Supporting Information

N-Heterocyclic Carbene and photocatalyst-catalyzed radical sp^3 C-H acylation for access to indole ketones

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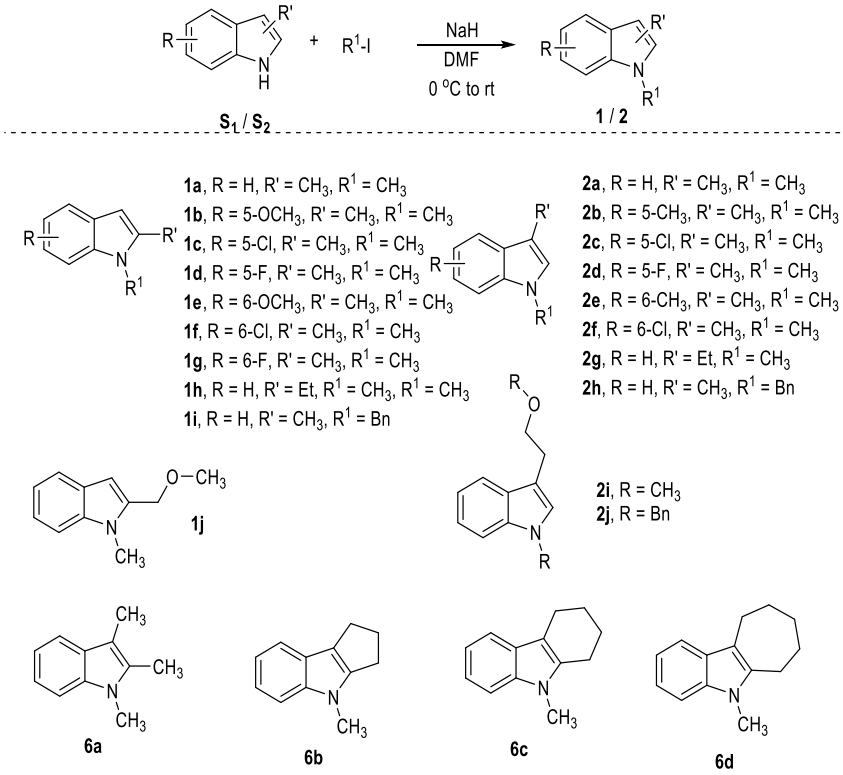
I. General information

Commercially available materials purchased from Energy Chemical were used as received. Unless otherwise specified, all reactions were carried out under an atmosphere in 10 mL dry Schlenk tube. NMR spectra were recorded on a Brüker ASCEND 400 (400 MHz) spectrometer (^{1}H: 400 MHz, ^{13}C: 101 MHz, ^{19}F: 377 MHz). Chemical shifts (δ) for ^{1}H and ^{13}C NMR spectra are given in ppm relative to TMS. The residual solvent signals were used as references for ^{1}H and ^{13}C NMR spectra and the chemical shifts converted to the TMS scale ($CDCl_3$: δH = 7.26 ppm, δC = 77.0 ppm). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, b = broad, and etc. All first-order splitting patterns were assigned on the base of the appearance of the multiplet. Splitting patterns that could not be easily interpreted are designated as multiplet (m) or broad (br). High resolution mass spectrometer analysis (HRMS) was performed on Thermo Fisher Q Exactive mass spectrometer. Melting point (m.p.): melting points were measured on a Beijing Tech Instrument X-4 digital display micro melting point apparatus and are uncorrected. Analytical thin-layer chromatography (TLC) was carried out on pre-coated silica gel plate (0.2 mm thickness).

II. Preparation of substrates

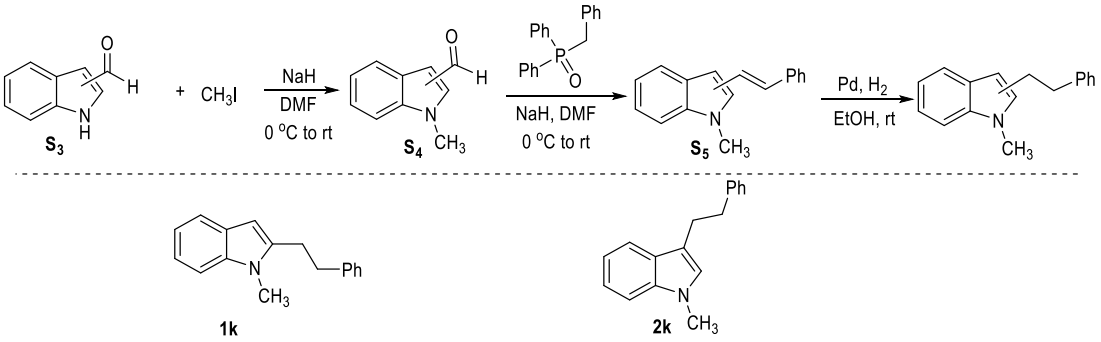
1. Preparation of substrates

Method 1: General Procedure for the Preparation of Indole derivatives[1]



To a stirred solution of NaH (1.2 equiv, 60% suspension in mineral oil) in dry DMF (10 mL), substrate $\mathbf{S_1}$ or $\mathbf{S_2}$ (1.0 equiv.) in DMF (5 mL) was added dropwise at 0°C. The mixture was allowed to warm up to room temperature and stirred for 30 min. After cooling down to 0 °C, iodomethane (1.2 equiv.) was added dropwise. The reaction mixture was stirred at room temperature for another 6 h and then it was quenched by the addition of water and was extracted with ethyl acetate (10 mL, 3 times). The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give the corresponding compounds **1** or **2**.

Method 2: General Procedure for the Preparation of **1-methyl-2-phenethyl-1*H*-indole**[2]



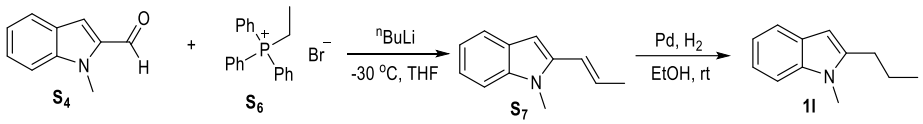
Step 1: Substrate $\mathbf{S_4}$ was synthesized according to **Method 1**.

Step 2: To a stirred solution of NaH (1.2 equiv, 60% suspension in mineral oil) in dry DMF (20

mL), diphenyl phosphoryl methylbenzene (1.2 equiv.) in DMF (10 mL) was added dropwise at 0°C. The mixture was allowed to warm up to room temperature and stirred for 30 min. After cooling down to 0 °C, substrate **S4** (1.0 equiv.) was added dropwise. The reaction mixture was stirred at room temperature for another 6 h and then it was quenched by the addition of water and was extracted with ethyl acetate (10 mL, 3 times). The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give the corresponding compounds **S5**.

Step 3: To a 100 mL flame-dry Schlenk reaction tube equipped with a magnetic stir bar was added compound **S5** (1.0 equiv.) and Pd/C (0.1 equiv.), the Schlenk tube was sealed with a septum, evacuated and refilled with H_2 (3 cycles, balloon). EtOH (30 mL) was then added via syringe. The reaction mixture was allowed to stir for 12 h at room temperature. The mixture was concentrated under reduced pressure, the resulting crude residue was purified via column chromatography on silica gel to afford the desired product **1-methyl-2-phenethyl-1*H*-indole**.

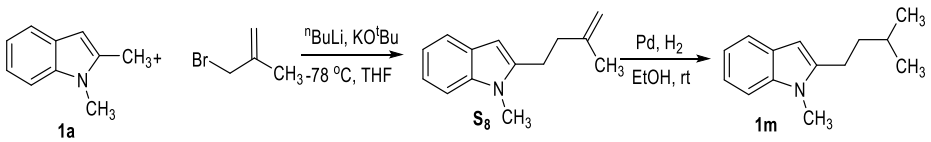
Method 3: General Procedure for the Preparation of **1-methyl-2-propyl-1*H*-indole (1l)**[2]



Step 1: To suspension of the corresponding triphenyl phosphonium bromide **S6** (1.2 equiv.) in THF (30 mL), at -30 °C, a solution of the corresponding base (1.2 equiv.) was slowly added. The resulting mixture was stirred and allowed to warm to 0 °C during 45 minutes. The reaction was cooled to -30 °C, substrate **S4** (1.0 equiv.) in THF (20 mL) was added. The resulting suspension was then stirred at room temperature for 3 h, then poured onto H_2O and extracted with EtOAc. The combined organic phases were dried over Na_2SO_4 and concentrated under vacuum. The residue was purified by flash chromatography on silica gel to give the corresponding compounds **S7**.

Step 2: **1-methyl-2-propyl-1*H*-indole** was synthesized according to Step 3 of **Method 2**.

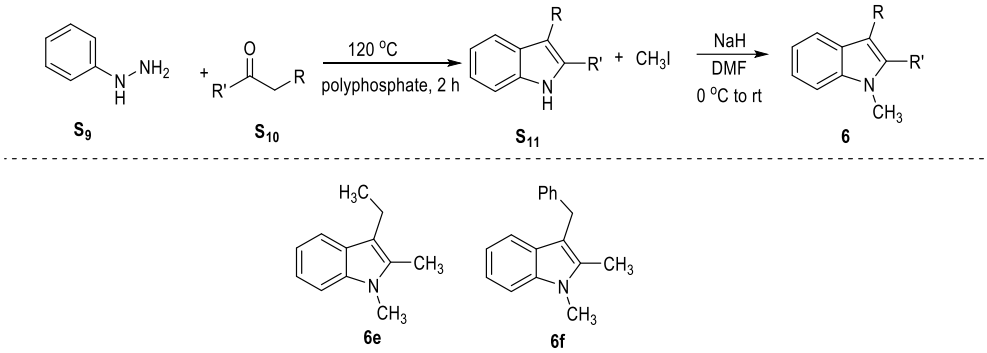
Method 4: General Procedure for the Preparation of **2-isopentyl-1-methyl-1*H*-indole (1m)**[3]



Step 1: In a nitrogen-filled round bottom flask, 2-methylindole **1a** was dissolved in THF at room temperature. Butyllithium in hexane solution (2.5 M, 1.2 equiv.) was added dropwise to the stirring mixture. Then potassium tert-butoxide (1.2 equiv.) was added in one portion. The color of the mixture became bright yellow. After stirring for 30 min, the mixture was cooled to - 78 °C, bromide (3.0 equiv.) was added dropwise. After stirring for another 2 hours at -78 °C, several drops of water were added to quench the reaction. Ammonium chloride solution was added to adjust the pH to neutral. After separation, the aqueous layer was washed with ether and the organic layer was combine. The ether solution was dried over anhydrous sodium sulfate and then the volatile was evaporated under reduced pressure. The crude product was purified by flash chromatography to afford the desired product **S8**.

Step 2: **2-isopentyl-1-methyl-1*H*-indole** (**1m**) was synthesized according to Step 3 of **Method 2**.

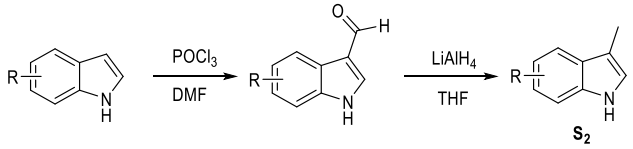
Method 5: General Procedure for the Preparation of **1,2-dimethyl-1H-indole** (**6**)[1]



Step 1: A round bottom flask was charged with phenyl hydrazine **S9** (1.0 equiv), Substrate **S10** (1.5 equiv) and polyphosphate (15 g). The mixture was heated at 120 °C for 2 hours and cooled back to room temperature. Then it was quenched by the addition of water and was extracted with ethyl acetate (10 mL, 3 times). The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to give the corresponding compounds **S11**.

Step 2: **1,2-dimethyl-1*H*-indole** (**6**) was synthesized according to **Method 1**.

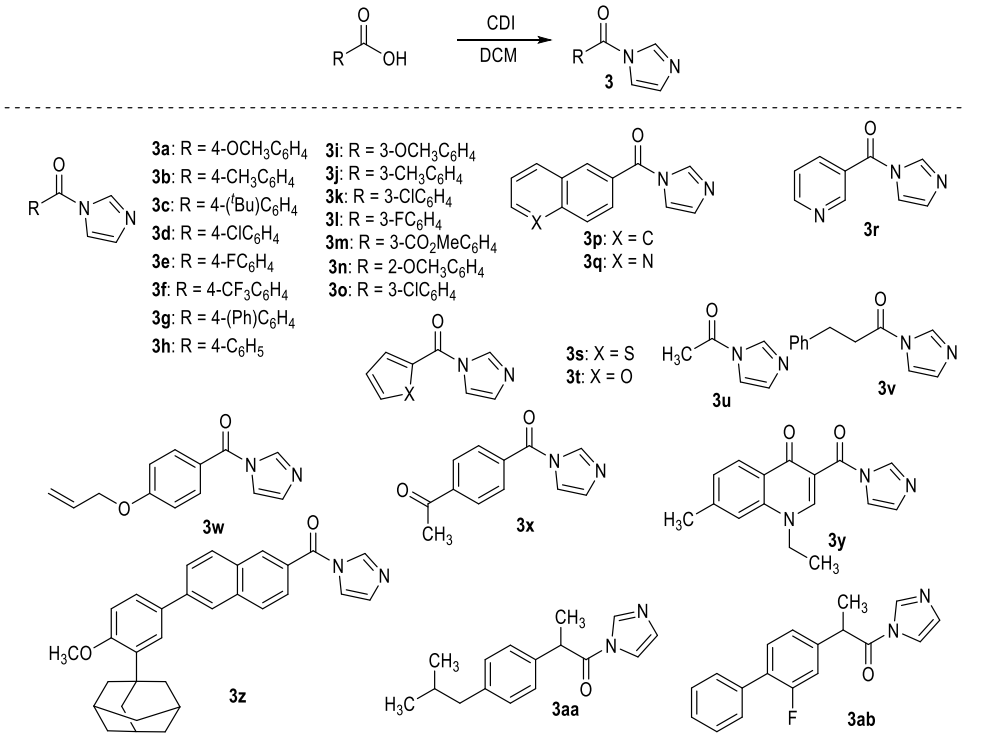
Method 6: General Procedure for the Preparation of **3-methyl-1*H*-indole**[1]



Step1: Phosphorus oxychloride (1.2 equiv.) was added dropwise to DMF (20 mL) with ice-bath. The mixture was stirred for 5 min then added to a solution of 1*H*-indole (1.0 equiv) in DMF (10 mL) at 0 °C. The mixture was then warm to room temperature and stirred for 30 min. The reaction became a heavy suspension that required vigorousstirring 5.0 M aqueous potassium hydroxide was added until pH>9 and the mixture was heated at 100 °C for 2 h. The resulting suspension was cooled down to 0 °C, the precipitate was filtered off, washed with water then dried under vacuum overnight and used in the next step without further purification.

Step 2: To a suspension of $LiAlH_4$ (2.0 equiv.) in THF (55 mL) at 0 °C under argon atmosphere was added previously synthesized 3-formyl-1H-indole (1.0 equiv.) over spatula. The suspension was then warm to room temperature and stirred for 4 h. The reaction was cooled down at 0 °C, distillated water (0.5 mL) was added dropwise then aqueous solution of NaOH 10% (0.5 mL) then again H_2O (1.0 mL). The resulting slurry was strirred vigorously for 30 min, diluted with Et_2O and anhydrous $MgSO_4$ was added. The white precipitate was filtered on Celite then washed with Et_2O. The solvent was removed under vacuum and the product was used in the next step without further purification.

2. Preparation of substrates 3[4]



Charge a round bottomed flask equipped with a stir bar with acid (10 mmol) and DCM (0.4 M based on carboxylic acid). Add *N, N′*-carbonyldiimidazole (20 mmol) slowly to the mixture at room temperature. Stir the resulting mixture for at room temperature overnight. Add water to the mixture. Wash the separated organic layer with water twice and brine once. Dry the organic phase over Na_2SO_4. Filter the organic phase. Concentrate the organic phase under reduced pressure.

References:

1. Kim, W.; Koo, J.; Lee, H. G. Benzylic C(sp^3)–C(sp^2) cross-coupling of indoles enabled by oxidative radical generation and nickel catalysis. *Chem. Sci.* **2021**, *12*, 4119-4125.

2. Rojas-Martín, J.; Veguillas, M.; Ribagorda, M.; Carreño, M. C. Synthesis of indole substituted twistenediones from a 2-quinonyl boronic acid. *Org. Lett.* **2013**, *15*, 5686-5689.

3. Wen, J.; Fan, X.; Tan, R.; Chien, H.-C.; Zhou, Q.; Chung, L. W.; Zhang, X. Brønsted-acid-promoted Rh-Catalyzed asymmetric hydrogenation of *N*-unprotected indoles: A cocatalysis of transition metal and anion binding. *Org. Lett.* **2018**, *20*, 2143-2147.

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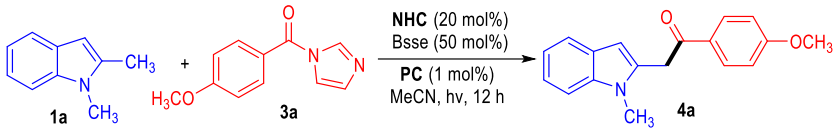
III. Condition optimization

Table 1. Optimization of 2-methylindole condition



Entry	Variation from standaed conditions	**4a**/yield[b]
1	none	75
2	**PC-1**instead of **PC-2**	50
3	**PC-3** instead of **PC-2**	0
4	**PC-4** instead of **PC-2**	55
5	**PC-5** instead of **PC-2**	21
6	**PC-4** (5 mol%)	68
7	**B** instead of **A**	Trace
8	**C** instead of **A**	23
9	**D** instead of **A**	0
10	K_3PO_4 instead of Cs_2CO_3	39
11	K_2CO_3 instead of Cs_2CO_3	18
12	Na_2CO_3, $NaHCO_3$ instead of Cs_2CO_3	0-trace
13	DMF instead of MeCN	57
14	DMSO instead of MeCN	46
15	Toluene instead of MeCN	36
16	Cs_2CO_3 (0.2 eq)	69
17	Cs_2CO_3 (0.3 eq)	73
18	Cs_2CO_3 (1.0 eq)	48
19	**3a** (1.2 equiv.)	17
20	**3a** (1.5 equiv.)	64
21	NHC (5 mol%.)	36
22	NHC (10 mol%.)	38
23	Without **NHC** or **PC** catalyst	0
24	Without light irradiation	0

[a] substrate **1a** (0.1 mmol), substrate **3a** (0.20 mmol), **NHC A** (20 mol%), **PC** (0.001 mmol), and Cs_2CO_3 (0.05 mmol, 0.5 equiv.) in MeCN (2.0 mL) under irradiation with a 9 W blue LED (450-465 nm) for 12 h. [b]Isolated yield of **4a** based on substrate **1a**.

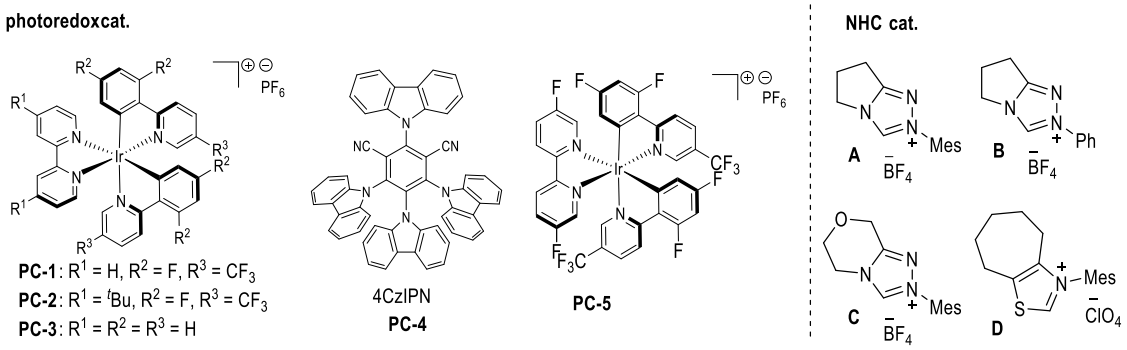
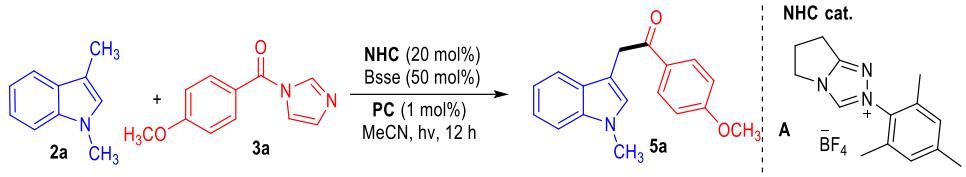


Table 2. Optimization of 3-methylindole condition

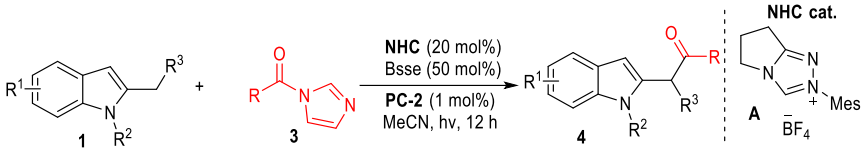


Entry	PC	Blue LED	Base	Solvent	5a/yield[b]
1	**PC-1**	450-465 nm (9 W)	Cs_2CO_3	MeCN	36
2	**PC-2**	450-465 nm (9 W)	Cs_2CO_3	MeCN	59
3	**PC-3**	450-465 nm (9 W)	Cs_2CO_3	MeCN	0
4	**PC-4**	450-465 nm (9 W)	Cs_2CO_3	MeCN	33
5	**PC-5**	450-465 nm (9 W)	Cs_2CO_3	MeCN	17
6	**PC-2**	450-465 nm (9 W)	KO^{t}Bu	MeCN	Trace
7	**PC-2**	450-465 nm (9 W)	K_3PO_4	MeCN	trace
8	**PC-2**	450-465 nm (9 W)	K_2CO_3	MeCN	18
9	**PC-2**	450-465 nm (9 W)	Na_2CO_3	MeCN	<10
10	**PC-2**	450-465 nm (9 W)	KH_2PO_4	MeCN	0
11	**PC-2**	450-465 nm (9 W)	Cs_2CO_3	DMSO	36
12	**PC-2**	450-465 nm (9 W)	Cs_2CO_3	DMF	50
13	**PC-2**	450-465 nm (9 W)	Cs_2CO_3	Toluene	trace
14	**PC-2**	450-465 nm (9 W)	Cs_2CO_3	DCM	<10
15	**PC-2**	450-465 nm (9 W)	Cs_2CO_3 (0.2 eq)	MeCN	47
16	**PC-2**	450-465 nm (9 W)	Cs_2CO_3 (0.4 eq)	MeCN	54
17	**PC-2**	450-465 nm (9 W)	Cs_2CO_3 (0.8 eq)	MeCN	40
18	**PC-2**	450-465 nm (9 W)	Cs_2CO_3 (0.5 eq)	MeCN	57
19	**PC-2**	445-450 nm (10 W)	Cs_2CO_3 (0.5 eq)	MeCN	58
20	**PC-2**	445-450 nm (15 W)	Cs_2CO_3 (0.5 eq)	MeCN	72

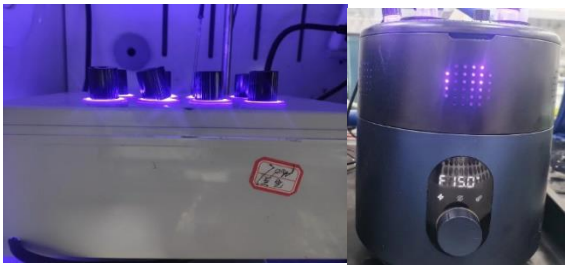
[a]Reaction conditions: substrate **2a** (0.1 mmol), substrate **3a** (0.20 mmol), **NHC A** (20 mol%), **PC** (0.001 mmol), and Cs_2CO_3 (0.05 mmol, 0.5 equiv.) in MeCN (2.0 mL) under irradiation with a 15 W blue LED (440-445 nm) for 12 h; [b]Isolated yield of **5a** based on substrate **2a**.

IV. General procedure for the synthesis of 4,5,7,9.

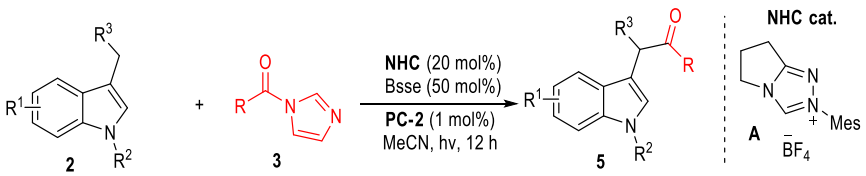
General procedure for the catalytic reactions of substrates **1** and substrates **3** to synthesize compound **4**:



To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **1** (0.10 mmol, 1.0 equiv.), substrates **3** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.001 mmol, 1.12 mg, 0.01 equiv.) and Cs_2CO_3(0.05mmol, 16.3 mg, 0.50 equiv.). The Schlenk tube was sealed and placed under argon before 2 mL of dry MeCN was added. The reaction was stirred and irradiated with blue LED (450-465 nm, 9 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (30:1) to afford the desired product **4**.

