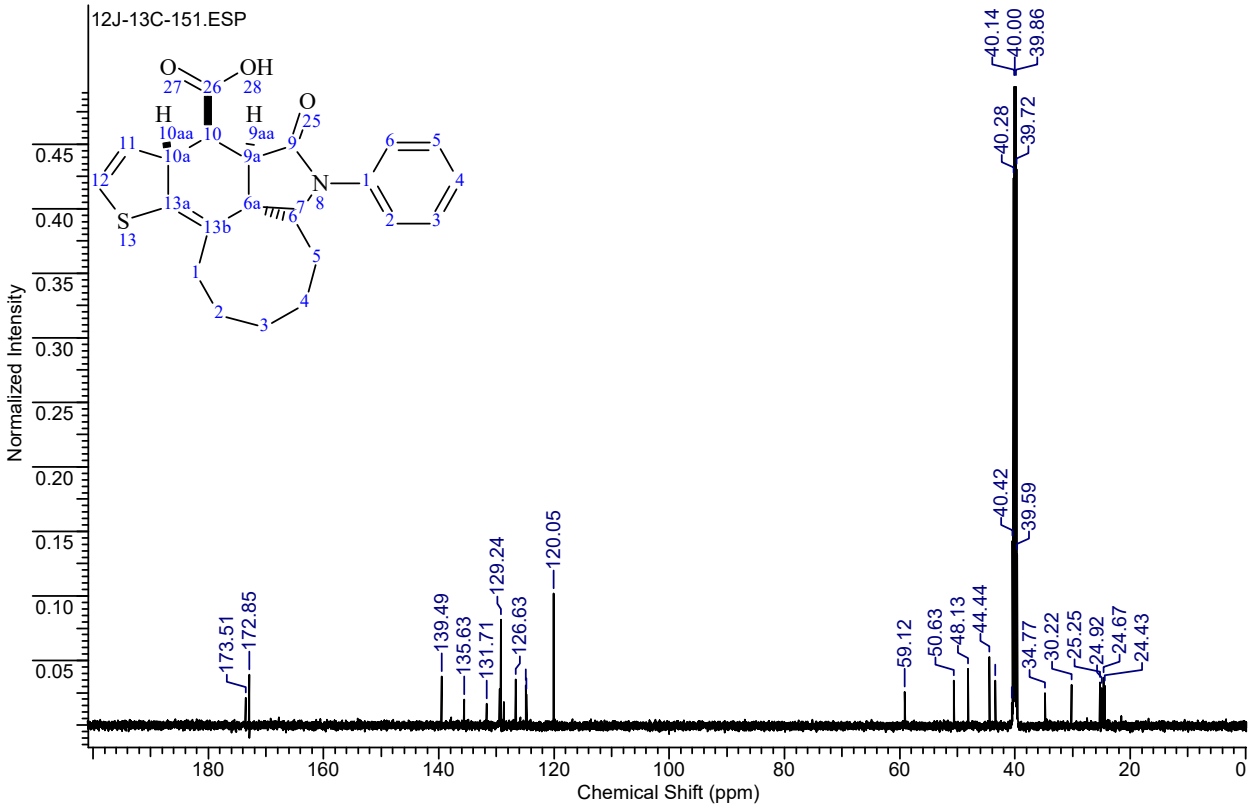
(4a*RS*,7a*RS*,8*SR*,8a*SR*)-7-Oxo-6-phenyl-1,2,3,4,5,6,7,7a,8,8a-decahydrobenzo[*d*]thieno[2,3-*f*]isoindole-8-carboxylic acid (12h). *Contains an impurity of toluene*





(6a*RS*,9a*RS*,10*SR*,10a*SR*)-9-Oxo-8-phenyl-1,2,3,4,5,6,7,8,9,9a,10,10a-dodecahydrocycloocta[*d*]thieno[2,3-*f*]isoindole-10-carboxylic acid (12j).





(6a*RS*,9a*RS*,10*SR*,10a*SR*)-9-Oxo-8-phenyl-5,6,7,8,9,9a,10,10a-octahydronaphtho[2,1-*d*]thieno[2,3-*f*]isoindole-10-carboxylic acid (12k).