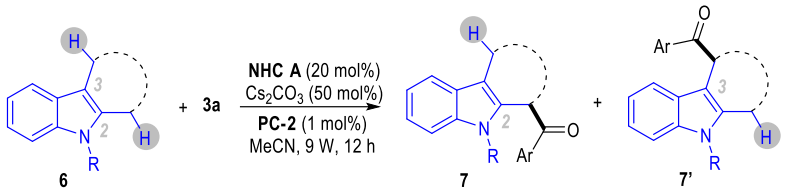


General procedure for the catalytic reactions of substrates **2** and substrates **3** to synthesize compound **5**:



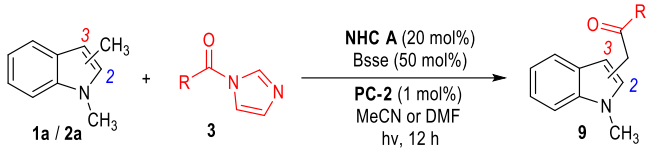
To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **2** (0.10 mmol, 1.0 equiv.), substrates **3** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.001 mmol, 1.12 mg, 0.01 equiv.) and Cs_2CO_3 (0.05mmol, 16.3 mg, 0.50 equiv.). The Schlenk tube was sealed and placed under argon before 2 mL of dry MeCN was added. The reaction was stirred and irradiated with blue LED (445-450 nm, 15 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (20:1) to afford the desired product **5**.

General procedure for the catalytic reactions of substrates **6** and substrates **3a** to synthesize compound **7**:



To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **6** (0.10 mmol, 1.0 equiv.), substrates **3a** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.001 mmol, 1.12 mg, 0.01 equiv.) and Cs_2CO_3(0.05mmol, 16.3 mg, 0.50 equiv.). The Schlenk tube was sealed and placed under argon before 2 mL of dry MeCN was added. The reaction was stirred and irradiated with blue LED (450-465 nm, 9 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (20:1) to afford the desired product **7** and **7'**.

General procedure for the catalytic reactions of substrates **1a**, **2a** and substrates **3** to synthesize compound **9**:

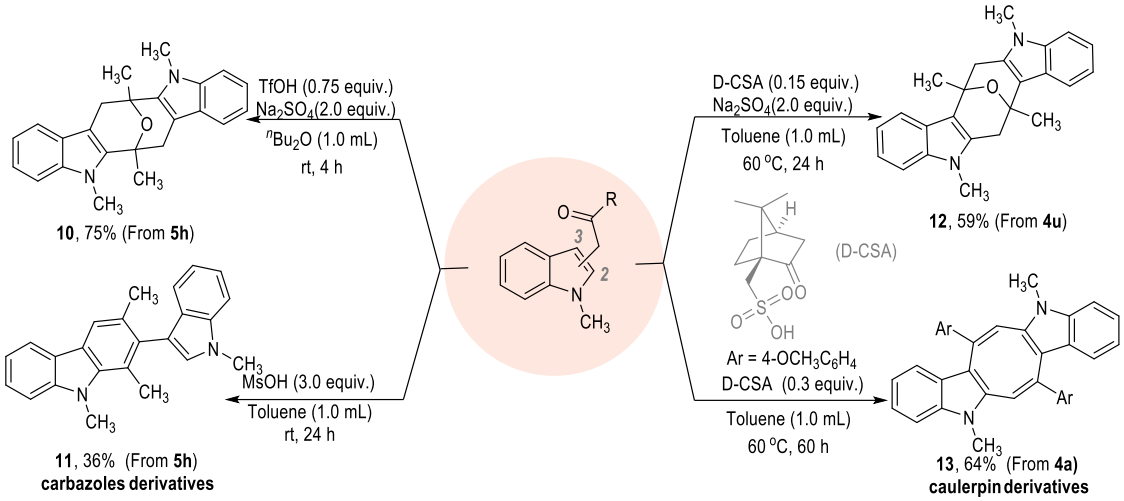


For **9a** and **9b**: To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **1a** or **2a** (0.10 mmol, 1.0 equiv.), substrates **3** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.001 mmol, 1.12 mg, 0.01 equiv.) and Cs_2CO_3 (0.05mmol, 16.3 mg, 0.50 equiv.). The Schlenk tube was sealed and placed under argon before 4 mL of dry MeCN was added. The reaction was stirred and irradiated with blue LED (445-450 nm, 15 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (10:1) to afford the desired product **9a** and **9b**.

For **9c** and **9d**: To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **1a** or **2a** (0.10 mmol, 1.0 equiv.), substrates **3** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.001 mmol, 1.12 mg, 0.01 equiv.) and Cs_2CO_3 (0.05mmol, 16.3 mg, 0.50 equiv.). The Schlenk tube was sealed and placed under argon before 4 mL of dry DMF was added. The reaction was stirred and irradiated with blue LED (445-450 nm, 15 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (20:1) to afford the desired product **9c** and **9d**.

For **9e** – **9h**: To a 10 mL vial equipped with a magnetic stir bar was added chiral pre-catalyst triazolium salt **A** (0.02 mmol, 6.3 mg, 0.20 equiv.), substrates **1a** or **2a** (0.10 mmol, 1.0 equiv.), substrates **3** (0.2 mmol, 2.0 equiv.), photocatalyst **PC-2** (0.002 mmol, 2.24 mg, 0.02 equiv.) and Cs_2CO_3 (0.03mmol, 9.9 mg, 0.30 equiv.). The Schlenk tube was sealed and placed under argon before 4 mL of dry MeCN was added. The reaction was stirred and irradiated with blue LED (445-450 nm, 15 W) for 12 hours, and then completion of the reaction monitored by TLC, the mixture was concentrated under reduced pressure, and the residue was purified *via* column chromatography on silica gel with PE/EtOAc (30:1) to afford the desired product **9e** – **9h**.

V. Synthetic Transformations.



To a solution of **5h** (0.2 mmol) in Anisole (1.0 mL, 0.2 M) was added TfOH (3.0 equiv.), and the resulting mixture was stirred at 30 °C. Upon completion, the reaction mixture was cooled to room temperature, and then saturated $NaHCO_3$ solution was added. The resulting mixture was extracted with dichloromethane three times. The combined organic layers were dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The residue was purified by column chromatography (silica gel, EtOAc/Petroleum ether) to provide the desired product **10**.

To a solution of **5h** (0.2 mmol) in toluene (1.0 mL, 0.2 M) was added MsOH (3.0 equiv.), and the resulting mixture was stirred at 30 °C. Upon completion, the reaction mixture was cooled to room temperature, and then saturated $NaHCO_3$ solution was added. The resulting mixture was extracted with dichloromethane three times. The combined organic layers were dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The residue was purified by column chromatography (silica gel, EtOAc/Petroleum ether) to provide the desired product **11**.

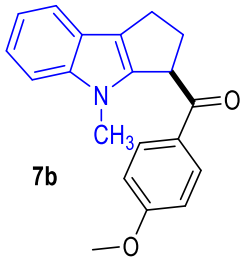
To solution of **4u** (0.2 mmol) in toluene (1 mL, 0.2 M) was added D-CSA (0.15 equiv.) and the resulting mixture was stirred at 60 °C for the desired time. Upon completion, the reaction mixture was cooled to room temperature, and then saturated $NaHCO_3$ solution was added. The resulting mixture was extracted with dichloromethane three times. The combined organic layers were dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The residue was purified by column chromatography (silica gel, EtOAc/Petroleum ether) to provide the desired product **12**.

To solution of **4a** (0.2 mmol) in toluene (1.0 mL, 0.2 M) was added D-CSA (0.3 equiv.) and the resulting mixture was stirred at 60 °C for the desired time. Upon completion, the reaction mixture was cooled to room temperature, and then saturated $NaHCO_3$ solution was added. The resulting mixture was extracted with dichloromethane three times. The combined organic layers were dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The residue was purified by column chromatography (silica gel, EtOAc/Petroleum ether to provide the desired product **13**.

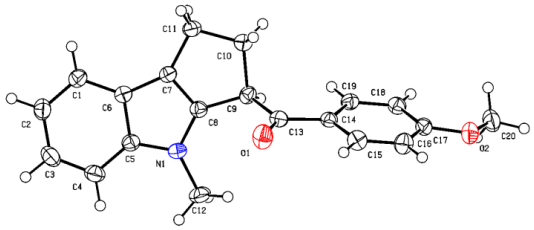
VI. *X*-ray crystallography of compound

A colorless needle crystal of **7b** was obtained by vaporization of its DCM /PE solution. A colorless needle crystal of **7d'** was obtained by vaporization of its DCM /PE solution. A colorless needle crystal of **7d'** was obtained by vaporization of its EA /PE solution. **CCDC 2296216**, **2296214** and **2296215** contain the supplementary X-ray crystallographic data of **7b**, **7d** and **7d'**, respectively. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data request/cif

Table 3. Crystal data of **7b**, **7c** and **7c'**



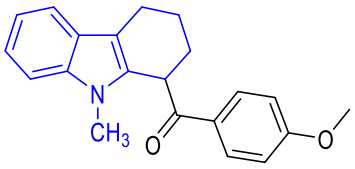
7b



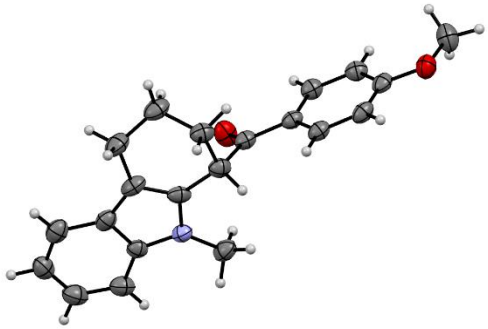
CCDC 2296216

Crystal data and structure refinement for 7b.	
Identification code	**7b**
Empirical formula	$C_{20}H_{19}NO_2$
Formula weight	305.36
Temperature/K	170.00
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	9.9529(5)
b/Å	15.6474(6)
c/Å	10.0527(5)
α/°	90
β/°	99.830(2)
γ/°	90
Volume/Å^3	1542.59(12)
Z	4
ρ_{calc}g/cm^3	1.315
μ/mm^{-1}	0.085
F(000)	648.0
Crystal size/mm^3	0.38 × 0.26 × 0.23
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	4.868 to 55.068

Index ranges	-12 ≤ h ≤ 12, -20 ≤ k ≤ 17, -13 ≤ l 13
Reflections collected	30179
Independent reflections	3535 [R_{int} = 0.0880, R_{sigma} = 0.0428]
Data/restraints/parameters	3535/0/210
Goodness-of-fit on F^2	1.128
Final R indexes [I>=2σ (I)]	R_1 = 0.0627, wR_2 = 0.1200
Final R indexes [all data]	R_1 = 0.0895, wR_2 = 0.1335
Largest diff. peak/hole / e $Å^{-3}$	0.27/-0.30



7d

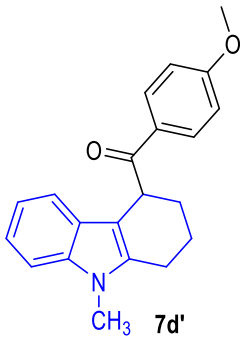


CCDC 2296214

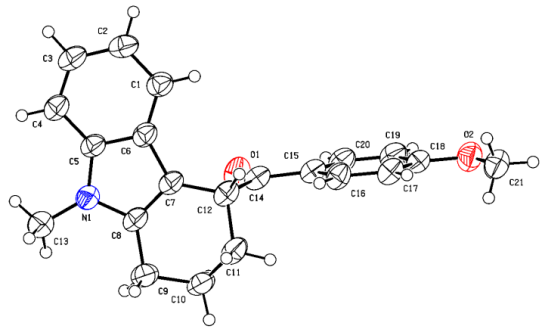
Crystal data and structure refinement for 7d.

Identification code	**7d**
Empirical formula	$C_{21}H_{21}NO_2$
Formula weight	319.39
Temperature/K	170.00
Crystal system	triclinic
Space group	P-1
a/Å	9.6651(6)
b/Å	10.0573(7)
c/Å	18.1252(12)
α/°	83.474(2)
β/°	89.157(2)
γ/°	70.718(2)
Volume/$Å^3$	1651.76(19)
Z	4
$\rho_{calc}g/cm^3$	1.284
μ/mm^{-1}	0.414
F(000)	680.0
Crystal size/mm^3	0.15 × 0.08 × 0.07
Radiation	GaKα (λ = 1.34139)
2Θ range for data collection/°	4.27 to 121.802

Index ranges	$-11 \le h \le 12, -13 \le k \le 13, -23 \le l \le 23$
Reflections collected	32984
Independent reflections	7473 [R_{int} = 0.0639, R_{sigma} = 0.0556]
Data/restraints/parameters	7473/32/447
Goodness-of-fit on F^2	1.081
Final R indexes [I>=2σ (I)]	R_1 = 0.0723, wR_2 = 0.1966
Final R indexes [all data]	R_1 = 0.0910, wR_2 = 0.2090
Largest diff. peak/hole / e $Å^{-3}$	0.72/-0.54



7d'



CCDC 2296215

Crystal data and structure refinement for 7d'.

Identification code	**7d'**
Empirical formula	$C_{21}H_{21}NO_2$
Formula weight	319.39
Temperature/K	170.15
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	8.746(5)
b/Å	14.913(9)
c/Å	12.807(8)
α/°	90
β/°	96.41(2)
γ/°	90
Volume/$Å^3$	1660.0(17)
Z	4
$\rho_{calc}g/cm^3$	1.278
μ/mm^{-1}	0.412
F(000)	680.0
Crystal size/mm^3	0.13 × 0.09 × 0.05
Radiation	GaKα (λ = 1.34139)
2Θ range for data collection/°	7.946 to 107.804
Index ranges	$-10 \le h \le 10, -17 \le k \le 17, -14 \le l \le 15$

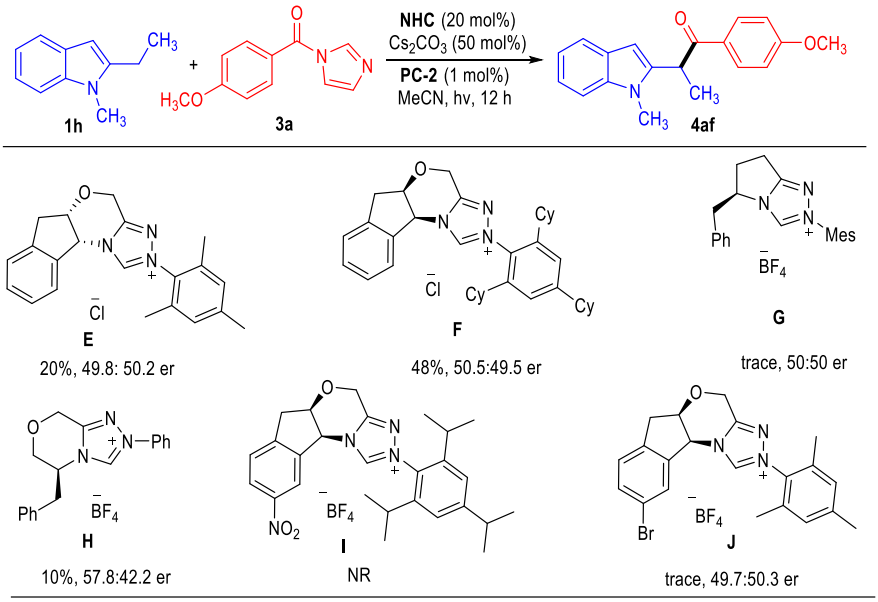
Reflections collected	11402
Independent reflections	3003 [R_{int} = 0.0877, R_{sigma} = 0.1316]
Data/restraints/parameters	3003/0/219
Goodness-of-fit on F^2	1.061
Final R indexes [I>=2σ (I)]	R_1 = 0.0632, wR_2 = 0.1548
Final R indexes [all data]	R_1 = 0.1063, wR_2 = 0.1759
Largest diff. peak/hole / e $Å^{-3}$	0.26/-0.25

VII. Inhibitive Activities of the Target Compounds Antifungal.

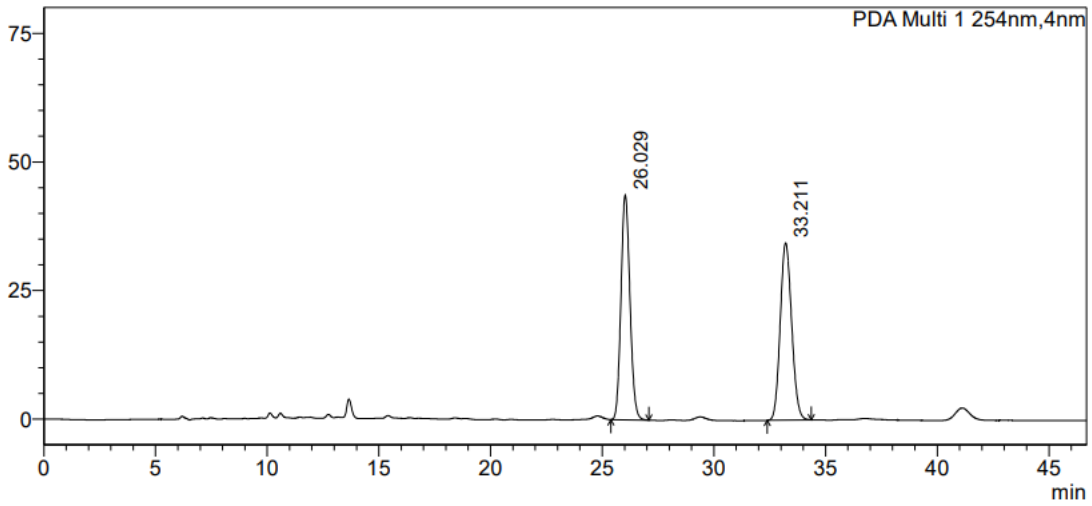
Table 4. Inhibitive Activities of the Target Compounds Antifungal

Compound	Inhibition rate / % (50 μg/mL)			
	P. capsici	*S. sclerotiorum*	*A. flavus*	*G. zeae (Schw.) Petch*
4c	36.25 ± 0.61	13.08 ± 1.60	26.11 ± 0.82	29.65 ± 1.11
4d	**43.57 ± 1.06**	9.82 ± 0.29	31.14 ± 1.12	14.87 ± 2.95
4e	37.84 ± 0.99	14.81 ± 0.93	**47.18 ± 0.76**	37.35 ± 0.59
4f	30.78 ± 0.92	23.72 ± 0.91	16.26 ± 0.39	26.61 ± 0.12
4h	30.14 ± 1.39	22.41 ± 0.48	36.17 ± 1.46	**53.56 ± 0.90**
4i	26.87 ± 1.27	27.98 ± 1.44	32.85 ± 2.12	**64.15 ± 1.64**
4k	28.09 ± 0.89	27.25 ± 1.11	29.59 ± 0.04	**62.91 ± 0.33**
4l	34.48 ± 0.53	18.13 ± 0.38	38.32 ± 1.52	15.83 ± 0.93
4m	34.86 ± 1.19	15.10 ± 2.60	**42.11 ± 0.98**	20.69 ± 1.65
4o	38.16 ± 0.48	25.16 ± 1.20	**40.33 ± 1.70**	**52.01 ± 1.93**
4p	**43.38 ± 1.08**	22.48 ± 0.59	**49.54 ± 1.42**	17.09 ± 0.62
4r	**47.88 ± 1.33**	19.99 ± 0.56	**47.11 ± 0.51**	6.25 ± 0.32
4s	27.65 ± 0.57	13.00 ± 0.49	29.30 ± 0.89	22.61 ± 0.32
4t	15.30 ± 1.14	18.40 ± 0.85	27.70 ± 1.70	21.58 ± 0.88
4u	**44.57 ± 1.02**	**45.58 ± 1.46**	**43.65 ± 0.31**	16.97 ± 1.35
4ad	30.37 ± 1.91	19.65 ± 1.76	38.00 ± 1.66	4.59± 0.20
4ak	**44.01 ± 0.39**	**61.83 ± 0.97**	38.09 ± 0.87	17.57± 1.91
5b	**50.44 ± 0.56**	38.77 ± 0.77	31.14 ± 0.82	10.08 ± 1.63
5c	36.38 ± 0.53	13.64 ± 1.93	**48.80 ± 0.98**	4.15 ± 1.49
5d	20.84 ± 664	23.32 ± 0.59	34.14 ± 1.43	5.57 ± 0.06
5e	32.96 ± 1.02	30.73 ± 1.56	**49.43 ± 1.28**	1.72 ± 0.98
5f	38.60 ± 1.30	21.37 ± 0.32	35.69 ± 0.68	9.57 ± 0.49
5n	24.98 ± 0.57	**43.63 ± 2.58**	**50.73 ± 1.18**	1.48 ± 0.78
7e	24.71 ± 1.23	**55.46 ± 0.88**	26.11 ± 1.84	12.72 ± 0.08
9e	35.19 ± 0.92	33.79 ± 0.51	34.67 ± 0.75	12.10 ± 1.62
9f	23.89 ± 1.46	25.24 ± 0.31	32.40 ± 0.40	7.37 ± 1.72
9h	22.43 ± 0.97	34.99 ± 1.68	**52.67 ± 0.98**	32.27 ± 0.32
10	29.01 ± 1.64	29.41 ± 1.93	**40.07 ± 0.68**	1.56 ± 0.64
Azoxystrobin	**63.71 ± 1.30**	**37.23 ± 1.60**	**34.90 ± 0.21**	**41.41 ± 0.50**

VIII. Attempt for enantioselective synthesis of indole ketones

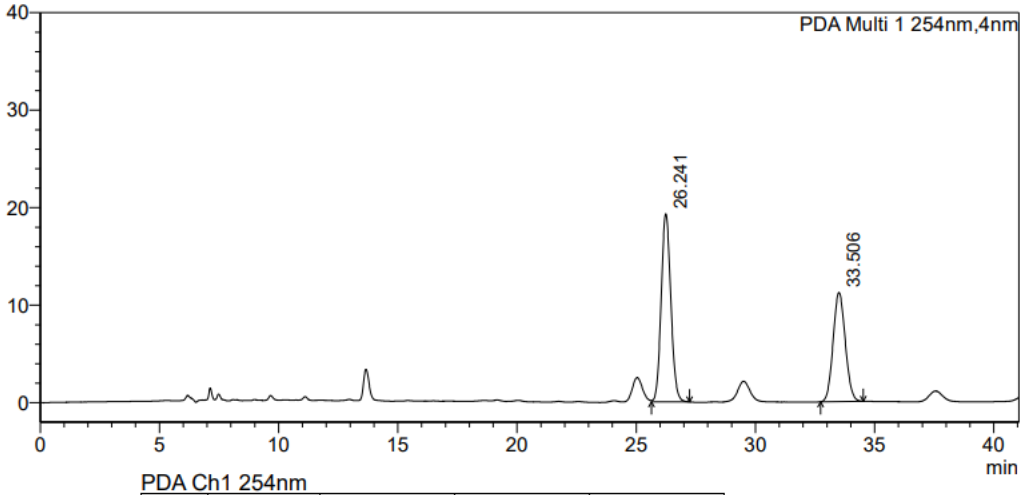


When **NHC-H** was used as catalyst, 57.8:42.2 er was determined by HPLC (ID, 90:10 hexane/iPrOH, 0.5 mL/min, tmaj = 26.2 min, tmin = 33.5 min.



PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Area%
1	26.029	1219444	43725	49.856
2	33.211	1226479	34481	50.144
Total		2445923	78206	100.000

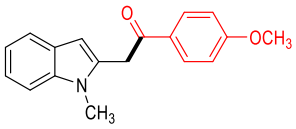


PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Area%
1	26.241	542613	19299	57.756
2	33.506	396884	11180	42.244
Total		939497	30480	100.000

IX. Characterization of products

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4a)



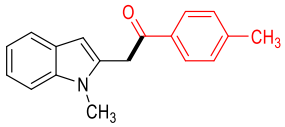
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 21 mg, 75% yield; m.p. 175 -177 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.03 (m, 2H), 7.55 – 7.52 (m, 1H), 7.30 – 7.28 (m, 1H), 7.21 – 7.16 (m, 1H), 7.09– 7.05 (m, 1H), 6.95 – 6.92 (m, 2H), 6.36 (d, *J* = 0.8 Hz, 1H), 4.41(s, 2H), 3.87 (s, 3H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.4, 163.8, 137.7, 133.8, 131.0, 129.3, 127.7, 121.2, 120.1, 119.4, 113.9, 109.1, 102.0, 55.5, 37.6, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NO_2^+$[M+Na]$^+$, 302.1152; found: 302.1149.

2-(1-methyl-1*H*-indol-2-yl)-1-(*p*-tolyl)ethan-1-one(4b)



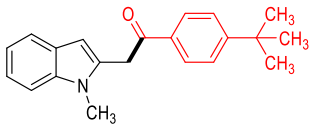
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 21.6 mg, 82% yield; m.p. 146 -148 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.98 – 7.95 (m, 2H), 7.55 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.31 – 7.28 (m, 3H), 7.22 – 7.18 (m, 1H), 7.11 – 7.07 (m, 1H), 6.38 (d, *J* = 0.8 Hz, 1H), 4.44 (d, *J* = 0.8 Hz, 2H), 3.69 (s, 3H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.5, 144.4, 137.7, 133.7, 133.5, 129.4, 128.7, 127.7, 121.2, 120.1, 119.4, 109.1, 102.0, 37.6, 30.0, 21.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NONa^+$[M+Na]$^+$, 286.1202; found: 286.1206.

1-(4-(tert-butyl)phenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4c)



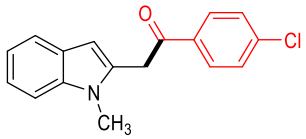
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 27 mg, 88% yield; m.p. 158 -160 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.03 – 8.00 (m, 2H), 7.57 – 7.49 (m, 3H), 7.30 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.11 – 7.07 (m, 1H), 6.40 (s, 1H), 4.45 (s, 2H), 3.70 (s, 3H), 1.36 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.4, 157.3, 137.7, 133.6, 133.6, 128.6, 127.7, 125.7, 121.2, 120.1, 119.4, 109.1, 102.0, 37.7, 35.2, 31.0, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{23}NONa^+$[M+Na]$^+$, 328.1672; found: 328.1673.

1-(4-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4d)



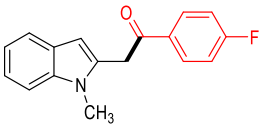
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 21 mg, 74% yield; m.p. 160 -162 ℃

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.01 – 7.97 (m, 2H), 7.54 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.11 – 7.07 (m, 1H), 6.37 –7.36 (m, 1H), 4.43 (d, *J* = 0.8 Hz, 2H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.7, 140.0, 137.7, 134.4, 132.8, 130.0, 129.1, 127.6, 121.4, 120.2, 119.6, 109.1, 102.2, 37.9, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{14}ClNONa^+$[M+Na]$^+$, 306.0656; found: 306.0655.

1-(4-fluorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4e)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 23 mg, 86% yield; m.p. 165 -167 ℃.

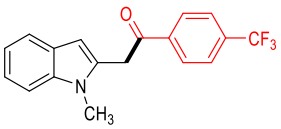
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.11 – 8.06 (m, 2H), 7.56 – 7.53 (m, 1H), 7.30 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.22 – 7.12 (m, 3H), 7.11 – 7.07 (m, 1H), 6.38 (s, 1H), 4.43 (s, 2H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.3, 166.0 (d, *J* = 256.0 Hz), 137. 8, 133.0, 132.6 (d, *J* = 4.0 Hz), 131.3 (d, *J* = 9.4 Hz), 127.7, 121.4, 120.2, 119.6, 115.9 (d, *J* = 21.9 Hz), 109.1, 102.2, 37.8, 30.0.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -104.24.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{14}FNONa^+$[M+Na]$^+$, 290.0952; found: 290.0952.

2-(1-methyl-1*H*-indol-2-yl)-1-(4-(trifluoromethyl)phenyl)ethan-1-one(4f)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 24.7 mg, 78% yield; m.p. 194 -196 ℃

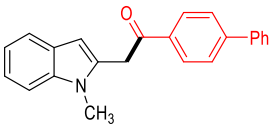
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.17 – 8.14 (m, 2H), 7.75 (d, *J* = 8.2 Hz, 2H), 7.55 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.31 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.23 – 7.19 (m, 1H), 7.11 – 7.07 (m, 1H), 6.38 (s, 1H), 4.48 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.9, 138.8, 137.8, 134.8 (q, *J* = 32.7 Hz), 132.4, 129.0, 127.6, 125.8 (q, *J* = 3.7 Hz), 123.5 (d, *J* = 273.1 Hz), 121.5, 120.3, 119.7, 109.2, 102.4, 38.1, 30.0.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -63.18.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{14}F_3NONa^+$[M+Na]$^+$, 340.0920; found: 340.0918.

1-([1,1'-biphenyl]-4-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4g)



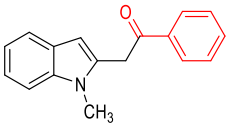
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 11.3 mg, 35% yield; m.p. 198 -199 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.15 – 8.13 (m, 2H), 7.73 – 7.67 (m, 2H), 7.65 – 7.62 (m, 2H), 7.57 – 7.54 (m, 1H), 7.51 – 7.47 (m, 2H), 7.44 – 7.39 (m, 1H), 7.32 – 7.30 (m, 1H), 7.22 – 7.18 (m, 1H), 7.11 – 7.07 (m, 1H), 6.42 (s, 1H), 4.50 (s, 2H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.4, 146.2, 139.7, 137.8, 134.9, 133.4, 129.2, 129.0, 128.4, 127.7, 127.4, 127.3, 121.3, 120.2, 119.5, 109.1, 102.1, 37.8, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{23}H_{19}NONa^+$[M+Na]$^+$, 348.1359; found: 348.1362.

2-(1-methyl-1*H*-indol-2-yl)-1-phenylethan-1-one(4h)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 18.8 mg, 75% yield; m.p. 121 -123 ℃.

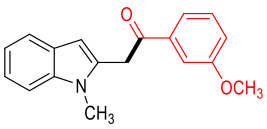
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.08 – 8.05 (m, 2H), 7.62 – 7.47 (m,

4H), 7.31 (dd, *J* = 8.4, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.11 – 7.07 (m, 1H), 6.39 (s, 1H), 4.47 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.8, 137.8, 136.2, 133.5, 133.3, 128.7, 128.6, 127.7, 121.2, 120.2, 119.5, 109.1, 102.1, 37.7, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{15}NONa^+$[M+Na]$^+$, 272.1046; found: 272.1049.

1-(3-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4i)



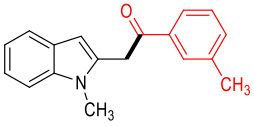
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 24 mg, 86% yield; m.p. 156 -158 ℃

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.58 – 7.54 (m, 2H), 7.40 (t, *J* = 8.0 Hz, 1H), 7.30 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.16 – 7.07 (m, 2H), 6.39 (s, 1H), 4.45 (s, 2H), 3.86 (s, 3H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.7, 159.9, 137.8, 137.6, 133.3, 129.7, 127.7, 121.2, 121.2, 120.2, 112.0, 119.5, 112.9, 109.1, 102.1, 55.4, 37.8, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NO_2Na^+$[M+Na]$^+$, 302.1152; found: 302.1153.

2-(1-methyl-1*H*-indol-2-yl)-1-(*m*-tolyl)ethan-1-one(4j)



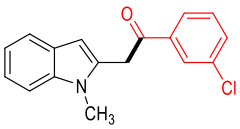
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 20.9 mg, 79% yield; m.p. 135 -137 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.88 – 7.85 (m, 2H), 7.55 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.43 – 7.36 (m, 2H), 7.31 – 7.28 (m, 1H), 7.21 – 7.17 (m, 1H), 7.10 – 7.06 (m, 1H), 6.38 (s, 1H), 4.46 (s, 2H), 3.69 (s, 3H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.0, 138.6, 137.8, 136.3, 134.3, 133.4, 129.1, 128.6, 127.7, 125.8, 121.2, 120.2, 119.4, 109.1, 102.1, 37.7, 30.0, 21.4.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NONa^+$[M+Na]$^+$, 286.1202; found: 286.1204.

1-(3-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4k)



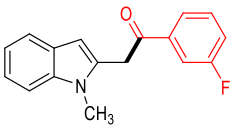
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 24.1 mg, 85% yield; m.p. 176 -178 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 (t, *J* = 1.8 Hz, 1H), 7.93 (dt, *J* = 7.8, 1.4 Hz, 1H), 7.57 – 7.53 (m, 2H), 7.43 (t, *J* = 8.0 Hz, 1H), 7.33 – 7.28 (m, 1H), 7.22 – 7.18 (m, 1H), 7.10 – 7.06 (m, 1H), 6.38 (s, 1H), 4.44 (s, 2H), 3.68 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.6, 137.8, 137.7, 135.2, 133.4, 132.6, 130.1, 128.7, 127.6, 126.7, 121.4, 120.3, 119.6, 109.1, 102.3, 37.8, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{14}ClNONa^+$[M+Na]$^+$, 306.0656; found: 306.0657.

1-(3-fluorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4l)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 22.3 mg, 83% yield; m.p. 149 -151 ℃.

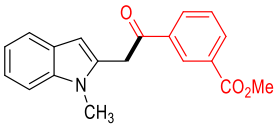
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.85 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.75 – 7.72 (m, 1H), 7.55 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.50 – 7.44 (m, 1H), 7.32 – 7.27 (m, 2H), 7.18 – 7.12 (m, 1H), 7.11 – 7.07 (m, 1H), 6.39 (s, 1H), 4.44 (s, 2H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.6 (d, *J* = 2.7 Hz), 162.9 (d, *J* = 248.5 Hz), 138.3 (d, *J* = 6.5 Hz), 137.8, 132.7, 130.5 (d, *J* = 7.9 Hz), 127.7, 124.4 (d, *J* = 2.9 Hz), 121.4, 120.6 (d, *J* = 21.4 Hz), 120.3, 119.6, 115.4 (d, *J* = 22.4 Hz), 109.2, 102.3, 37.9, 30.0.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -111.34.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{14}FNONa^+$[M+Na]$^+$, 290.0952; found: 290.0951.

methyl 3-(2-(1-methyl-1*H*-indol-2-yl)acetyl)benzoate(4m)



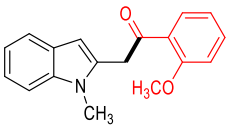
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 21.4 mg, 70% yield; m.p. 182 -184 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.72 (t, *J* = 1.8 Hz, 1H), 8.27 – 8.22 (m, 2H), 7.60 – 7.53 (m, 2H), 7.30 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.10 – 7.06 (m, 1H), 6.40 (s, 1H), 4.51 (s, 2H), 3.97 (s, 3H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.0, 166.1, 13 7.8, 136.4, 134.2, 132.77, 132.7, 130.9, 129.7, 129.1, 127.7, 121.4, 120.2, 119.5, 109.1, 102.3, 52.4, 37.8, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{17}NO_3Na^+$[M+Na]$^+$, 330.1100; found: 330.1103.

1-(2-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4n)



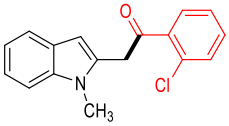
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 16.7 mg, 60% yield; m.p. 151 -153 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.72 (dd, *J* = 7.6, 1.8 Hz, 1H), 7.54 – 7.47 (m, 2H), 7.30 – 7.26 (m, 1H), 7.19 – 7.15 (m, 1H), 7.08 – 6.99 (m, 3H), 6.33 (d, *J* = 0.8 Hz, 1H), 4.51 (d, *J* = 0.8 Hz, 2H), 3.97 (s, 3H), 3.67 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.1, 158.6, 137.7, 134.2, 133.9, 130.7, 127.8, 127.6, 120.9, 120.9, 120.1, 119.2, 111.6, 109.0, 101.6, 55.6, 42.3, 29.9.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NO_2Na^+$[M+Na]$^+$, 302.1152; found: 302.1153.

1-(2-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4o)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 12.7 mg, 45% yield; m.p.168 -170 ℃.

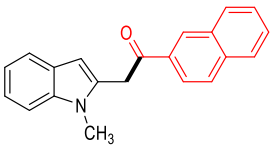
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (d, *J* = 7.8 Hz, 1H), 7.47 – 7.37 (m, 3H), 7.32 – 7.28 (m, 2H), 7.22 – 7.18 (m, 1H), 7.10 – 7.06 (m, 1H), 6.37 (s, 1H), 4.47 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.9, 138.66, 137.8, 132.3, 132.0, 130.9, 130.6, 129.3,

127.7, 127.0, 121.4, 120.3, 119.5, 109.2, 102.4, 41.6, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{17}H_{14}ClNONa^+[M+Na]^+$, 306.0656; found: 306.0657.

2-(1-methyl-1*H*-indol-2-yl)-1-(naphthalen-2-yl)ethan-1-one(4p)



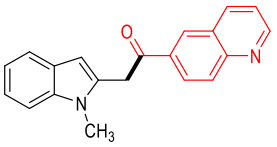
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 17.3 mg, 58% yield; m.p. 163 -165 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.62 – 8.61 (m, 1H), 8.09 (dd, *J* = 8.6, 1.8 Hz, 1H), 8.00 – 7.98 (m, 1H), 7.93 – 7.88 (m, 2H), 7.65 – 7.53 (m, 3H), 7.31 (dd, *J* = 8.4, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.10 – 7.06 (m, 1H), 6.43 (d, *J* = 0.8 Hz, 1H), 4.61 (s, 2H), 3.73 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.8, 137.8, 135.8, 133.6, 133.4, 132.5, 130.4, 129.7, 128.8 128.7, 127.8, 127.7, 126.3, 124.1, 121.3, 120.2, 119.5, 109.1, 102.2, 37.8, 30.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{17}NONa^+[M+Na]^+$, 322.1202; found: 322.11199.

2-(1-methyl-1*H*-indol-2-yl)-1-(quinolin-6-yl)ethan-1-one(4q)



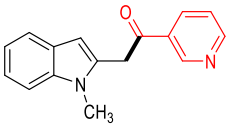
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 10/1 to 3/1). White solid, 18.1 mg, 60% yield; m.p. 136 -138 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.03 (dd, *J* = 4.4, 1.8 Hz, 1H), 8.59 (d, *J* = 2.0 Hz, 1H), 8.35 – 8.28 (m, 2H), 8.19 (d, *J* = 8.8 Hz, 1H), 7.55 – 7.48 (m, 2H), 7.32 – 7.29 (m, 1H), 7.22 – 7.18 (m, 1H), 7.10 – 7.06 (m, 1H), 6.42 (d, *J* = 0.8 Hz, 1H), 4.60 (d, *J* = 0.8 Hz, 2H), 3.73 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.2, 152.9, 150.2, 137.8, 137.7, 134.1, 133.0, 130.3, 130.2, 127.9, 127.7, 127.5, 122.1, 121.4, 120.3, 119.6, 109.2, 102.3, 38.0, 30.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{17}N_2^+[M+H]^+$, 301.1335; found: 301.1337.

2-(1-methyl-1*H*-indol-2-yl)-1-(pyridin-3-yl)ethan-1-one(4r)



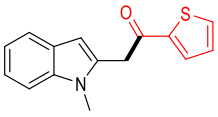
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 5/1 to 2/1). White solid, 20.7 mg, 67% yield; m.p. 127 - 129 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.29 (dd, *J* = 2.4, 0.8 Hz, 1H), 8.79 (dd, *J* = 4.8, 1.8 Hz, 1H), 8.30 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.54 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.45 – 7.41 (m 1H), 7.31 – 7.29 (m, 1H), 7.22 – 7.18 (m, 1H), 7.11 – 7.07 (m, 1H), 6.40 (s, 1H), 4.47 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.7, 153.8, 150.0, 137.8, 135.9, 132.1, 131.4, 127.6, 123.8, 121.5, 120.3, 119.6, 109.2, 102.4, 38.0, 30.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{16}H_{15}N_2O^+[M+H]^+$, 251.1179; found: 251.1181.

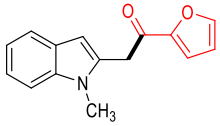
2-(1-methyl-1*H*-indol-2-yl)-1-(thiophen-2-yl)ethan-1-one(4s)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 16.8 mg, 66% yield; m.p. 99 -101 ℃.

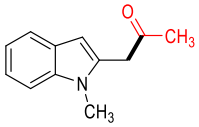
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 (dd, *J* = 3.8, 1.2 Hz, 1H), 7.66 (dd, *J* = 5.0, 1.2 Hz, 1H), 7.56 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.31 – 7.28 (m, 1H), 7.22 – 7.18 (m, 1H), 7.13 (dd, *J* = 5.0, 3.8 Hz, 1H), 7.11 – 7.07 (m, 1H), 6.44 (d, *J* = 0.9 Hz, 1H), 4.39 (s, 1H), 4.39 (s, 2H), 3.72 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 188.6, 143.2, 137.8, 134.3, 133, 132.9, 128.3, 127.6, 121.4, 120.2, 119.6, 109.2, 102.3, 38.8, 30.1.
HRMS (ESI-TOF, m/z): Mass calcd. for $C_{15}H_{13}NOSNa^+$[M+Na]$^+$, 278.0610; found: 278.0613.

1-(furan-2-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4t)



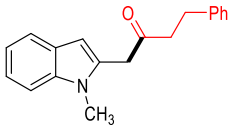
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 15.6 mg, 65% yield; m.p. 102 -104 °C.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 (dd, *J* = 1.8, 0.8 Hz, 1H), 7.54 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.29 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.25 – 7.24 (m, 1H), 7.21 – 7.17 (m, 1H), 7.10 – 7.06 (m, 1H), 6.54 (dd, *J* = 3.6, 1.8 Hz, 1H), 6.43 (q, *J* = 0.8 Hz, 1H), 4.32 (d, *J* = 0.7 Hz, 2H), 3.72 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 184.6, 152.0, 146.7, 137.8, 132.7, 127.7, 121.3, 120.2, 119.5, 118.2, 112.6, 109.2, 102.2, 37.5, 30.1.
HRMS (ESI-TOF, m/z): Mass calcd. for $C_{15}H_{13}NO_2Na^+$[M+Na]$^+$, 262.0839; found: 262.0841.

1-(1-methyl-1*H*-indol-2-yl)propan-2-one(4u)



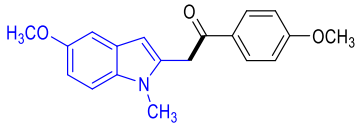
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 6 mg, 32% yield.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.58 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.31 – 7.28 (m, 1H), 7.23 – 7.19 (m, 1H), 7.13 – 7.09 (m, 1H), 6.41 (d, *J* = 0.8 Hz, 1H), 3.87 (s, 2H), 3.65 (s, 3H), 2.20 (s, 3H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 205.0, 137.8, 133.0, 127.7, 121.5, 120.2, 119.7, 109.2, 102.0, 42.9, 29.8, 28.9.
HRMS (ESI-TOF, m/z): Mass calcd. for $C_{12}H_{14}NO^+$[M+H]$^+$, 188.1070; found: 188.1073.

1-(1-methyl-1H-indol-2-yl)-4-phenylbutan-2-one(4v)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 11 mg, 40% yield.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.26 – 7.15 (m, 5H), 7.11 – 7.06 (m, 3H), 6.34 (s, 1H), 3.81 (s, 2H), 3.52 (s, 3H), 2.89 – 2.85 (m, 2H), 2.83 – 2.79 (m, 2H).
^{13}C NMR (101 MHz, Chloroform-*d*) δ 206.2, 140.6, 137.7, 132.8, 128.4, 128.3, 127.6, 126.2, 121.4, 120.2, 119.6, 109.2, 102.0, 42.8, 42.4, 29.7, 29.6.
HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NONa^+$[M+Na]$^+$, 300.1359; found: 300.1360.

2-(5-methoxy-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4aa)



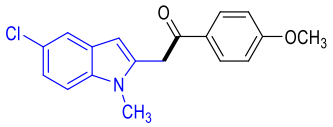
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 16.1 mg, 52% yield; m.p. 154 -156 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.02 (m, 2H), 7.19 – 7.16 (m, 1H), 7.01 (d, *J* = 2.4 Hz, 1H), 6.97 – 6.94 (m, 2H), 6.84 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.29 (d, *J* = 0.8 Hz, 1H), 4.38 (d, *J* = 0.8 Hz, 2H), 3.87 (s, 3H), 3.83 (s, 3H), 3.66 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.3, 163.8, 154.0, 134.2, 133.1, 131.0, 129.2, 127.9, 113.9, 111.2, 109.8, 102.1, 101.5, 55.9, 55.5, 37.6, 30.2.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_3Na^+$[M+Na]$^+$, 332.1257; found: 332.1261.

2-(5-chloro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ab)



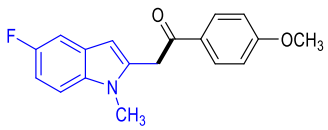
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 19.6 mg, 63% yield; m.p. 158 -160 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 – 8.01 (m, 2H), 7.48 (dd, *J* = 2.0, 0.6 Hz, 1H), 7.20 – 7.17 (m, 1H), 7.12 (dd, *J* = 8.8, 2.0 Hz, 1H), 6.97 – 6.94 (m, 2H), 6.31 (d, *J* = 1.0 Hz, 1H), 4.39 (s, 2H), 3.88 (s, 3H), 3.66 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.0, 163.9, 136.2, 135.2, 130.9, 129.2, 128.6, 125.1, 121.4, 119.5, 114.0, 110.1, 101.6, 55.5, 37.4, 30.3.

HRMS (ESI-TOF, m/z): Mass calcd. for$C_{18}H_{16}ClNO_2Na^+$ [M+Na]$^+$, 336.0762; found: 336.0759.

2-(5-fluoro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ac)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 19.8 mg, 67% yield; m.p. 134 -135℃.

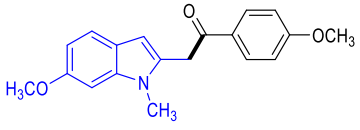
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.20 – 7.15 (m, 2H), 6.97 – 6.89 (m, 3H), 6.32 (d, *J* = 0.8 Hz, 1H), 4.40 (d, *J* = 0.8 Hz, 2H), 3.88 (s, 3H), 3.67 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.1, 163.9, 157.9 (d, *J* = 233.7 Hz), 135.4, 134.4, 130.9, 127.8 (d, *J* = 10.2 Hz), 113.9, 109.6 (d, *J* = 9.7 Hz), 109.5, 109.2, 104.9 (d, *J* = 23.7 Hz), 101.9 (d, *J* = 4.6 Hz), 55.52, 37.45, 30.27.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -125.52.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{16}FNO_2Na^+$ [M+Na]$^+$, 320.1057; found: 320.1053.

2-(6-methoxy-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ad)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 15 mg, 49% yield; m.p. 161 -162 ℃.

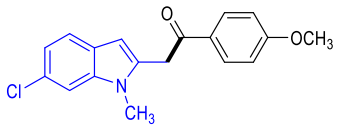
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.02 (m, 2H), 7.41 – 7.39 (m, 1H), 6.96 – 6.93 (m, 2H), 6.75 (d, *J* = 7.8 Hz, 2H), 6.29 (d, *J* = 0.8 Hz, 1H), 4.37 (d, *J* = 0.8 Hz, 2H), 3.87 (s, 6H), 3.64 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.6, 163.8, 156.0, 138.4, 132.6, 130.9, 129.3, 122.0,

120.7, 113.9, 109.1, 101.8, 93.1, 55.8, 55.5, 37.6, 30.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_3Na^+$[M+Na]$^+$, 332.1257; found: 332.1257.

2-(6-chloro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ae)



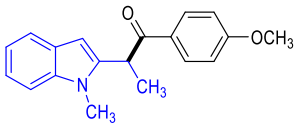
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 17.4 mg, 56% yield; m.p. 164 -162 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.42 (dd, *J* = 8.4, 0.6 Hz, 1H), 7.28 – 7.26 (m, 1H), 7.03 (dd, *J* = 8.4, 1.8 Hz, 1H), 6.97 – 6.94 (m, 2H), 6.34 (q, *J* = 0.8 Hz, 1H), 4.39 (d, *J* = 0.8 Hz, 2H), 3.88 (s, 3H), 3.64 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.1, 163.9, 138.2, 134.6, 130.9, 129.2, 127.22, 126.2, 120.9, 120.1, 114.0, 109.2, 102.1, 55.5, 37.3, 30.2.

HRMS (ESI-TOF, m/z): Mass calcd. for$C_{18}H_{16}ClNO_2Na^+$[M+Na]$^+$, 336.0762; found: 336.0759.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)propan-1-one(4af)



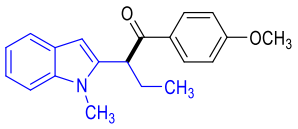
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 15.2 mg, 52% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 – 7.91 (m, 2H), 7.52 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.29 – 7.26 (m, 2H), 7.20 – 7.16 (m, 1H), 7.08 – 7.05 (m, 1H), 6.88 – 6.85 (m, 2H), 6.32 (t, *J* = 0.6 Hz, 1H), 4.79 (q, *J* = 7.0 Hz, 1H), 3.82 (s, 3H), 3.71 (s, 3H), 1.64 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.3, 163.4, 140.2, 137.7, 130.9, 129.1, 127.8, 121.2, 120.4, 119.5, 113.8, 109.0, 100.4, 55.4, 40.6, 29.9, 17.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+$[M+Na]$^+$, 316.1308; found: 316.1309.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)butan-1-one(4ag)



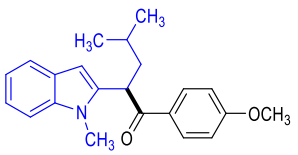
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 15.5 mg, 50% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 – 7.90 (m, 2H), 7.51 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.28 – 7.26 (m, 2H), 7.19 – 7.15 (mm, 1H), 7.08 – 7.04 (m, 1H), 6.87 – 6.84 (m, 2H), 6.34 (s, 1H), 4.58 (t, *J* = 7.0 Hz, 1H), 3.81 (s, 3H), 3.75 (s, 3H), 2.34 – 2.23 (m, 1H), 2.07 – 1.90 (m, 1H), 1.01 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 163.4, 138.7, 137.7, 130.8, 129.8, 127.8, 121.2, 120.3, 119.5, 113.8, 109.0, 101.1, 55.4, 47.8, 30.0, 25.6, 12.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{21}NO_2Na^+$[M+Na]$^+$, 330.1465; found: 330.14633.

1-(4-methoxyphenyl)-4-methyl-2-(1-methyl-1*H*-indol-2-yl)pentan-1-one(4ah)



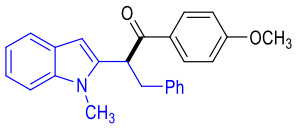
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 16.6 mg, 49% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 – 7.92 (m, 2H), 7.50 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.28 – 7.26 (m, 1H), 7.18 – 7.14 (m, 1H), 7.07 – 7.03 (m, 1H), 6.88 – 6.84 (m, 2H), 6.33 (s, 1H), 4.78 (dd, *J* = 8.2, 6.2 Hz, 1H), 3.82 (s, 3H), 3.75 (s, 3H), 2.25 – 2.18 (m, 1H), 1.80 – 1.73 (m, 1H), 1.70 – 1.63 (m, 1H), 0.97 (dd, *J* = 6.6, 2.4 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 163.4, 138.8, 137.7, 130.8, 129.7, 127.8, 121.2, 120.3, 119.5, 113.8, 109.0, 101.1, 55.4, 44.1, 41.3, 30.0, 26.3, 22.8, 22.6.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{22}H_{25}NO_2Na^+$[M+Na]$^+$, 358.1778; found: 358.1779.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)-3-phenylpropan-1-one(4ai)



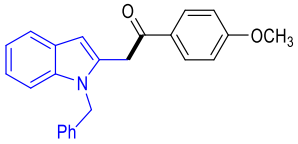
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 15.5 mg, 42% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.82 – 7.78 (m, 2H), 7.51 (d, *J* = 7.8 Hz, 1H), 7.23 – 7.14 (m, 5H), 7.10 – 7.04 (m, 3H), 6.82 – 6.79 (m, 2H), 6.37 (s, 1H), 4.87 (t, *J* = 7.2 Hz, 1H), 3.78 (s, 3H), 3.57 (dd, *J* = 13.6, 6.6 Hz, 1H), 3.42 (s, 3H), 3.22 (dd, *J* = 13.6, 7.6 Hz, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.5, 163.3, 139.5, 138.0, 137.5, 130.7, 129. 5, 129.1, 128.4, 127.9, 126.5, 121.3, 120.4, 119.6, 113.8, 109.1, 101.1, 55.4, 47.8, 39.3, 29.4.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{25}H_{23}NO_2Na^+$[M+Na]$^+$, 392.1621; found: 392.1619.

2-(1-benzyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4aj)



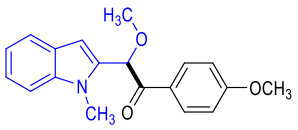
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 22 mg, 57% yield; m.p. 114 -116 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.89 (m, 2H), 7.57 (dt, *J* = 7.6, 1.0 Hz, 1H), 7.26 – 7.23 (m, 4H), 7.16 – 7.07 (m, 2H), 6.95 (dd, *J* = 7.4, 2.1 Hz, 2H), 6.91 – 6.87 (m, 2H), 6.43 (d, *J* = 0.9 Hz, 1H), 5.39 (s, 2H), 4.29 (d, *J* = 0.8 Hz, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 194.4, 163.8, 137.8, 137.6, 133.7, 131.0, 129.2, 128.8, 127.3, 126.1, 121.5, 120.3, 119.7, 113.8, 109.6, 102.9, 55.5, 46.9, 37.4.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{24}H_{21}NO_2Na^+$[M+Na]$^+$, 378.1455; found: 378.1456.

2-methoxy-1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4ak)



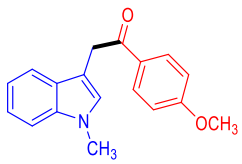
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow solid, 20.5 mg, 66% yield; m.p. 123 -125 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 – 8.03 (m, 2H), 7.55 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.32 – 7.30 (m, 1H), 7.25 – 7.20 (m, 1H), 7.10 – 7.06 (m, 1H), 6.89 – 6.86 (m, 2H), 6.53 (s, 1H), 5.77 (s, 1H), 3.83 (s, 3H), 3.80 (s, 3H), 3.48 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 193.8, 163.8, 138.4, 134.1, 131.4, 128.0, 127.1, 122.3, 120.9, 119.7, 113.7, 109.3, 104.5, 80.1, 57.1, 55.4, 30.4.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_3^+$[M+Na]$^+$, 332.1257; found: 332.1257.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5a)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 20.1 mg, 72% yield; m.p. 117 -119 ℃.

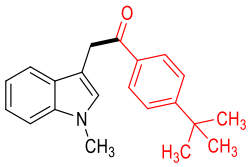
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.02 (m, 2H), 7.61 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.30 – 7.20 (m, 2H), 7.15 – 7.11 (m, 1H), 6.98 (s, 1H),

6.93 – 6.89 (m, 2H), 4.34 (d, *J* = 1.0 Hz, 2H), 3.85 (s, 3H), 3.74 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 163.4, 136.9, 130.9, 129.8, 127.8, 127.7, 121.7, 119.1, 118.9, 113.7, 109.3, 107.7, 55.4, 35.2, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{17}NO_2Na^+$[M+Na]$^+$, 302.1152; found: 302.1153.

1-(4-(tert-butyl)phenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5b)



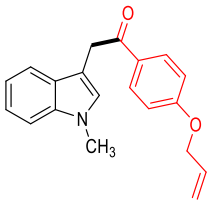
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 21 mg, 69% yield

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 7.99 (m, 2H), 7.62 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.47 – 7.45 (m, 2H), 7.30 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.26 – 7.21 (m, 1H), 7.16 – 7.12 (m, 1H), 7.01 (d, *J* = 1.0 Hz, 1H), 4.38 (d, *J* = 1.0 Hz, 2H), 3.74 (s, 3H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.5, 156.7, 136.9, 134.1, 128.6, 127.8, 125.5, 121.7, 119.2, 118.9, 109.3, 107.5, 35.31, 35.07, 32.69, 31.06.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{23}NONa^+$[M+Na]$^+$, 328.1672; found: 328.1664.

1-(4-(allyloxy)phenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5c)



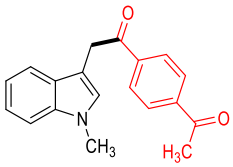
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 16.1 mg, 53% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.61 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.29 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.25 – 7.21 (m, 1H), 7.15 – 7.11 (m, 1H), 6.98 (d, *J* = 1.0 Hz, 1H), 6.94 – 6.90 (m, 2H), 6.09 – 5.99 (m, 1H), 5.57 – 5.25 (m, 2H), 5.42 (dq, J = 17.4, 1.6 Hz, 1H), 5.31 (dq, J = 10.6, 1.4 Hz, 1H), 4.34 (d, *J* = 0.4 Hz, 2H), 3.74 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 162.4, 136.9, 132.5, 130.9, 129.9, 127.8, 127.7, 121.7, 119.1, 118.9, 118.1, 114.4, 109.2, 107.6, 68.9, 35.2, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{19}NO_2Na^+$[M+Na]$^+$, 328.1308; found: 328.1309.

1-(4-acetylphenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5d)



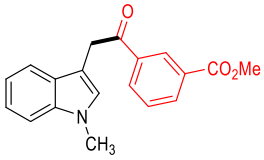
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 10.2 mg, 35% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.13 – 8.10 (m, 2H), 8.01 – 7.98 (m, 2H), 7.60 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.30 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.26 – 7.22 (m, 1H), 7.16 – 7.12 (m, 1H), 6.99 (d, *J* = 1.0 Hz, 1H), 4.42 (d, *J* = 1.0 Hz, 2H), 3.74 (s, 3H), 2.62 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.5, 197.3, 140.1, 139.9, 137.0, 128.8, 128.5, 127.9, 127.6, 121.9, 119.4, 118.7, 109.4, 106.7, 35.9, 32.7, 26.8.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{17}NO_2Na^+$[M+Na]$^+$, 314.1152; found: 314.1150.

methyl 3-(2-(1-methyl-1*H*-indol-3-yl)acetyl)benzoate(5e)



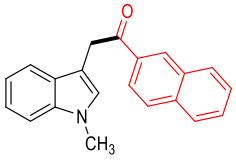
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 20.3 mg, 66% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.74 (t, *J* = 1.8 Hz, 1H), 8.24 – 8.19 (m, 2H), 7.63 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.52 (td, *J* = 7.8, 0.6 Hz, 1H), 7.30 (dt, *J* = 8.4, 1.0 Hz, 1H), 7.26 – 7.22 (m, 1H), 7.16 – 7.12 (m, 1H), 7.02 (d, *J* = 1.0 Hz, 1H), 4.44 (d, *J* = 1.0 Hz, 2H), 3.95 (s, 3H), 3.74 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 166.3, 136.9, 136.8, 133.7, 132.7, 130.6, 129.7, 128.8, 127.9, 127.7, 121.8, 119.2, 118.8, 109.3, 106.7, 52.3, 35.6, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{17}NO_3Na^+$[M+Na]$^+$, 330.1100; found: 330.1102.

2-(1-methyl-1*H*-indol-3-yl)-1-(naphthalen-2-yl)ethan-1-one(5f)



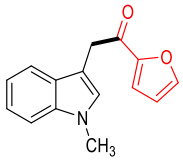
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 13.7 mg, 46% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.62 – 8.61 (m, 1H), 8.10 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.96 – 7.93 (m, 1H), 7.89 – 7.85 (m, 2H), 7.67 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.61 – 7.57 (m, 1H), 7.56 – 7.52 (m, 1H), 7.30 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.26 – 7.22 (m, 1H), 7.18 – 7.14 (m, 1H), 7.03 (d, *J* = 1.0 Hz, 1H), 4.53 (d, *J* = 1.0 Hz, 2H), 3.74 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.9, 137.0, 135.6, 134.1, 132.6, 130.3, 129.6, 128.4, 127.85, 127.8, 127.7, 126.7, 124.4, 121.8, 119.2, 118.9, 109.3, 107.4, 35.5, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{17}NONa^+$[M+Na]$^+$, 322.1202; found: 322.1203.

1-(furan-2-yl)-2-(1-methyl-1H-indol-3-yl)ethan-1-one(5g)



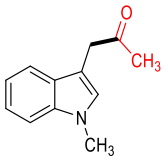
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 9.6 mg, 40% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.63 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.59 (dd, *J* = 1.6, 0.8 Hz, 1H), 7.29 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.24 – 7.20 (m, 2H), 7.14 – 7.10 (m, 1H), 7.06 (d, *J* = 1.0 Hz, 1H), 6.51 (dd, *J* = 3.6, 1.6 Hz, 1H), 4.25 (d, *J* = 1.0 Hz, 2H), 3.76 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 187.0, 152.5, 146.3, 136.9, 128.0, 127.8, 121.7, 119.2, 118.9, 117.6, 112.3, 109.3, 106. 7, 35.2, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{15}H_{13}NO_2Na^+$[M+Na]$^+$, 262.0839; found: 262.0842.

1-(1-methyl-1*H*-indol-3-yl)propan-2-one(5h)



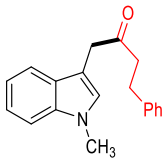
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 6 mg, 32% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.53 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.32 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.26 – 7.22 (m, 1H), 7.15 – 7.11 (m, 1H), 7.00 (d, *J* = 1.0 Hz, 1H), 3.81 (s, 2H), 3.78 (s, 3H), 2.17 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 207.5, 137.0, 127.8, 127.7, 121.9, 119.3, 119.3, 118.8, 109.3, 107.1, 40.7, 32.7, 28.9.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{12}H_{13}NONa^+$[M+Na]$^+$, 210.0889; found: 210.0894.

1-(1-methyl-1H-indol-3-yl)-4-phenylbutan-2-one(5i)



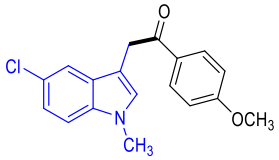
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 8 mg, 29% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.50 (d, *J* = 7.9 Hz, 1H), 7.30 (d, *J* = 8.2 Hz, 1H), 7.26 – 7.21 (m, 3H), 7.18 – 7.10 (m, 4H), 6.91 (s, 1H), 3.78 (s, 2H), 3.75 (s, 3H), 2.89 – 2.85 (m, 2H), 2.84 – 2.78 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 208.4, 141.1, 136.9, 128.4, 127.8, 127.7, 126.0, 121.8, 119.26, 118.7, 109.3, 106.9, 42.85, 40.04, 32.69, 29.82.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NONa^+$[M+Na]$^+$, 300.1359; found: 300.1360.

2-(5-chloro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5j)



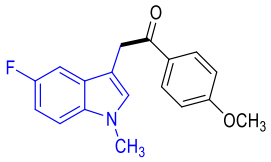
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 16.6 mg, 46% yield; m.p. 143 -145 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.56 (dd, *J* = 1.8, 0.8 Hz, 1H), 7.21 – 7.15 (m, 2H), 7.01 (s, 1H), 6.95 – 6.91 (m, 2H), 4.29 (d, *J* = 0.8 Hz, 2H), 3.86 (s, 3H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.1, 163.5, 135.4, 130.8, 129.6, 129.1, 128.8, 125.1, 122.0, 118.4, 113.8, 110.3, 107.4, 55.5, 34.8, 32.9.

HRMS (ESI-TOF, m/z): Mass calcd. for$C_{18}H_{16}ClNO_2Na^+$[M+Na]$^+$, 336.0762; found: 336.0760.

2-(5-fluoro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5k)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 15.3 mg, 52% yield; m.p. 126 -128 ℃.

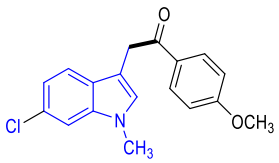
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.02 (m, 2H), 7.26 – 7.16 (m, 2H), 7.03 (s, 1H), 6.99 – 6.91 (m, 3H), 4.29 (d, *J* = 0.8 Hz, 2H), 3.86 (s, 3H), 3.73 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.2, 163.5, 157.9 ((d, *J* = 235.3 Hz), 133.6, 130.9, 129.7, 129.4, 128.1 (d, *J* = 10.1 Hz), 113.8, 110.2, 109.9 (d, *J* = 8.9 Hz), 107.6 (d, *J* = 5.0 Hz), 103.8 (d, *J* = 23.4 Hz), 55.4, 35.0, 33.0.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -125.18.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{18}H_{16}FNO_2Na^+$[M+Na]$^+$, 320.1057; found: 320.1057.

2-(6-chloro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5l)



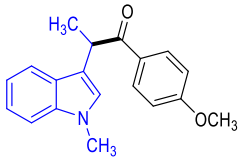
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 14.5 mg, 46% yield; m.p. 119 -121 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 – 8.01 (m, 2H), 7.49 (d, *J* = 8.4 Hz, 1H), 7.27 (d, *J* = 1.8 Hz, 1H), 7.08 (dd, *J* = 8.4, 1.8 Hz, 1H), 6.98 (d, *J* = 1.0 Hz, 1H), 6.94 – 6.91 (m, 2H), 4.31 (d, *J* = 1.0 Hz, 2H), 3.86 (s, 3H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.2, 163.5, 137.4, 130.9, 130.8, 129.6, 128.4, 127.9, 126.4, 119.9, 113.8, 109.3, 108.1, 55.45, 34.97, 32.78.

HRMS (ESI-TOF, m/z): Mass calcd. for$C_{18}H_{16}ClNO_2Na^+$[M+Na]$^+$, 336.0762; found: 336.0760.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)propan-1-one(5m)



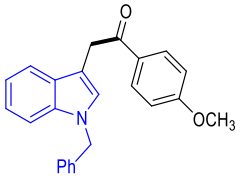
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 21.2 mg, 46% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.00 – 7.97 (m, 2H), 7.70 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.29 – 7.12 (m, 3H), 6.88 – 6.81 (m, 3H), 4.93 (q, *J* = 6.8 Hz, 1H), 3.80 (s, 3H), 3.69 (s, 3H), 1.57 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 199.5, 163.1, 137.1, 130.9, 130.4, 129.6, 126.6, 121.7, 119.1, 118.7, 115.2, 114.1, 113.8, 113.6, 109.4, 55.4, 38.2, 32.7, 18.8.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+$[M+Na]$^+$, 316.1308; found: 316.1306.

2-(1-benzyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5n)



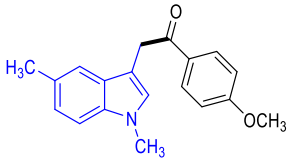
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 20.2 mg, 55% yield; m.p. 125 -127 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.00 (m, 2H), 7.65 – 7.63 (m, 1H), 7.29 – 7.23 (m, 4H), 7.19 – 7.13 (m, 2H), 7.11 – 7.06 (m, 3H), 6.94 – 6.89 (m, 2H), 5.27 (s, 2H), 4.36 (d, *J* = 1.0 Hz, 2H), 3.85 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.5, 163.4, 137.5, 136.6, 130.9, 130.4, 129.8, 128.7, 128.1, 127.5, 127.2, 126.8, 121.9, 119.4, 119.0, 114.1, 113.7, 109.8, 108.5, 55.42, 49.99, 35.32.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{24}H_{21}NO_2Na^+$[M+Na]$^+$, 378.1455; found: 378.1453.

2-(1,5-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5o)



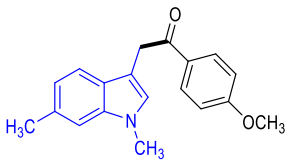
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 18.2 mg, 62% yield; m.p. 116 -117℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 – 8.02 (m, 2H), 7.40 (dt, *J* = 1.8, 0.9 Hz, 1H), 7.17 (d, *J* = 8.3 Hz, 1H), 7.05 (dd, *J* = 8.4, 1.6 Hz, 1H), 6.93 – 6.89 (m, 3H), 4.31 (d, *J* = 0.9 Hz, 2H), 3.85 (s, 3H), 3.70 (s, 3H), 2.47 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-d) δ 196.6, 163.4, 135.4, 130.9, 129.8, 128.4, 128.0, 127.8, 123.4, 118.5, 113.7, 109.0, 107.1, 55.4, 35.2, 32.7, 21.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+$ [M+Na]$^+$, 316.1308; found: 316.1310.

2-(1,6-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5p)



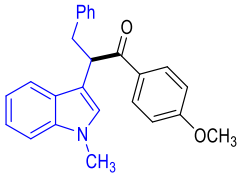
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 14.7 mg, 50% yield; m.p. 103 -105 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 – 8.02 (m, 2H), 7.49 (d, *J* = 8.1 Hz, 1H), 7.07 (s, 1H), 6.96 (dd, *J* = 8.1, 1.4 Hz, 1H), 6.90 (d, *J* = 8.6 Hz, 3H), 4.30 (d, *J* = 0.9 Hz, 2H), 3.84 (s, 3H), 3.69 (s, 3H), 2.48 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 163.4, 137.4, 131.6, 130.9, 129.8, 127.1, 125.7, 120.9, 118.5, 113.7, 109.3, 107.6, 55.4, 35.3, 32.6, 21.8.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+[M+Na]^+$, 316.1308; found: 316.1309.

1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)-3-phenylpropan-1-one(5q)



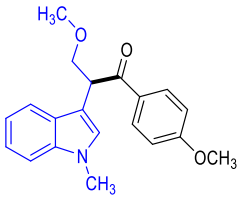
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 15.5 mg, 42% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.89 (m, 2H), 7.66 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.29 – 7.26 (m, 1H), 7.23 (dd, *J* = 6.8, 1.2 Hz, 1H), 7.21 – 7.18 (m, 4H), 7.15 – 7.11 (m, 2H), 6.87 (s, 1H), 6.79 – 6.77 (m, 2H), 5.08 (dd, *J* = 8.6, 5.6 Hz, 1H), 3.77 (s, 3H), 3.69 (s, 3H), 3.62 (dd, *J* = 13.6, 8.6 Hz, 1H), 3.14 (dd, *J* = 13.6, 5.6 Hz, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.1, 163.1, 140.7, 137.1, 130.8, 129.9, 129.1, 128.2, 127.2, 126.7, 125.9, 121.7, 119.2, 118.7, 113.5, 113.1, 109.4, 55.3, 46.2, 39.6, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{25}H_{23}NO_2Na^+[M+Na]^+$, 392.1621; found: 392.1622.

3-methoxy-1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)propan-1-one(5r)



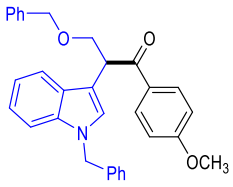
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 12.9 mg, 40% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 7.98 (m, 2H), 7.79 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.29 – 7.16 (m, 3H), 6.89 (s, 1H), 6.85 – 6.81 (m, 2H), 5.15 (dd, *J* = 9.4, 4.4 Hz, 1H), 4.21 (t, *J* = 9.4 Hz, 1H), 3.79 (s, 3H), 3.69 – 3.66 (m, 4H), 3.37 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.3, 163.3, 137.1, 130.9, 129.9, 127.6, 126.9, 121.9, 119.4, 118.6, 113.6, 109.7, 109.5, 74.3, 59.1, 55.4, 44.1, 32.7.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{21}NO_3Na^+[M+Na]^+$, 346.1414; found: 346.1409.

2-(1-benzyl-1*H*-indol-3-yl)-3-(benzyloxy)-1-(4-methoxyphenyl)propan-1-one(5s)



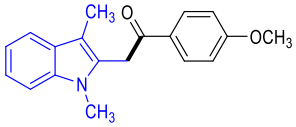
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 16.5 mg, 35% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 – 7.92 (m, 2H), 7.79 – 7.72 (m, 1H), 7.30 – 7.11 (m, 12H), 6.98 – 6.96 (m, 3H), 6.84 – 6.80 (m, 2H), 5.22 – 5.12 (m, 3H), 4.61 – 4.48 (m, 2H), 4.33 – 4.29 (m, 1H), 3.83 – 3.76 (m, 4H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.4, 163.2, 138.4, 137.2, 136.6, 130.9, 130.0, 128.7, 128.3, 127.6, 127.6, 127.4, 127.2, 127.1, 126.6, 122.1, 119.7, 118.8, 113.6, 110.5, 110.0, 73.4, 71.8, 55.4, 50.1, 44.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{32}H_{29}NO_3Na^+[M+Na]^+$, 498.2040; found: 498.2037.

2-(1,3-dimethyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7a)



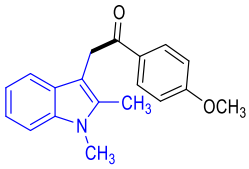
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 7.5 mg, 26% yield; m.p. 142 -144 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.52 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.27 – 7.24 (m, 1H), 7.20 – 7.10 (m, 1H), 7.10 – 7.06 (m, 1H), 6.97 – 6.93 (m, 2H), 4.40 (s, 2H), 3.88 (s, 3H), 3.63 (s, 3H), 2.30 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.7, 163.7, 137.1, 130.7, 129.9, 129.5, 128.2, 121.2, 118.7, 118.4, 113.9, 108.8, 108.4, 55.5, 35.3, 29.7, 9.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+$[M+Na]$^+$, 316.1308; found: 316.1304.

2-(1,2-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(7a')



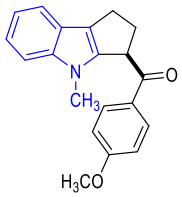
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 9.1 mg, 31% yield; m.p. 91 -92℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.02 (m, 2H), 7.49 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.26 – 7.23 (m, 1H), 7.16 – 7.12 (m, 1H), 7.09 – 7.05 (m, 1H), 6.92 – 6.88 (m, 2H), 4.30 (s, 2H), 3.84 (s, 3H), 3.66 (s, 3H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 163.3, 136.6, 134.55, 130.7, 129.9, 127.6, 120.7, 119.1, 117.9, 113.7, 108.7, 104.1, 55.4, 35.0, 29.6, 10.6.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{19}H_{19}NO_2Na^+$[M+Na]$^+$, 316.1308; found: 316.1309.

(4-methoxyphenyl)(4-methyl-1,2,3,4-tetrahydrocyclopenta[*b*]indol-3-yl)methanone(7b)



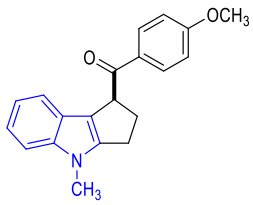
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 12.8 mg, 42% yield; m.p. 183 -185 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.03 – 7.99 (m, 2H), 7.49 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.28 – 7.26 (m, 1H), 7.20 – 7.15 (m, 1H), 7.11 – 7.07 (m, 1H), 6.99 – 6.95 (m, 2H), 4.93 – 4.88 (m, 1H), 3.89 (s, 3H), 3.56 (s, 3H), 3.13 – 2.90 (m, 3H), 2.68 – 2.60 (m, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.8, 163.6, 143.1, 141.9, 131.1, 1290, 123.9, 120.6, 119.7, 118.9, 118.9, 113.9, 109.6, 55.5, 47.5, 35.6, 31.1, 24.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{19}NO_2Na^+$[M+Na]$^+$, 328.1308; found: 328.1310.

(4-methoxyphenyl)(4-methyl-1,2,3,4-tetrahydrocyclopenta[*b*]indol-1-yl)methanone(7b')



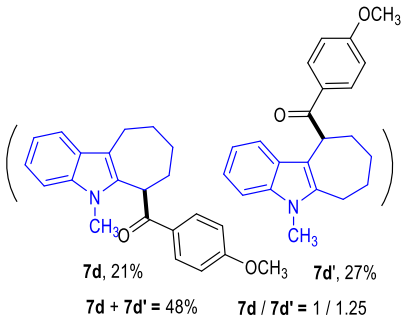
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 11.1 mg, 32% yield; m.p. 134 -136 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 – 8.12 (m, 2H), 7.21 (d, *J* = 8.2 Hz, 1H), 7.09 – 6.99 (m, 4H), 6.94 – 6.90 (m, 1H), 5.10 – 5.06 (m, 1H), 3.91 (s, 3H), 3.68 (s, 3H), 3.16 – 3.09 (m, 1H), 2.97 – 2.88 (m, 2H), 2.87 – 2.78 (m, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 199.8, 163.5, 147.2, 141.5, 131.0, 130.1, 123.8, 120.2, 119.3, 118.6, 115.5, 113.8, 109.5, 55.5, 46.3, 32.8, 30.9, 24.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{19}NO_2Na^+$[M+Na]$^+$, 328.1308; found: 328.1310.

(4-methoxyphenyl)(5-methyl-5,6,7,8,9,10-hexahydrocyclohepta[*b*]indol-6-yl)methanone(7c)
(4-methoxyphenyl)(5-methyl-5,6,7,8,9,10-hexahydrocyclohepta[*b*]indol-10-yl)methanone(7c')



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 16 mg, 48% yield (yield of isolated mixture).

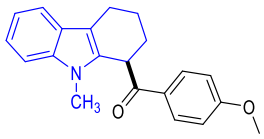
[7d] **^{1}H NMR (400 MHz, Chloroform-*d*)** 8.05 – 8.02 (m, 2H), 7.56 (d, *J* = 8.0 Hz, 1H), , 7.27 – 7.06 (m, 7H), 7.02 – 6.92 (m, 6H), 5.06 (dd, *J* = 5.6, 4.0 Hz, 1H), 3.89 (d, *J* = 3.3 Hz, 6H), 3.54 (s, 3H), 33.19 – 3.12 (m, 1H), 3.02 – 2.96 (m, 3H), 2.49 – 2.34 (m, 2H), 2.26 – 2.22 (m, 1H), 2.10 – 2.02 (m, 4H), 1.90 – 1.57 (m, 7H).

[7d'] **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.11 – 8.09 (m, 2H), 7.34 (d, *J* = 8.0 Hz, 1H), 7.27 – 7.06 (m, 7H), 7.02 – 6.92 (m, 6H), 5.22 (t, *J* = 4.5 Hz, 1H), 3.89 (d, *J* = 3.3 Hz, 6H), 3.71 (s, 4H), 3.19 – 3.12 (m, 1H), 3.02 – 2.96 (m, 3H), 2.49 – 2.34 (m, 2H), 2.26 – 2.22 (m, 1H), 2.10 – 2.02 (m, 4H), 1.90 – 1.57 (m, 7H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 199.8, 197.5, 163.5, 163.2, 141.4, 135.9, 135.1, 130.7, 130.67, 129.7, 129.1, 127.9, 127.5, 121.0, 120.4, 118.8, 118.6, 118.2, 117.0, 116.5, 114.0, 113.8, 110.5, 109.0, 108.7, 55.5, 55.4, 45.8, 43.1, 31.6, 30.4, 29.7, 29.6, 27.6, 27.2, 26.6, 25.62, 25.6, 22.9.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{22}H_{23}NO_2Na^+$[M+Na]$^+$, 356.1621; found: 356.1623.

(4-methoxyphenyl)(9-methyl-2,3,4,9-tetrahydro-1*H*-carbazol-1-yl)methanone(7d)



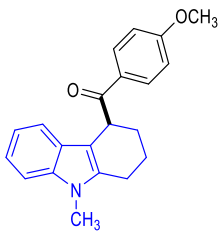
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 13 mg, 41% yield; m.p. 182 -183 °C.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 7.53 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.26 – 7.23 (m, 1H), 7.20 – 7.16 (m, 1H), 7.11 – 7.07 (m, 1H), 6.99 – 6.95 (m, 2H), 4.74 (dd, *J* = 7.0, 5.44 Hz, 1H), 3.89 (s, 3H), 3.42 (s, 3H), 2.91 – 2.73 (m, 2H), 2.36 – 2.15 (m, 2H), 1.97 – 1.81 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.8, 163.7, 137.2, 133.2, 131.0, 128.6, 126.9, 121.2, 118.7, 118.3, 114.0, 111.9, 108.7, 55.5, 42.4, 29.7, 28.9, 21.1, 21.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{21}NO_2Na^+$[M+Na]$^+$, 342.1465; found: 342.1462.

(4-methoxyphenyl)(9-methyl-2,3,4,9-tetrahydro-1*H*-carbazol-4-yl)methanone(7d')



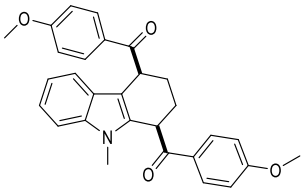
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 13.7 mg, 43% yield; m.p. 180 -181°C.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.14 – 8.11 (m, 2H), 7.27 – 7.24 (m, 1H), 7.13 – 7.07 (m, 2H), 7.011 – 6.91 (m, 3H), 4.90 (td, *J* = 6.3, 3.1 Hz, 1H), 3.90 (s, 3H), 3.66 (s, 3H), 2.90 – 2.73 (m, 2H), 2.28 – 1.88 (m, 4H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 200.9, 163.4, 137.1, 137.0, 130.9, 129.8, 126.3, 120.7, 118.9, 118.2, 113.9, 108.7, 107.5, 55.5, 41.1, 29.1, 28.3, 21.9, 21.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{21}H_{21}NO_2Na^+[M+Na]^+$, 342.1465; found: 342.1462.

(9-methyl-2,3,4,9-tetrahydro-1H-carbazole-1,4-diyl)bis((4-methoxyphenyl)methanone) (7d")

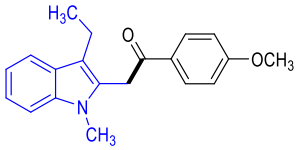


Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 5 mg, 11% yield; m.p. 158 -160℃

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 – 8.04 (m, 4H), 7.24 – 7.11 (m, 3H), 7.03 – 6.89 (m, 5H), 5.07 – 4.67 (m, 2H), 3.91 – 3.84 (m, 6H), 3.46 (d, *J* = 5.5 Hz, 3H), 2.59 – 2.41 (m, 1H), 2.37 – 2.07 (m, 3H).

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{29}H_{27}NO_4Na^+[M+Na]^+$, 476.1832; found: 476.1829.

2-(3-ethyl-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7e)



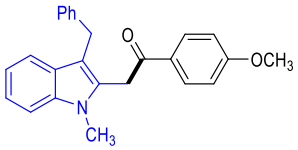
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow oil, 16.1 mg, 52% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 – 8.02 (m, 2H), 7.58 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.29 – 7.25 (m, 2H), 7.20 – 7.16 (m, 1H), 7.10 – 7.06 (m, 1H), 6.99 – 6.95 (m, 2H), 4.41 (s, 2H), 3.89 (s, 3H), 3.62 (s, 3H), 2.76 (q, *J* = 7.6 Hz, 2H), 1.20 (t, *J* = 7.6 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.6, 163.8, 137.2, 130.7, 129.6, 129.3, 127.2, 121.1, 118.6, 118.6, 115.5, 113.9, 108.9, 55.5, 34.9, 30.0, 17.9, 15.8.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{20}H_{21}NO_2Na^+[M+Na]^+$, 330.1465; found: 330.1464.

2-(3-benzyl-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7f)



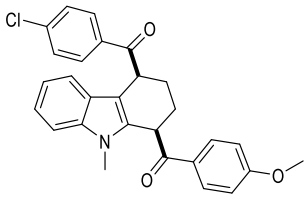
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 18.3 mg, 31% yield; m.p. 169 -171 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.96 – 7.92 (m, 2H), 7.42 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.29 (dt, *J* = 8.2, 0.9 Hz, 1H), 7.20 – 7.16 (m, 5H), 7.13 – 7.08 (m, 1H), 7.05 – 7.01 (m, 1H), 6.94 – 6.87 (m, 2H), 4.39 (s, 2H), 4.13 (s, 2H), 3.86 (s, 3H), 3.65 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.4, 163.8, 141.2, 137.3, 131.0, 130.6, 129.5, 128.3, 128.3, 127.8, 125.7, 121.3, 119.0, 118.8, 113.9, 111.7, 108.9, 55.5, 35.0, 30.5, 30.2.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{25}H_{23}NO_2Na^+[M+Na]^+$, 392.1621; found: 392.16117.

(4-(4-chlorobenzoyl)-9-methyl-2,3,4,9-tetrahydro-1H-carbazol-1-yl)(4-methoxyphenyl)methanone(8)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 10/1 to 5/1). White solid, 29.7 mg, 65% yield; m.p. 167 -168 ℃.

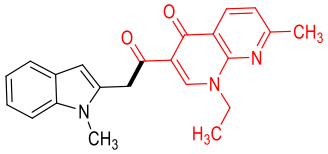
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.13 – 8.00 (m, 4H), 7.52 – 7.36 (m, 2H), 7.26 – 7.13 (m, 3H), 7.01 – 6.95 (m, 3H), 5.04 – 4.62 (m, 2H), 3.89 (d, *J* = 6.3 Hz, 3H), 3.47 (d, *J* = 11.5 Hz, 3H), 2.55 – 1.97 (m, 4H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 200.6, 197.9, 163.9, 139.6, 137.4, 134.8, 130.9, 130.0, 129.1,

128.8, 128.3, 126.0, 121.5, 119.1, 118.1, 114.2, 109.5, 109.1, 55.6, 40.7, 39.7, 29.7, 24.9, 24.2.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{28}H_{24}ClNO_3Na^+$[M+Na]$^+$, 480.1337; found: 480.1333.

1-ethyl-7-methyl-3-(2-(1-methyl-1*H*-indol-2-yl)acetyl)-1,8-naphthyridin-4(1*H*)-one(9a)



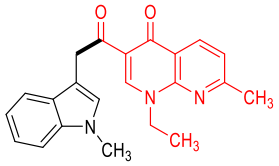
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 10/1 to 5/1). White solid, 17.2 mg, 48% yield; m.p. 199 -201 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.68 – 8.65 (m, 2H), 7.52 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.29 (d, *J* = 8.2 Hz, 2H), 7.18 – 7.14 (m, 1H), 7.06 – 7.02 (m, 1H), 6.40 (s, 1H), 4.81 (s, 2H), 4.49 (q, *J* = 7.2 Hz, 2H), 3.72 (s, 3H), 2.68 (s, 3H), 1.49 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.2, 163.0, 148.8, 148.5, 137.7, 136.8, 134.6, 127.9, 121.9, 121.4, 120.8, 120.1, 119.1, 118.6, 109.0, 101.5, 46.8, 41.1, 29.9, 25.1, 15.2.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{22}H_{21}N_3O_2Na^+$[M+Na]$^+$, 382.1526; found: 382.1521.

1-ethyl-7-methyl-3-(2-(1-methyl-1*H*-indol-3-yl)acetyl)-1,8-naphthyridin-4(1*H*)-one(9b)



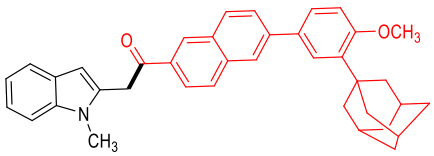
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 10/1 to 5/1). White solid, 12.1 mg, 34% yield; m.p. 179 -181 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.69 (d, *J* = 8.2 Hz, 1H), 8.62 – 8.61 (m, 1H), 7.69 – 7.66 (m, 1H), 7.28 – 7.24 (m, 2H), 7.21 – 7.16 (m, 2H), 7.11 – 7.01 (m, 1H), 4.72 (s, 2H), 4.47 – 4.42 (m, 2H), 3.73 (s, 3H), 2.67 (s, 3H), 1.47 – 1.44 (m, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 176.0, 162.7, 148.8, 148.5, 136.9, 136.8, 128.4, 128.4, 122.0, 121.4, 121.1, 119.5, 119.1, 118.9, 109.0, 107.7, 46.67, 39.21, 32.62, 25.04, 15.10.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{22}H_{21}N_3O_2Na^+$[M+Na]$^+$, 382.1526; found: 382.1519.

1-(6-(3-((3r,5r,7r)-adamantan-1-yl)-4-methoxyphenyl)naphthalen-2-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(9c)



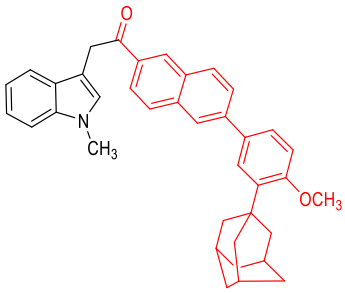
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 24.2 mg, 45% yield; m.p. 217 - 219 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.61 (d, *J* = 1.8 Hz, 1H), 8.10 (dd, *J* = 8.6, 1.8 Hz, 1H), 8.02 – 8.00 (m, 2H), 7.94 (d, *J* = 8.6 Hz, 1H), 7.82 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.61 (d, *J* = 2.4 Hz, 1H), 7.57 – 7.53 (m, 2H), 7.31 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.21 – 7.17 (m, 1H), 7.10 – 7.06 (m, 1H), 7.00 (d, *J* = 8.6 Hz, 1H), 6.43 (s, 1H), 4.61 (s, 2H), 3.91 (s, 3H), 3.74 (s, 3H), 2.19 – 2.18 (m, 6H), 2.11 (t, *J* = 3.4 Hz, 3H), 1.81 (t, *J* = 3.2 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.7, 159.1, 142.0, 139.1, 137.8, 136.2, 133.5, 133.2, 132.4, 131.2, 130.3, 130.0, 128.7, 127.8, 126.7, 126.0, 125.8 124.7, 124.5, 121.2, 120.2, 119.5, 112.2, 109.1, 102.2, 55.2, 40.6, 37.8, 37.2, 37.1, 30.1, 29.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{38}H_{37}NO_2Na^+$[M+Na]$^+$, 562.2717; found: 562.2714.

1-(6-(3-((3*r*,5*r*,7*r*)-adamantan-1-yl)-4-methoxyphenyl)naphthalen-2-yl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(9d)



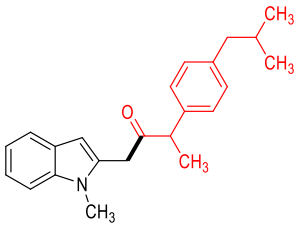
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 21 mg, 39% yield; m.p. 192 -194 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.61 (d, *J* = 1.8 Hz, 1H), 8.11 (dd, *J* = 8.6, 1.8 Hz, 1H), 8.00 – 7.96 (m, 2H), 7.91 (d, *J* = 8.6 Hz, 1H), 7.79 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.68 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.60 (d, *J* = 2.4 Hz, 1H), 7.54 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.32 – 7.29 (m, 1H), 7.24 (dd, *J* = 8.2, 1.2 Hz, 1H), 7.16 – 7.14 (m, 1H), 7.03 (d, *J* = 1.2 Hz, 1H), 7.00 (d, *J* = 8.4 Hz, 1H), 4.53 (d, *J* = 1.0 Hz, 2H), 3.91 (s, 3H), 3.74 (s, 3H), 2.19 (d, *J* = 3.0 Hz, 6H), 2.11 (s, 3H), 1.80 (d, *J* = 3.2 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.8, 159.0, 141.6, 139.1, 137.0, 136.0, 133.7, 132.5, 131.3, 130.1, 123.0, 128.5, 127.9, 126.5, 126.0, 125.7, 124.8, 124.7, 121.8, 119.2, 118.9, 112.2, 109.3, 107.6, 55.2, 40.6, 37.2, 37.1, 35.5, 32.7, 29.1.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{38}H_{37}NO_2Na^+$[M+Na]$^+$, 562.2717; found: 562.2716.

3-(4-isobutylphenyl)-1-(1-methyl-1*H*-indol-2-yl)butan-2-one(9e)



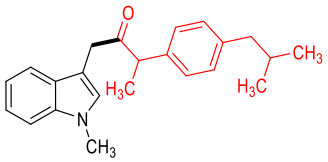
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 19.3 mg, 58% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.56 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.24 – 7.17 (m, 2H), 7.13 – 7.05 (m, 5H), 6.29 (s, 1H), 3.95 (q, *J* = 7.0 Hz, 1H), 3.87 – 3.77 (m, 2H), 3.39 (s, 3H), 2.47 (d, *J* = 7.2 Hz, 2H), 1.87 (dt, *J* = 13.6, 6.8 Hz, 1H), 1.39 (d, *J* = 7.0 Hz, 3H), 0.93 (dd, *J* = 6.6, 1.4 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 207.0, 140.9, 137.6, 137.2, 133.1, 129.7, 127.7, 127.7, 121.2, 120.1, 119.5, 109.1, 102.0, 51.1, 45.0, 40.1, 30.2, 29.5, 22.4, 22.3, 17.5.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{23}H_{27}NONa^+$[M+Na]$^+$, 356.1985; found: 356.1981.

3-(4-isobutylphenyl)-1-(1-methyl-1*H*-indol-3-yl)butan-2-one(9f)



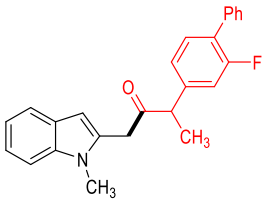
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 10.6 mg, 32% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.31 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.28 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.22 – 7.18 (m, 1H), 7.11 (s, 4H), 7.09 – 7.02 (m, 1H), 6.86 (s, 1H), 3.90 (q, *J* = 6.8 Hz, 1H), 3.80 – 3.69 (m, 5H), 2.47 (d, *J* = 7.2 Hz, 2H), 1.87 (dt, *J* = 13.6, 6.8 Hz, 1H), 1.34 (d, *J* = 6.8 Hz, 3H), 0.92 (d, *J* = 6.6 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 209.0, 140.6, 138.0, 136.8, 129.6, 128.0, 127.8, 127.7, 121.7, 119.1, 118.8, 109.2, 107.1, 51.1, 45.0, 37.7, 32.7, 30.2, 22.4, 17.8.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{23}H_{27}NONa^+$[M+Na]$^+$, 356.1985; found: 356.1984.

3-(2-fluoro-[1,1'-biphenyl]-4-yl)-1-(1-methyl-1*H*-indol-2-yl)butan-2-one(9g)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 19.1 mg, 51% yield.

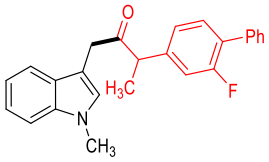
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.58 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.55 – 7.52 (m, 2H), 7.48 – 7.43 (m, 2H), 7.41 – 7.33 (m, 3H), 7.26 – 7.18 (m, 2H), 7.13 – 7.09 (m, 1H), 6.99 – 6.96 (m, 2H), 6.36 (d, *J* = 0.8 Hz, 1H), 4.02 (q, *J* = 7.0 Hz, 1H), 3.97 – 3.81 (m, 2H), 3.47 (s, 3H), 1.42 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 206.3, 159.83 (d, *J* = 249.3 Hz), 141.21 (d, *J* = 7.4 Hz), 137.7, 135.2, 132.6, 131.10 (d, *J* = 3.8 Hz), 128.9 (d, *J* = 2.9 Hz), 128.5, 128.1, 127.8, 127.6, 124.0 (d, *J* = 3.5 Hz), 121.47, 119.63, 115.54 (d, *J* = 23.3 Hz), 109.14, 102.23, 50.5, 40.7, 29.7, 17.7.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -116.92.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{25}H_{22}FNONa^+$[M+Na]$^+$, 394.1578; found: 394.1574.

3-(2-fluoro-[1,1'-biphenyl]-4-yl)-1-(1-methyl-1*H*-indol-3-yl)butan-2-one(9h)



Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 18.9 mg, 51% yield.

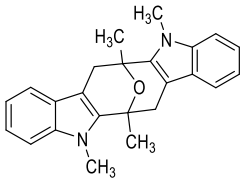
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.55 – 7.53 (m, 2H), 7.47 – 7.43 (m, 2H), 7.40 – 7.35 (m, 3H), 7.30 (dt, *J* = 8.4, 1.0 Hz, 1H), 7.25 – 7.21 (m, 1H), 7.12 – 7.07 (m, 1H), 7.02 (dd, *J* = 8.0, 1.8 Hz, 1H), 6.96 (dd, *J* = 11.6, 1.8 Hz, 1H), 6.91 (s, 1H), 3.97 (q, *J* = 7.0 Hz, 1H), 3.89 – 3.77 (m, 2H), 3.76 (s, 3H), 1.39 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 208.2, 159.8 (d, *J* = 248.8 Hz), 142.1 (d, *J* = 7.4 Hz), 136.9, 135.4, 131.0 (d, *J* = 4.2 Hz), 128.9 (d, *J* = 2.9 Hz), 128.5, 128.0, 127.8, 127.7, 123.9 (d, *J* = 3.6 Hz), 121.8, 119.3, 118.7, 115.6 (d, *J* = 23.3 Hz), 109.3, 106.7, 50.6, 38.3, 32.7, 17.9.

^{19}F NMR (377 MHz, Chloroform-*d*) δ -117.39.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{25}H_{22}FNONa^+$[M+Na]$^+$, 394.1578; found: 394.1572.

5,6,12,13-tetramethyl-5,6,7,12,13,14-hexahydro-6,13-epoxycycloocta[1,2-b:5,6-*b*']diindole(10)



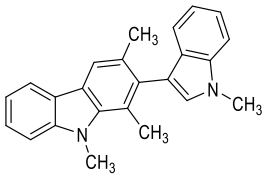
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 26.7 mg, 75% yield; m.p. 195 - 197 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 (dt, *J* = 7.8, 1.0 Hz, 2H), 7.18 (dt, *J* = 8.2, 1.0 Hz, 2H), 7.13 – 7.09 (m, 2H), 7.03 – 6.99 (m, 2H), 3.78 (s, 6H), 3.22– 3.10 (m, 4H), 1.91 (s, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 137.7, 137.5, 126.1, 121.2, 118.9, 117.7, 108.8, 107.0, 72.1, 34.1, 31.3, 27.0.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{24}H_{24}N_2ONa^+$[M+Na]$^+$, 379.1781; found: 379.1775.

1,3,9-trimethyl-2-(1-methyl-1H-indol-3-yl)-9*H*-carbazole(11)



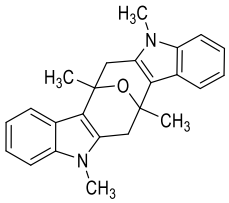
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). White solid, 12.2 mg, 36% yield; m.p. 212 -214 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.87 (s, 1H), 7.47 – 7.36 (m, 3H), 7.29 – 7.19 (m, 3H), 7.10 – 7.06 (m, 1H), 6.95 (s, 1H), 4.12 (s, 3H), 3.90 (s, 3H), 2.58 (s, 3H), 2.21 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.5, 139.1, 136.8, 132.9, 129.8, 128.3, 127.6, 125.3, 122.9, 122.7, 121.5, 121.1, 120.2, 119.8, 119.1, 118.7, 118.1, 115.2, 109.1, 108.6, 33.0, 32.8, 21.7, 17.4.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{24}H_{23}N_2^+[M+H]^+$, 339.1856; found: 339.1850.

5,7,12,14-tetramethyl-5,6,7,12,13,14-hexahydro-7,14-epoxycycloocta[1,2-*b*:5,6-*b'*]diindole(12)



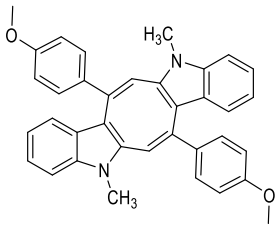
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow solid, 20.9 mg, 59% yield; m.p. 185 - 187 ℃

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.59 – 7.599 (m, 2H), 7.21 – 7.18 (m, 2H), 7.14 – 7.07 (m, 4H), 3.48 (s, 6H), 3.15 – 3.01 (m, 4H), 1.99 (s, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 137.0, 134.4, 123.9, 120.2, 118.8, 118.3, 112.6, 109.0, 72.2, 34.7, 29.0, 28.2.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{24}H_{24}N_2ONa^+[M+Na]^+$, 379.1781; found: 379.1775.

(6*Z*,13*Z*)-7,14-bis(4-methoxyphenyl)-5,12-dimethyl-5,12-dihydrocycloocta[1,2-*b*:5,6-*b'*]diindole(13)



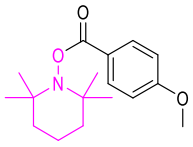
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Yellow solid, 33.3 mg, 64% yield; m.p. 300 - 302 ℃.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.41 – 7.37 (m, 4H), 7.20 (dt, *J* = 8.2, 0.8 Hz, 2H), 7.10 – 7.05 (m, 2H), 6.85 – 6.80 (m, 8H), 6.70 (dt, *J* = 7.8, 1.0 Hz, 2H), 3.82 (s, 6H), 3.75 (s, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.6, 144.7, 138.1, 138.1, 134.3, 129.1, 127.2, 121.3, 120.5, 119.1, 117.0, 113.9, 113.6, 108.9, 55.3, 29.9.

HRMS (ESI-TOF, m/z): Mass calcd. for $C_{36}H_{30}N_2O_2Na^+[M+Na]^+$, 545.2199; found: 545.2194.

2,2,6,6-tetramethylpiperidin-1-yl 4-methoxybenzoate(14)



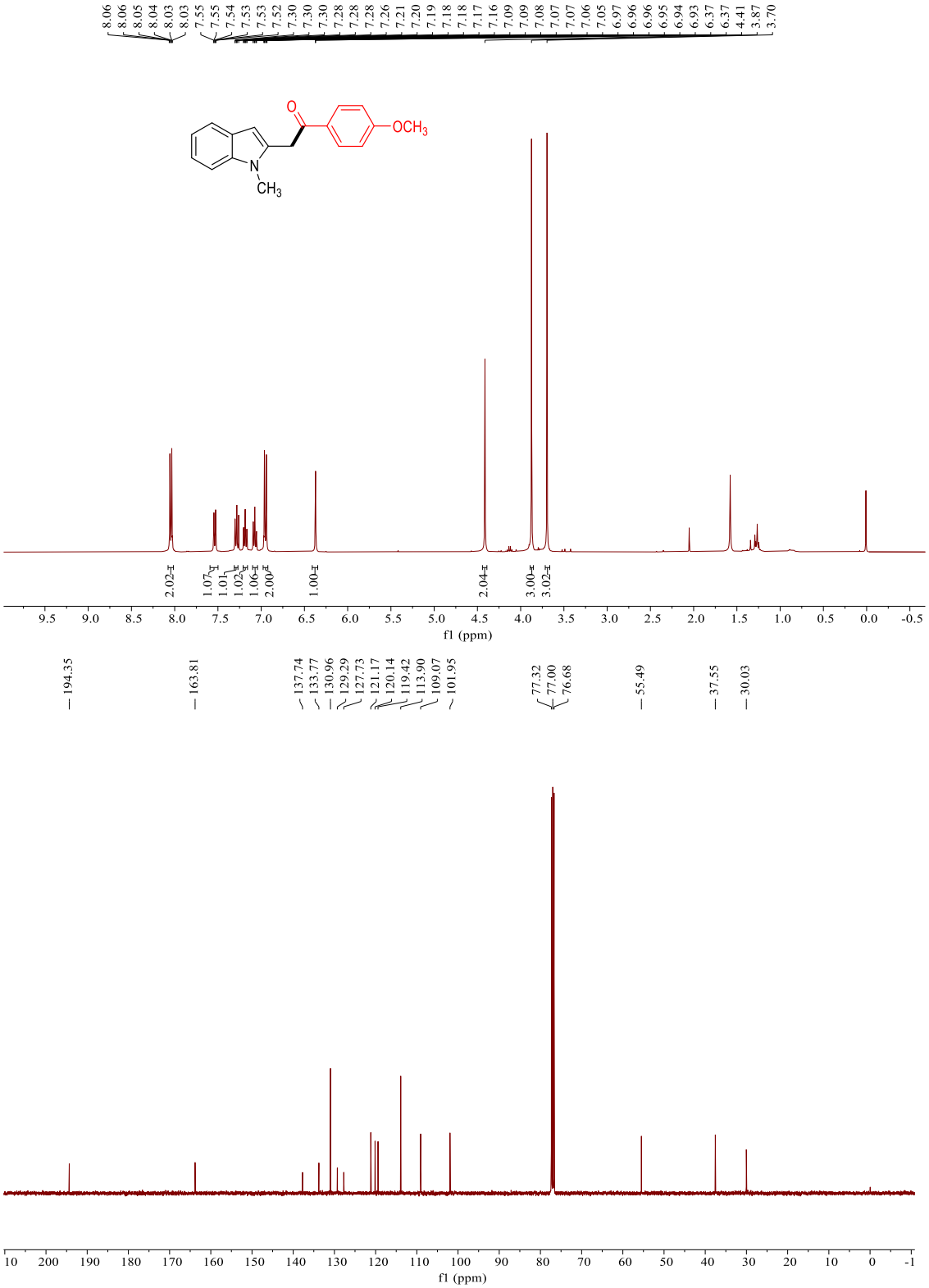
Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 30/1 to 20/1). Colourless oil, 5.6 mg, 19% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 – 8.01 (m, 2H), 6.96 – 6.93 (m, 2H), 3.87 (s, 3H), 1.82 – 1.63 (m, 3H), 1.60 – 1.56 (m, 2H), 1.48 – 1.42 (m, 1H), 1.26 (s, 6H), 1.11 (s, 6H).

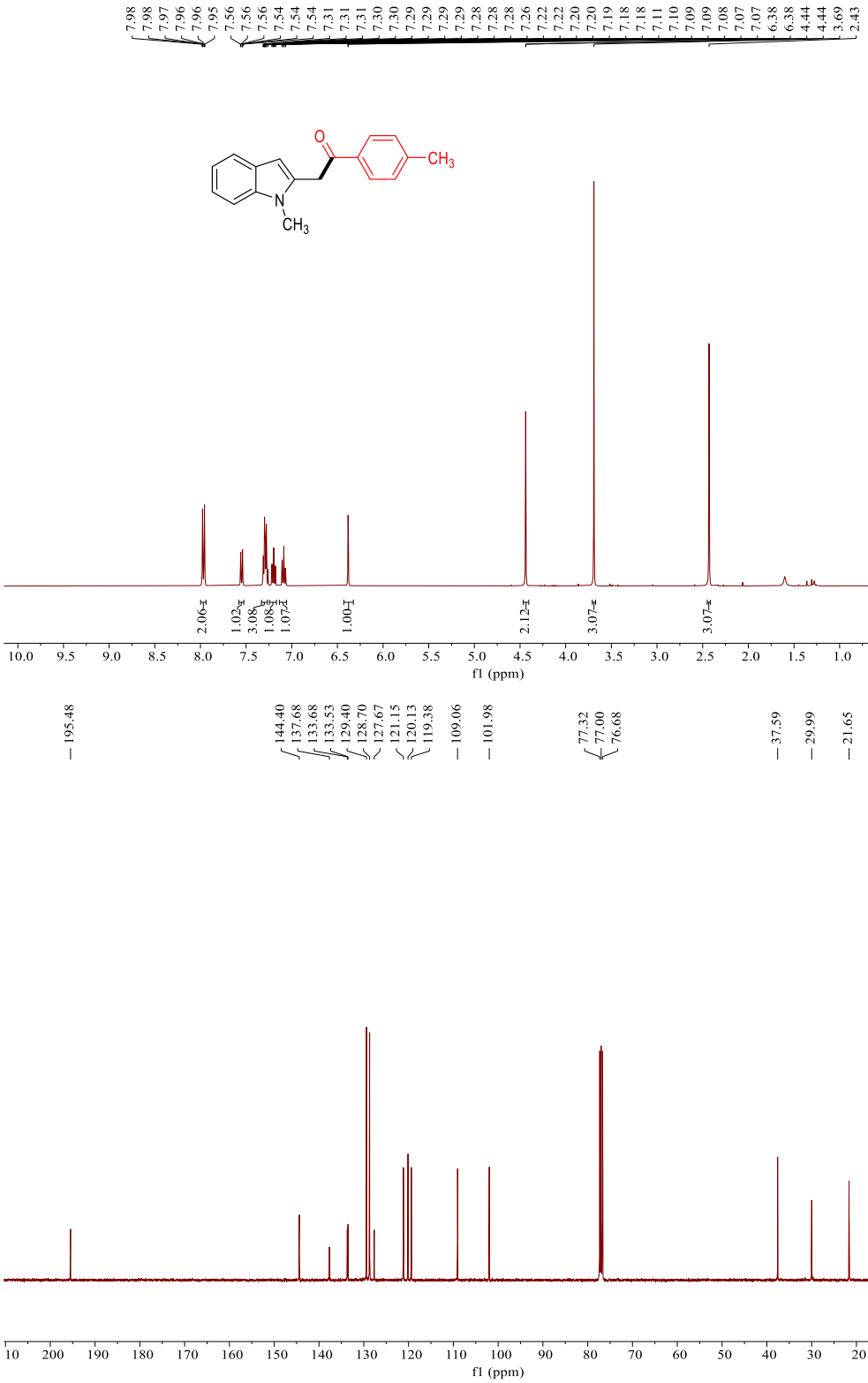
^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.0, 163.2, 131.4, 121.9, 113.6, 60.2, 55.3, 38.9, 31.8, 20.7, 16.9.

X. NMR spectra

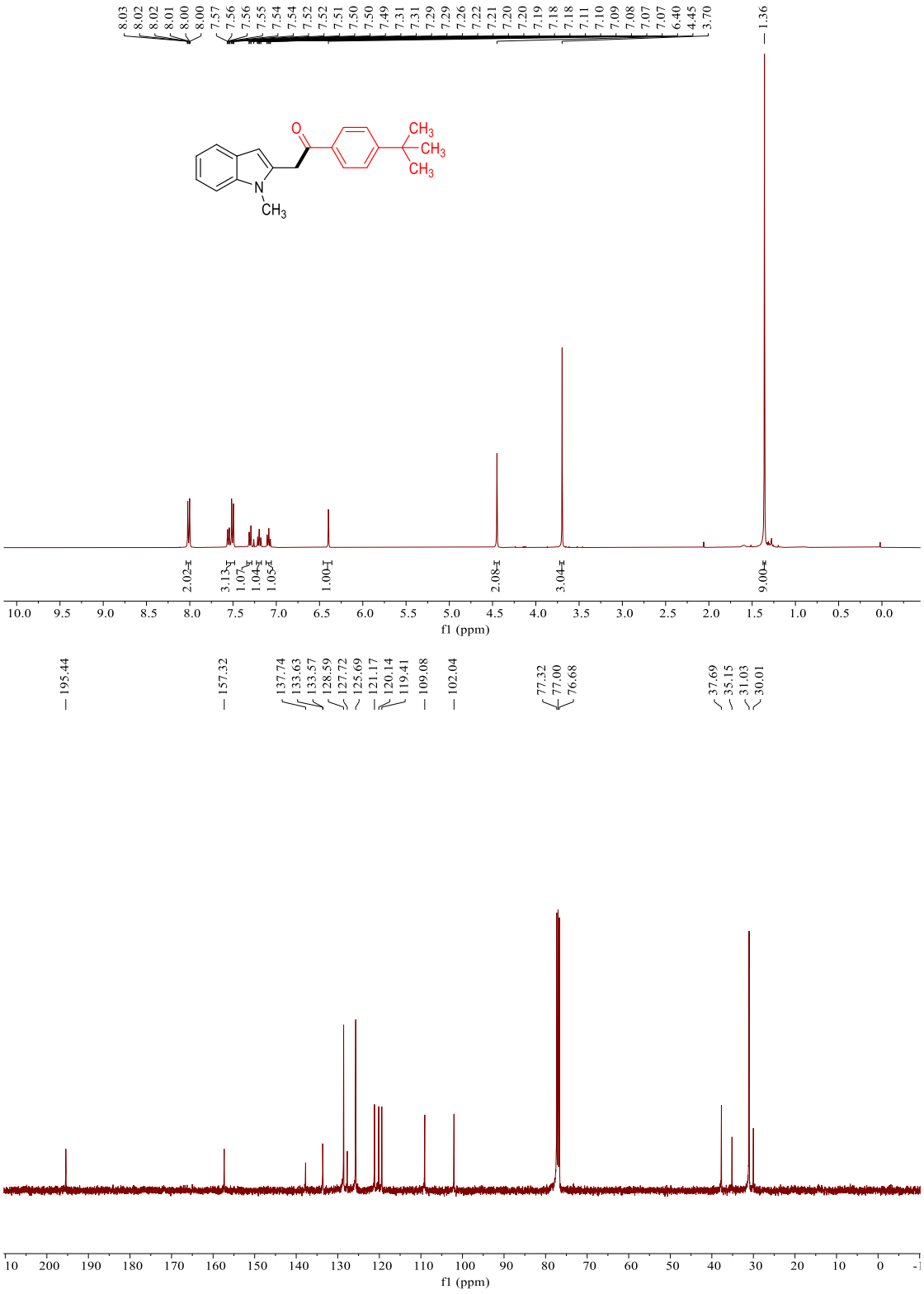
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4a)



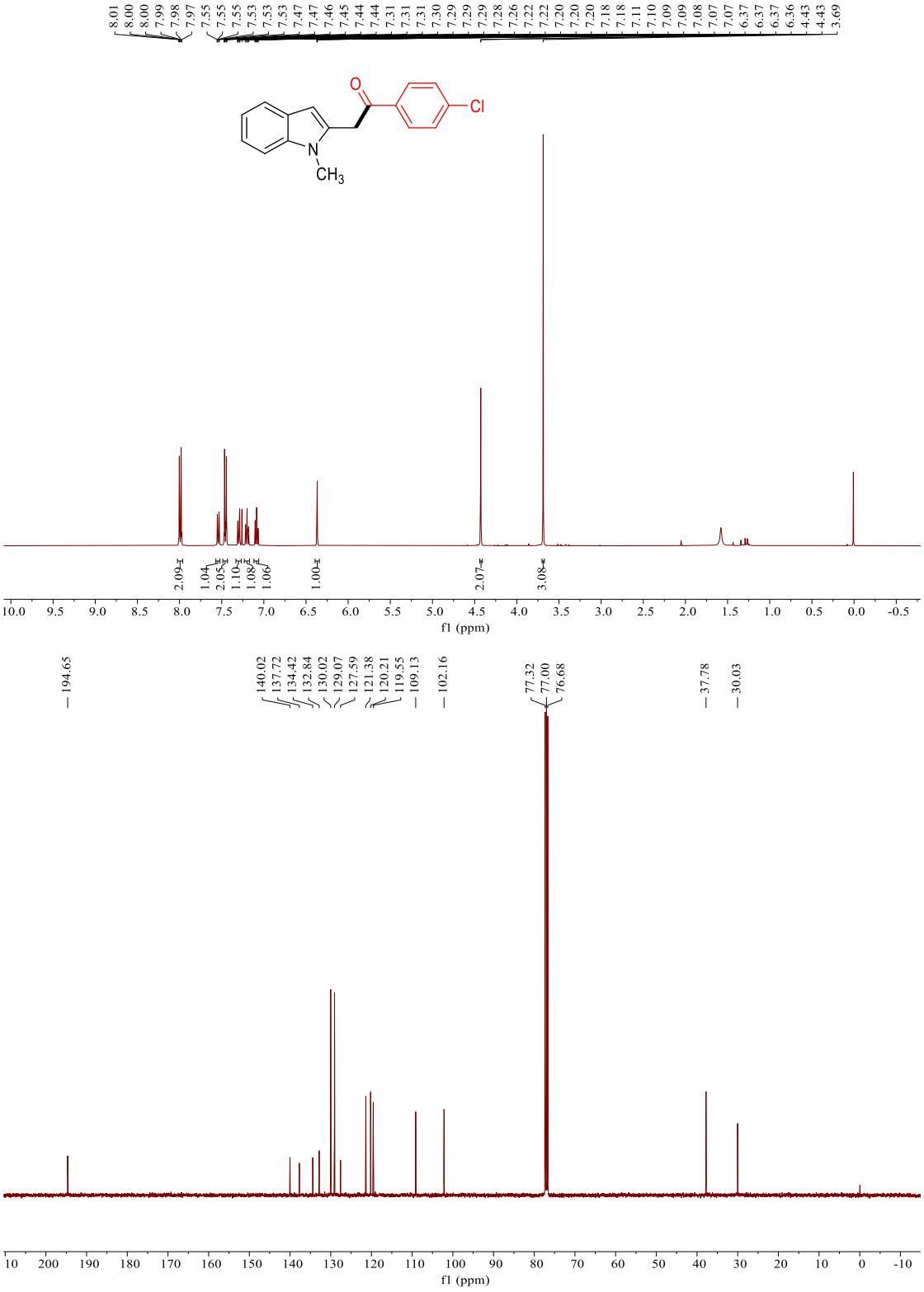
2-(1-methyl-1*H*-indol-2-yl)-1-(p-tolyl)ethan-1-one(4b)



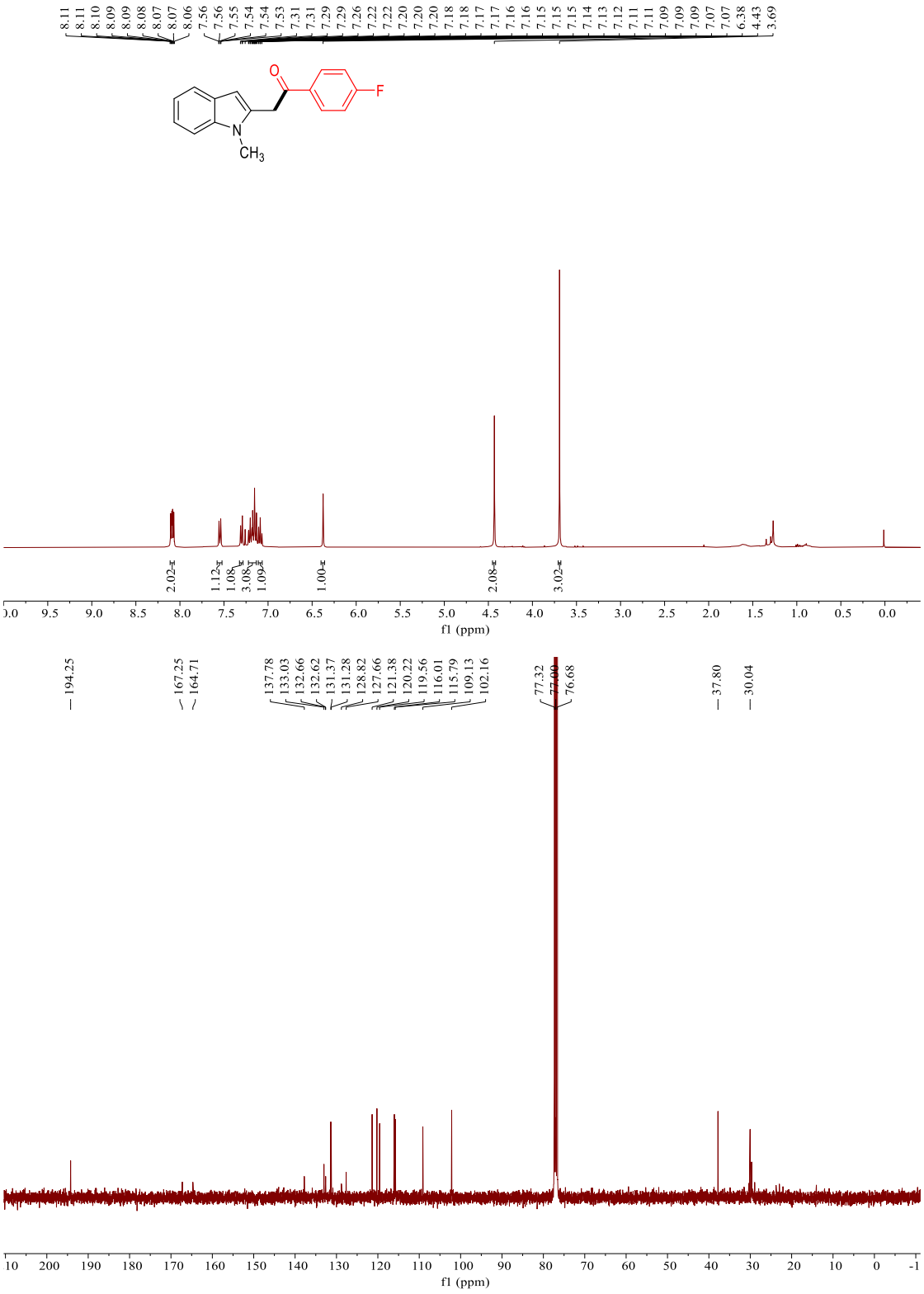
1-(4-(tert-butyl)phenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4c)

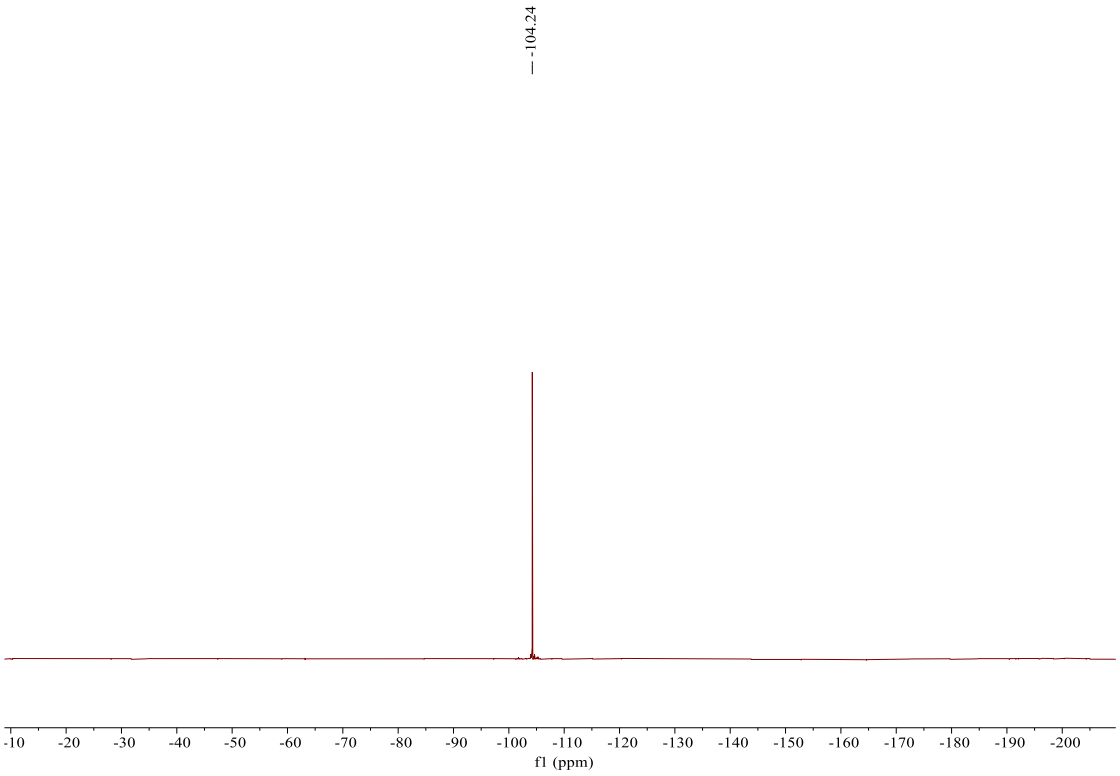


1-(4-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4d)



1-(4-fluorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4e)

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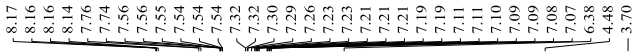
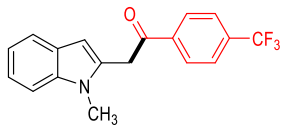
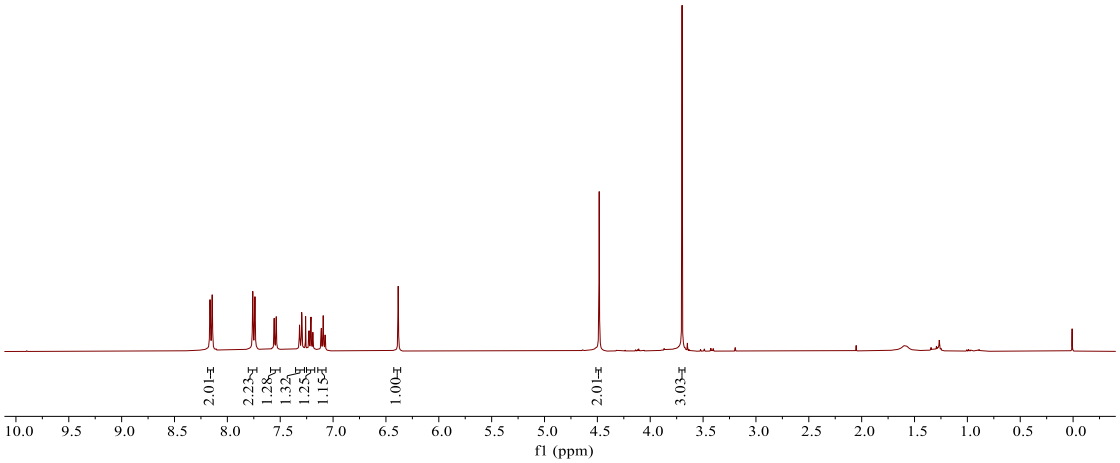
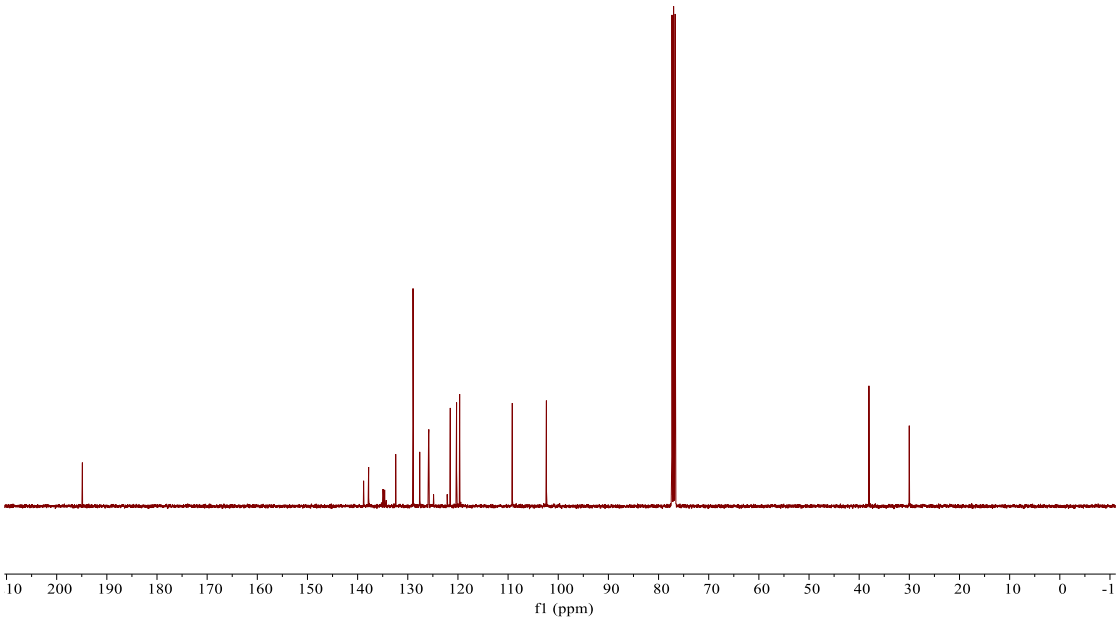
f1 (ppm)

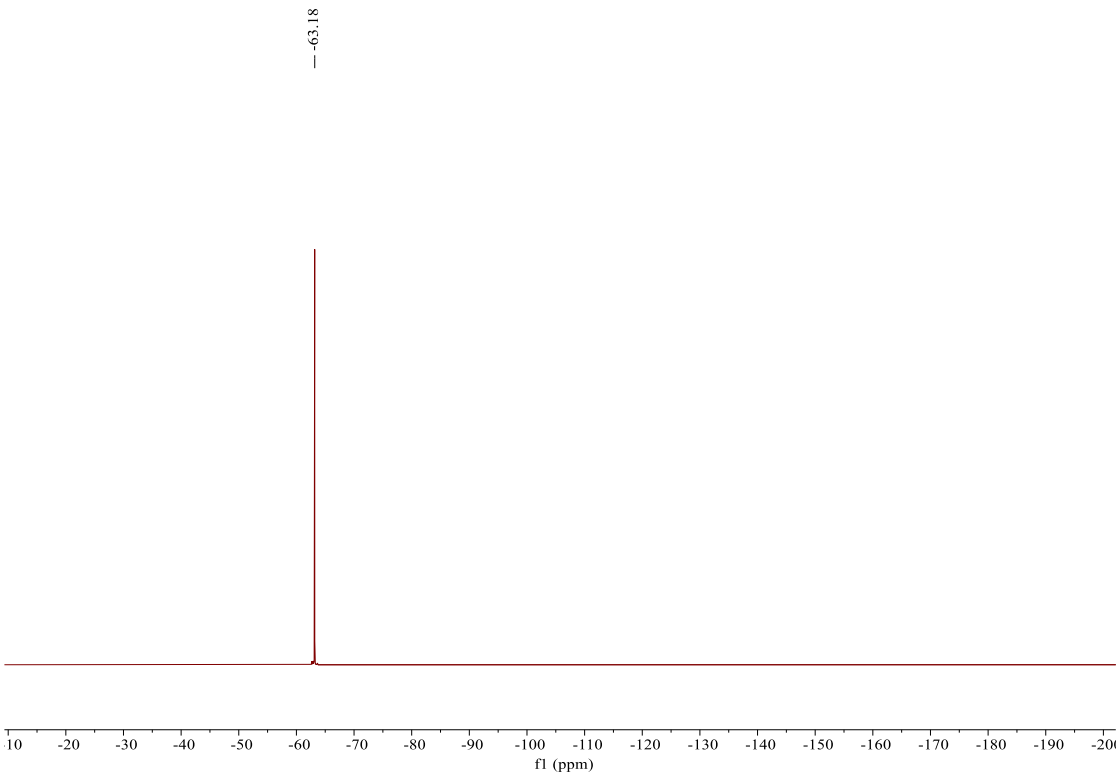
2-(1-methyl-1*H*-indol-2-yl)-1-(4-(trifluoromethyl)phenyl)ethan-1-one(4f)



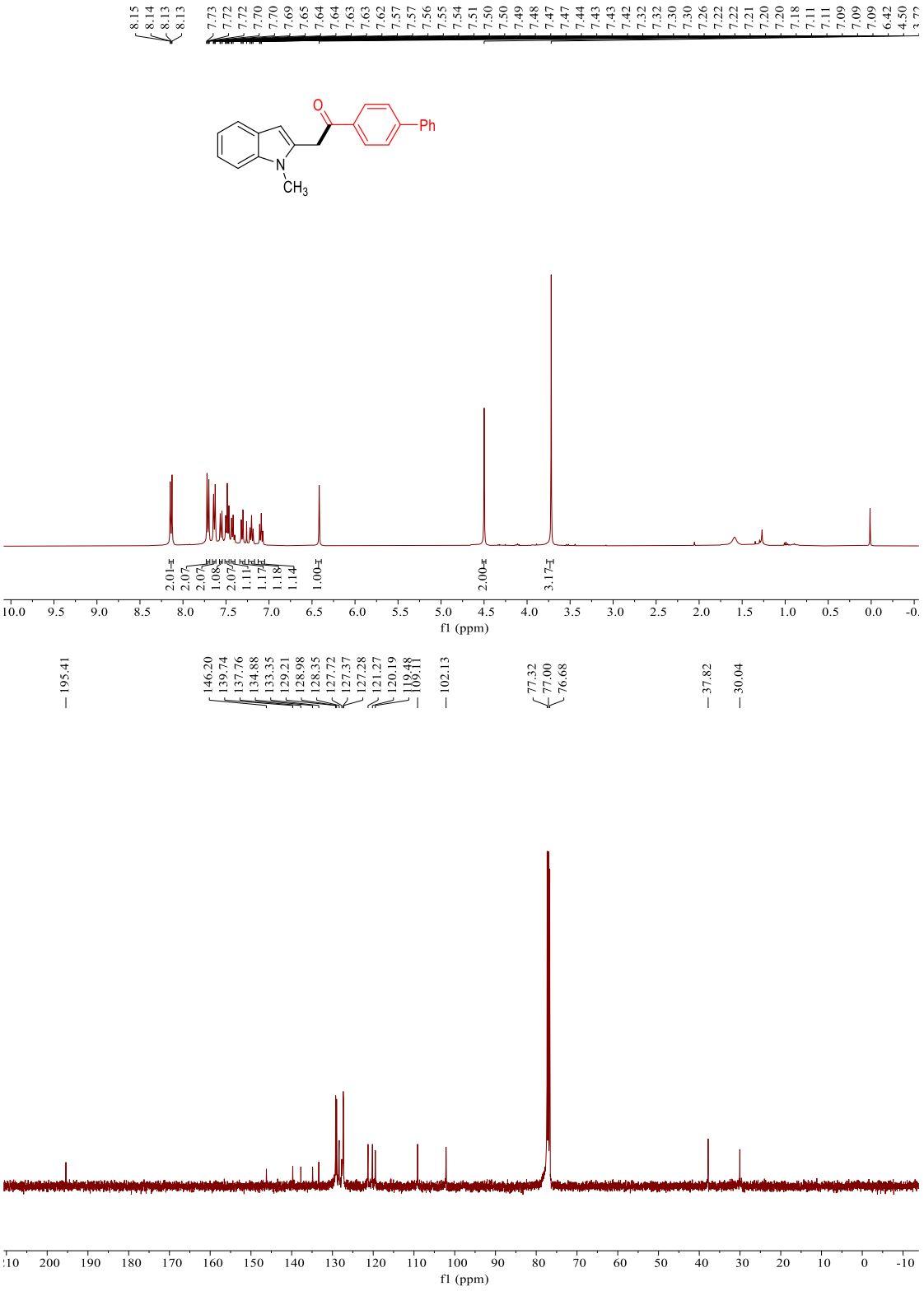




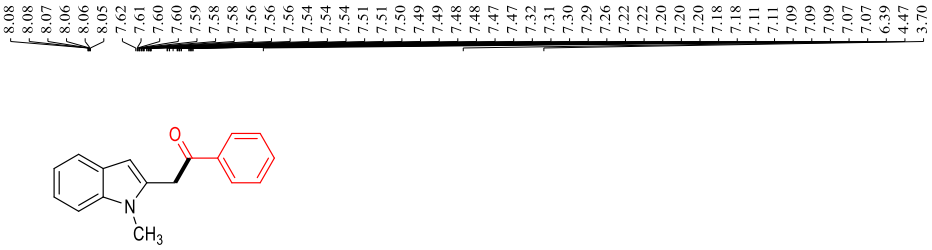


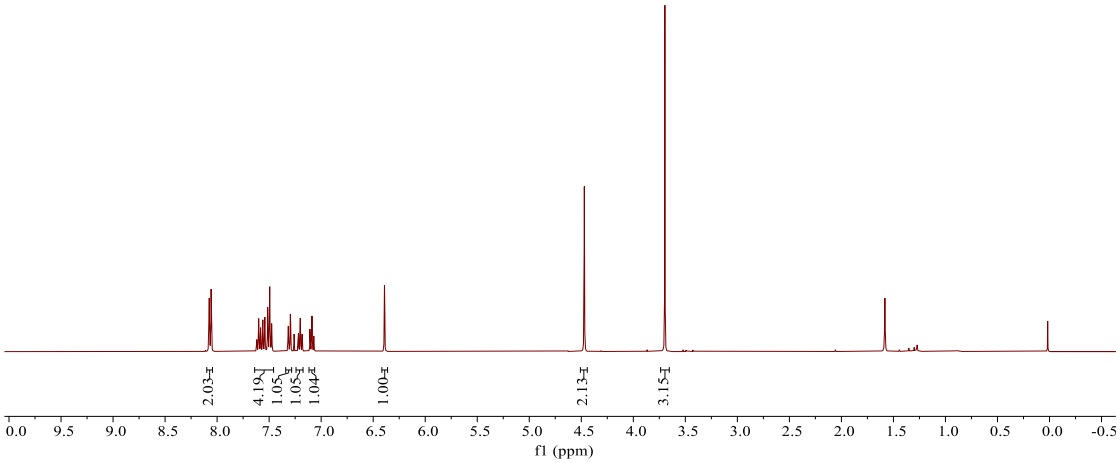

-63.18
10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -20
f1 (ppm)

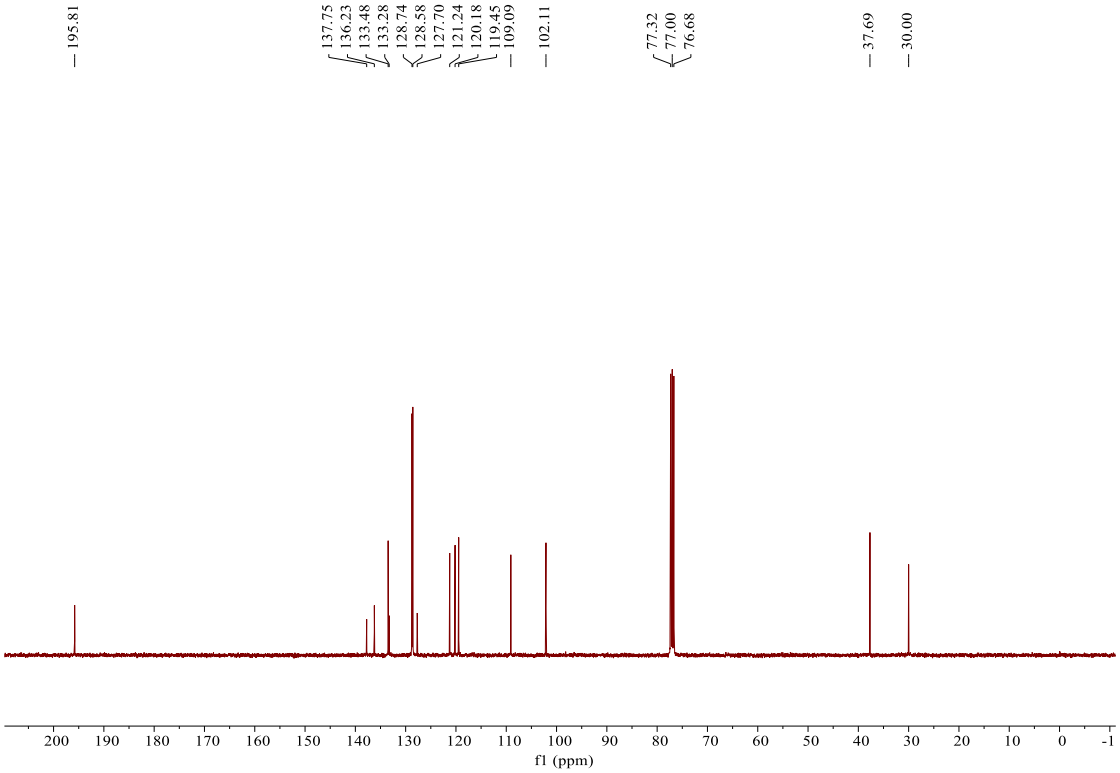
1-([1,1'-biphenyl]-4-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4g)



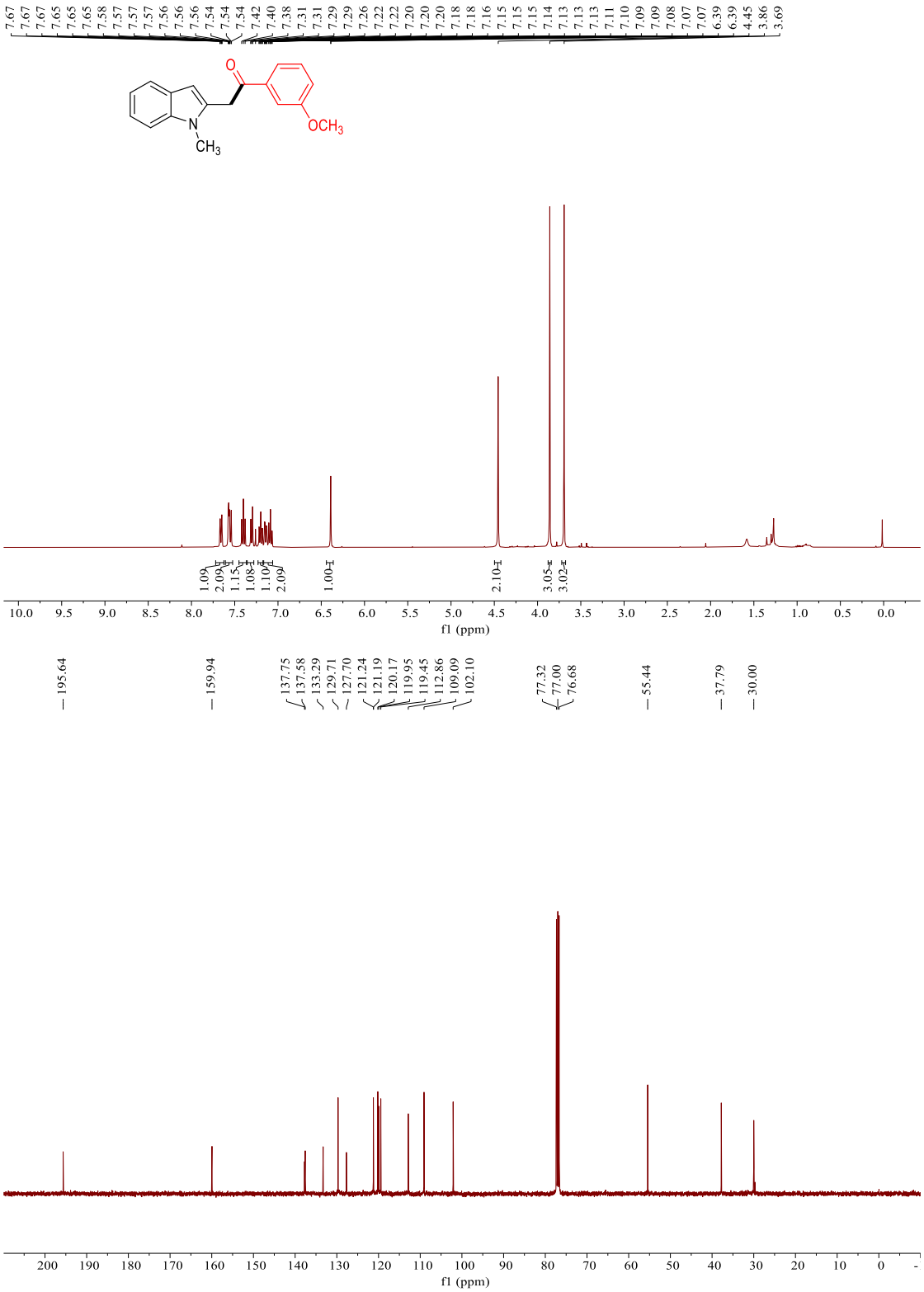
2-(1-methyl-1*H*-indol-2-yl)-1-phenylethan-1-one(4h)



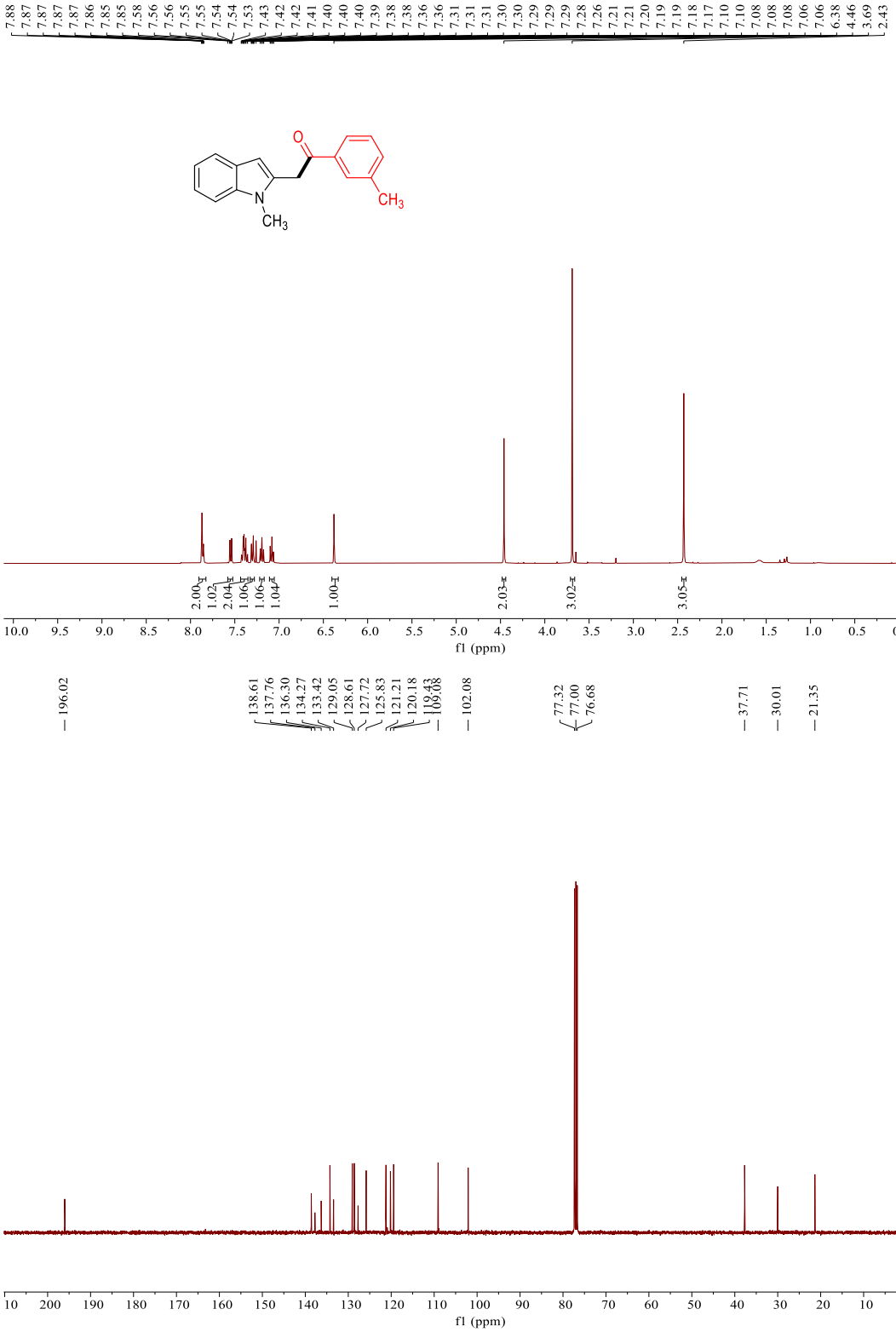




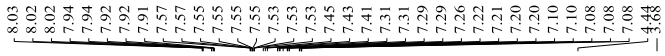
1-(3-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4i)

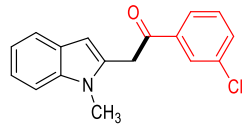


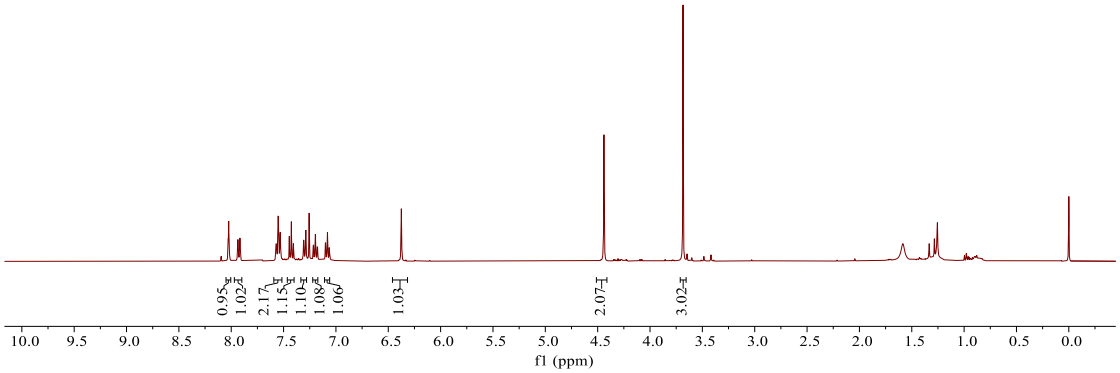
2-(1-methyl-1*H*-indol-2-yl)-1-(m-tolyl)ethan-1-one(4j)

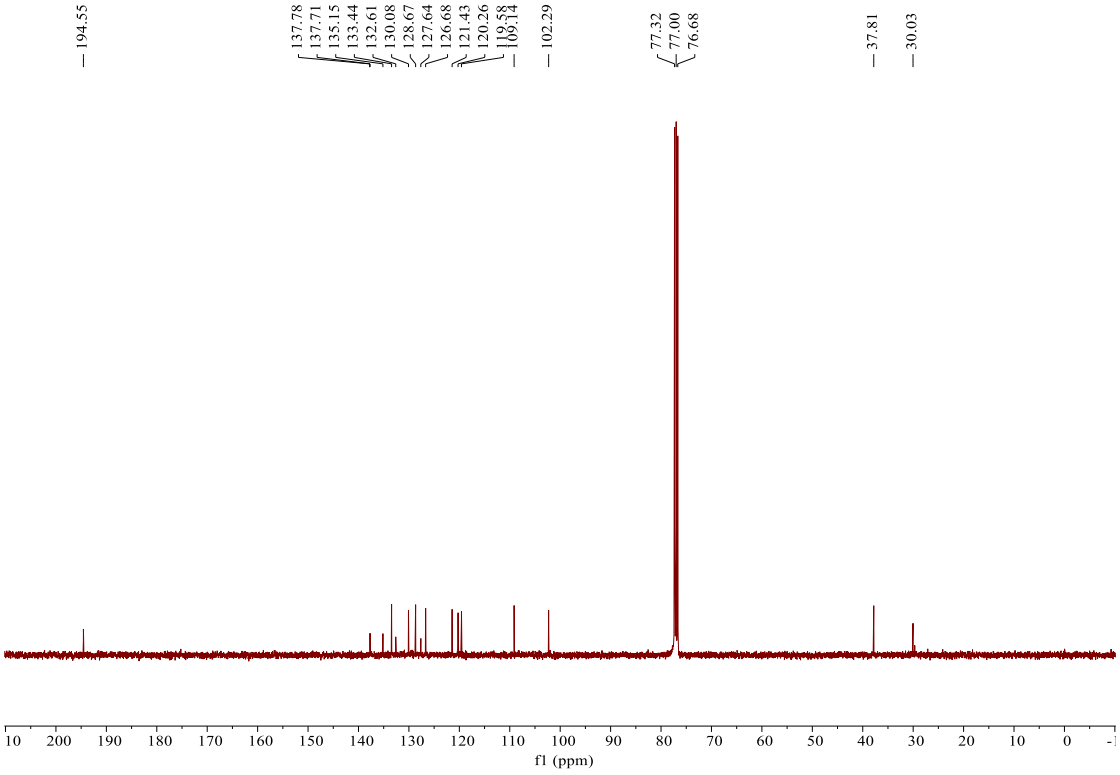


1-(3-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4k)

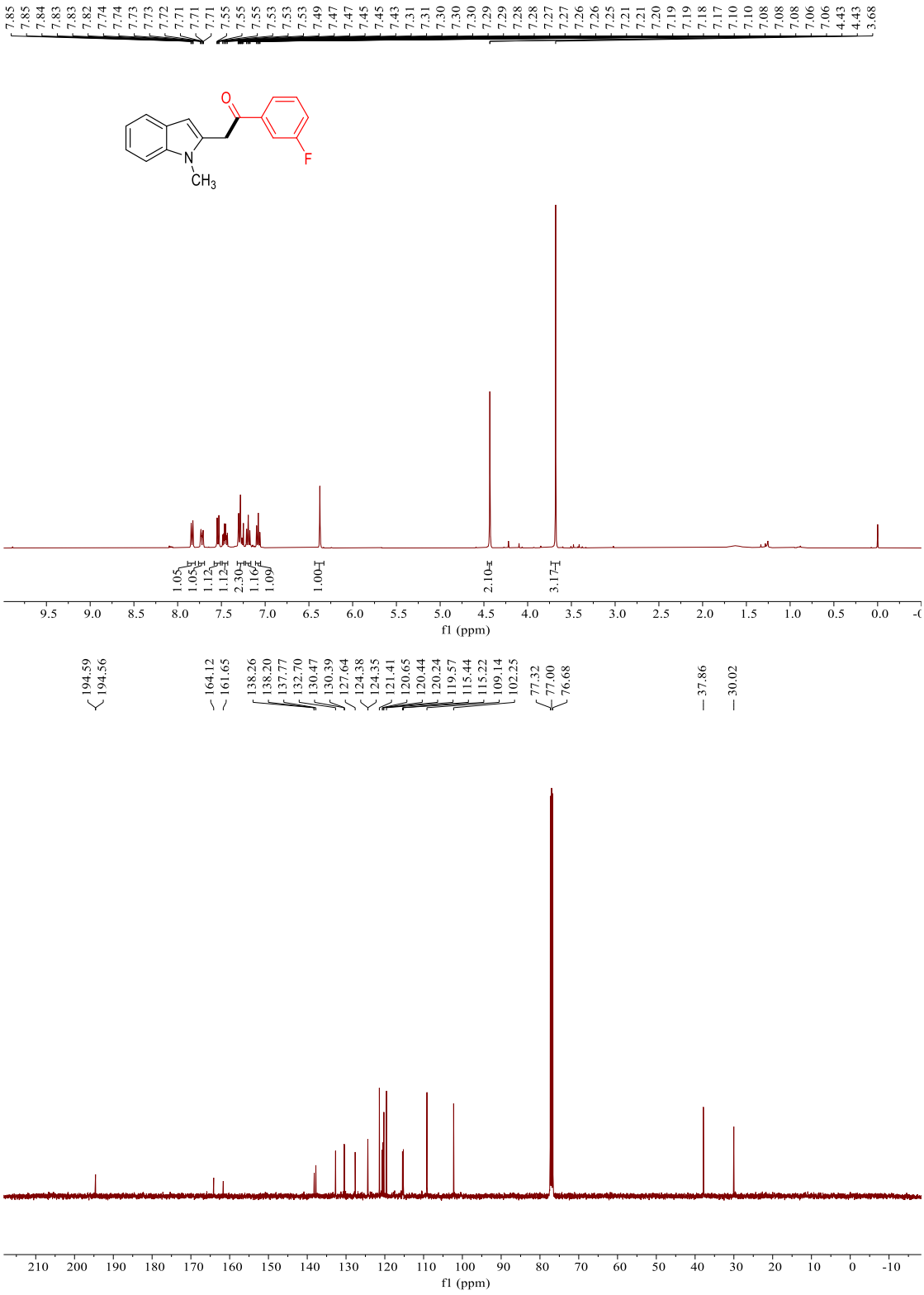


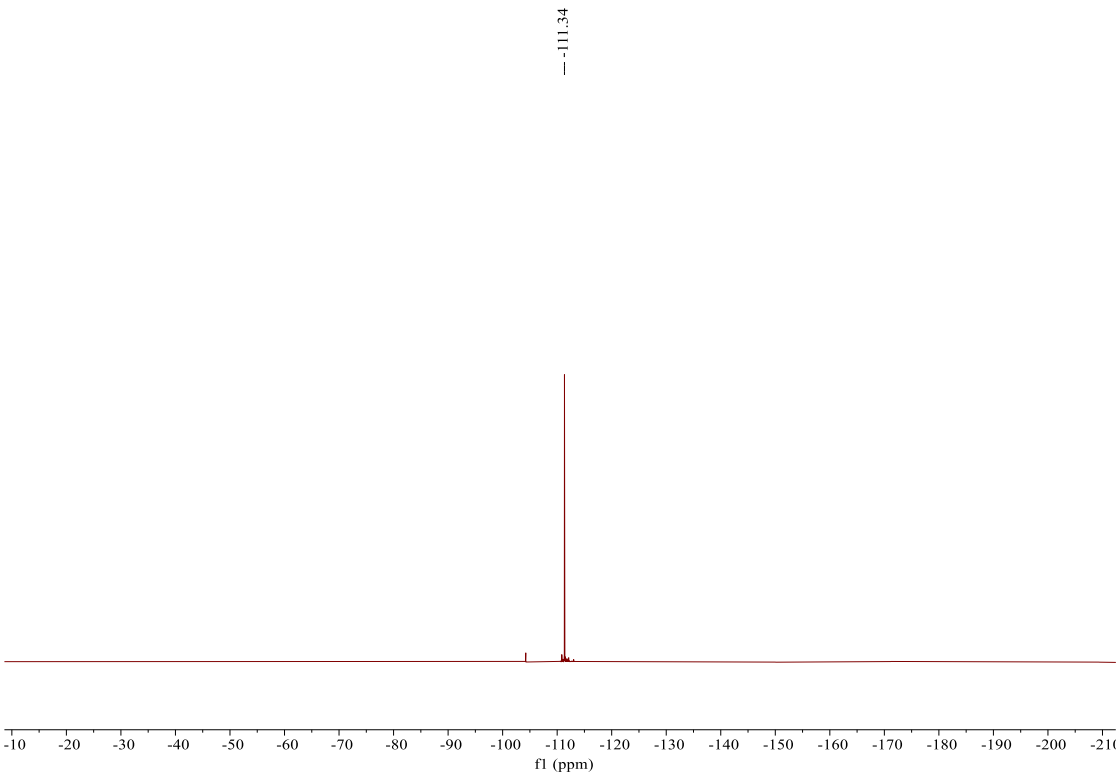






1-(3-fluorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4l)

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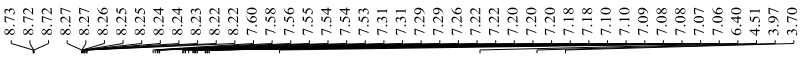
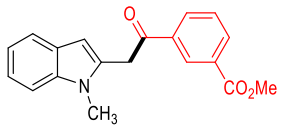
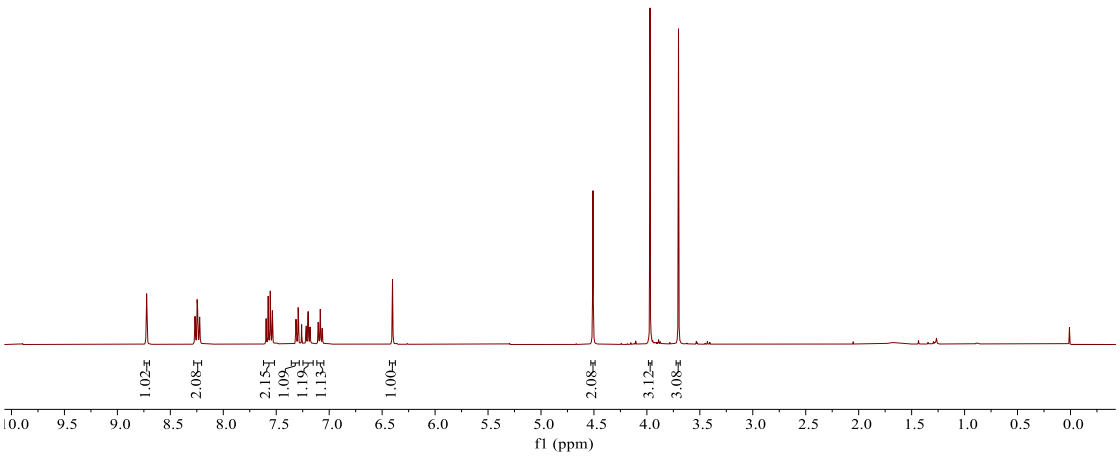
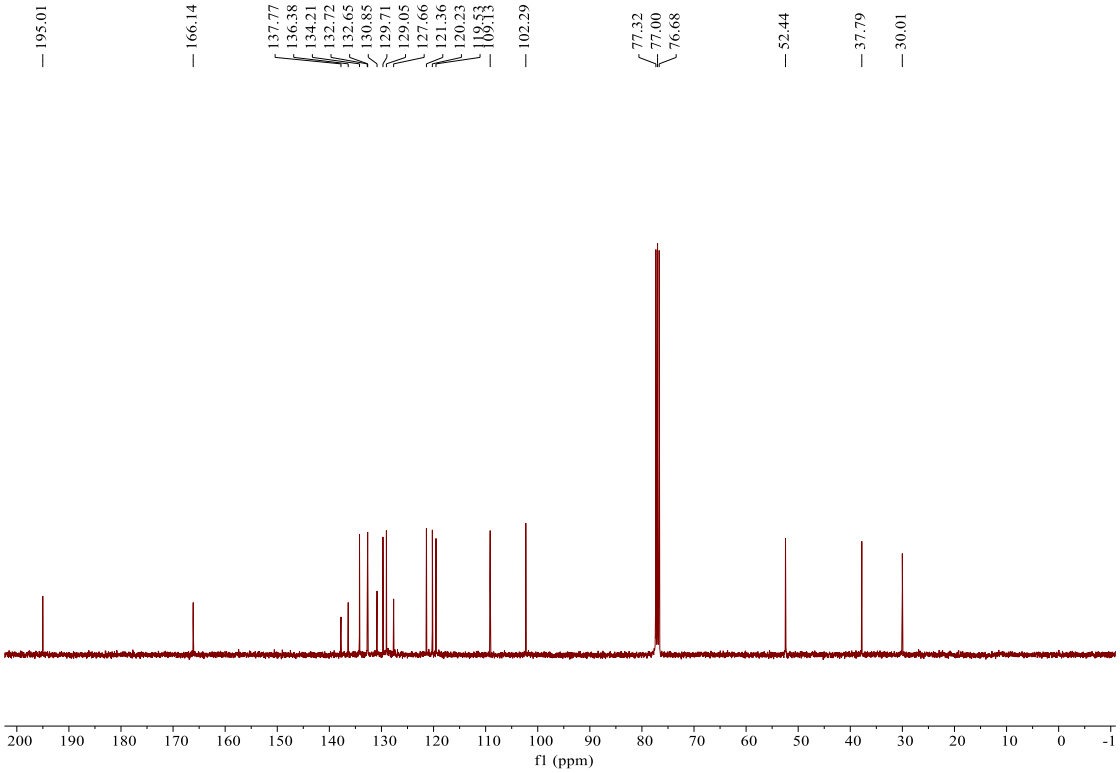
-170
-180
-190
-200
f1 (ppm)

methyl 3-(2-(1-methyl-1*H*-indol-2-yl)acetyl)benzoate(4m)

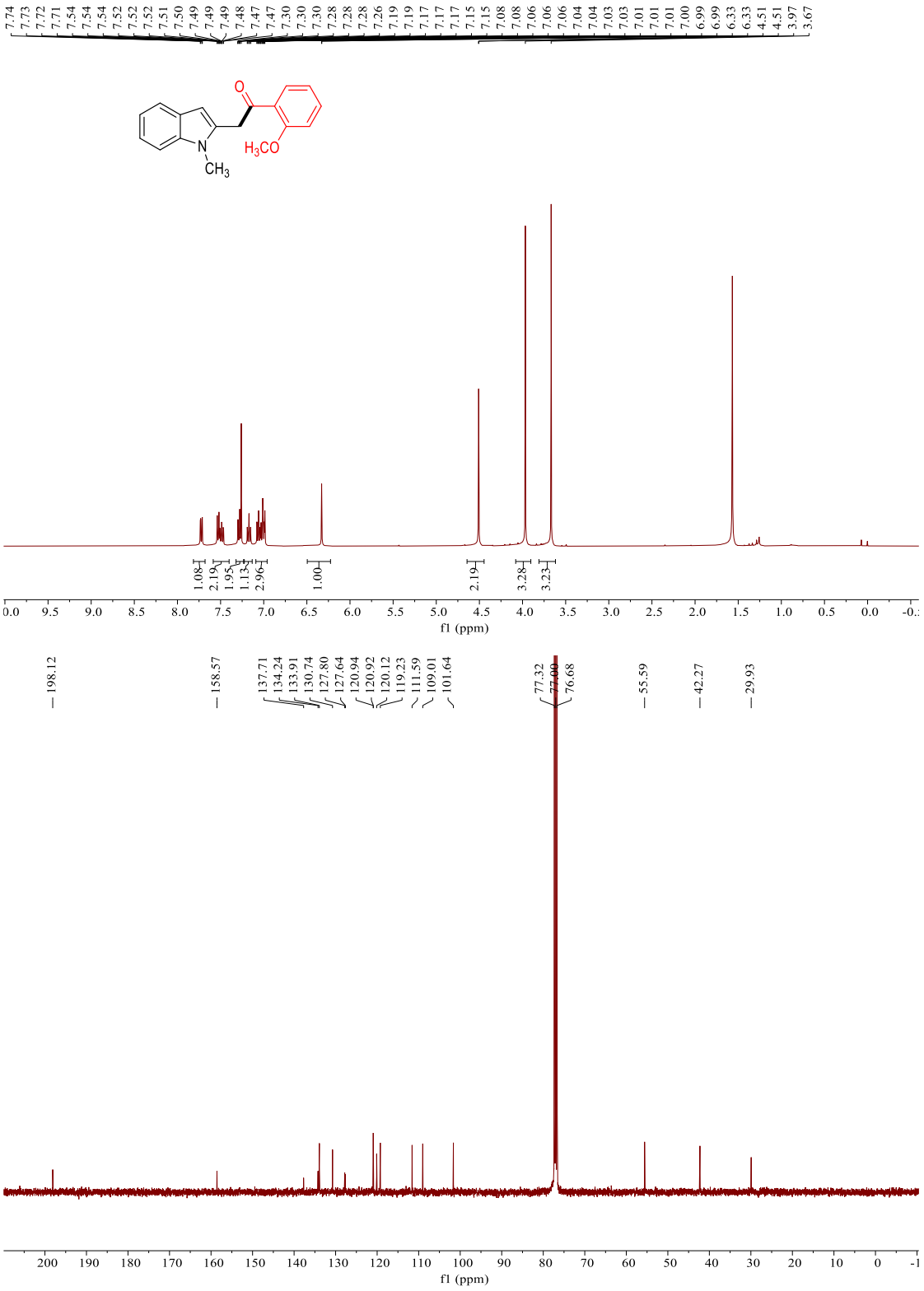




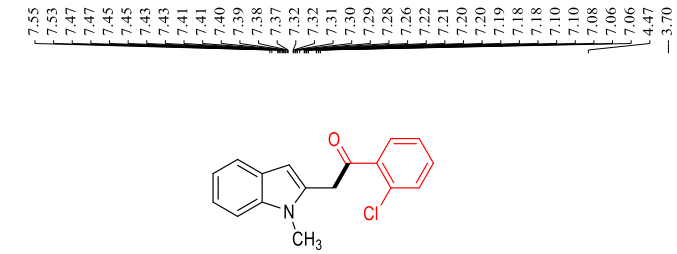


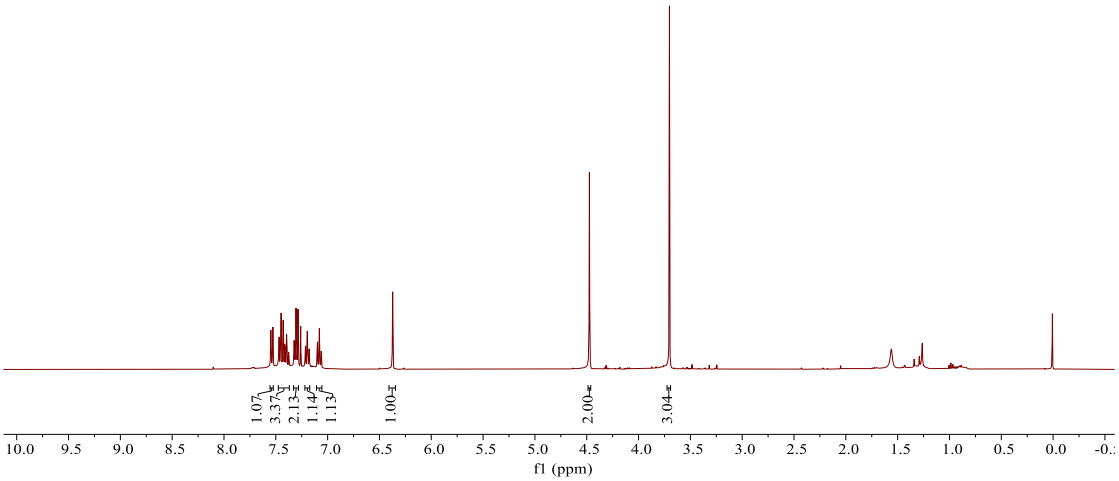


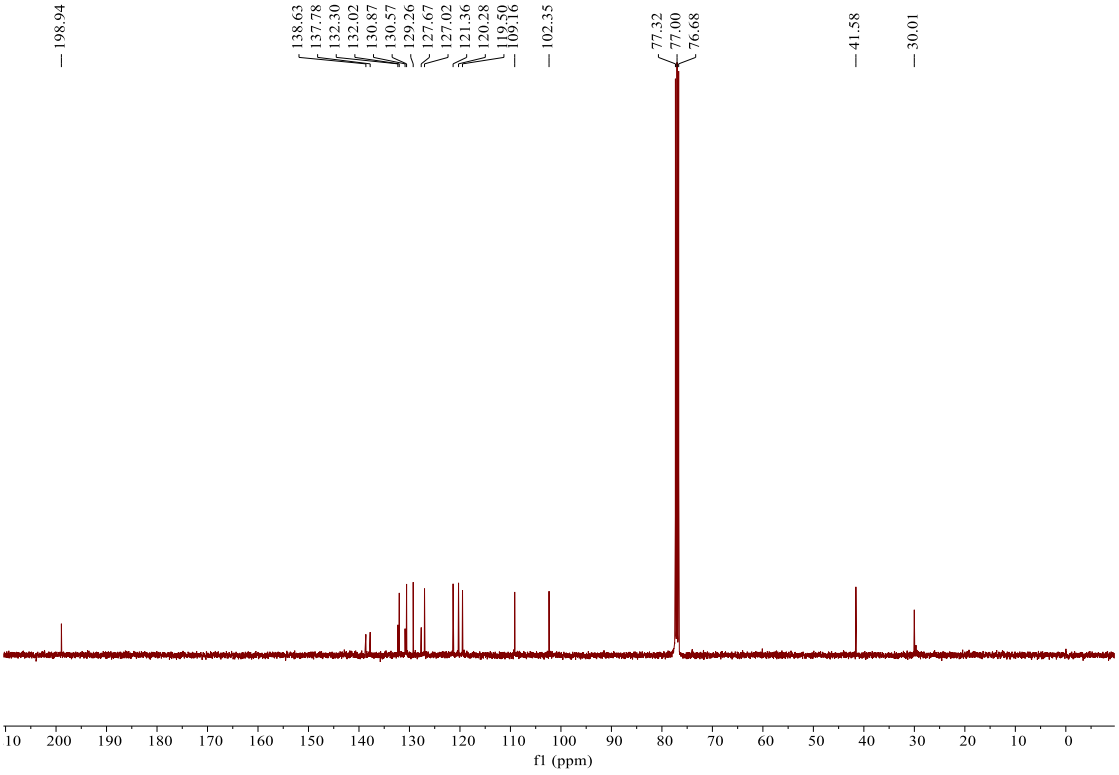
1-(2-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4n)



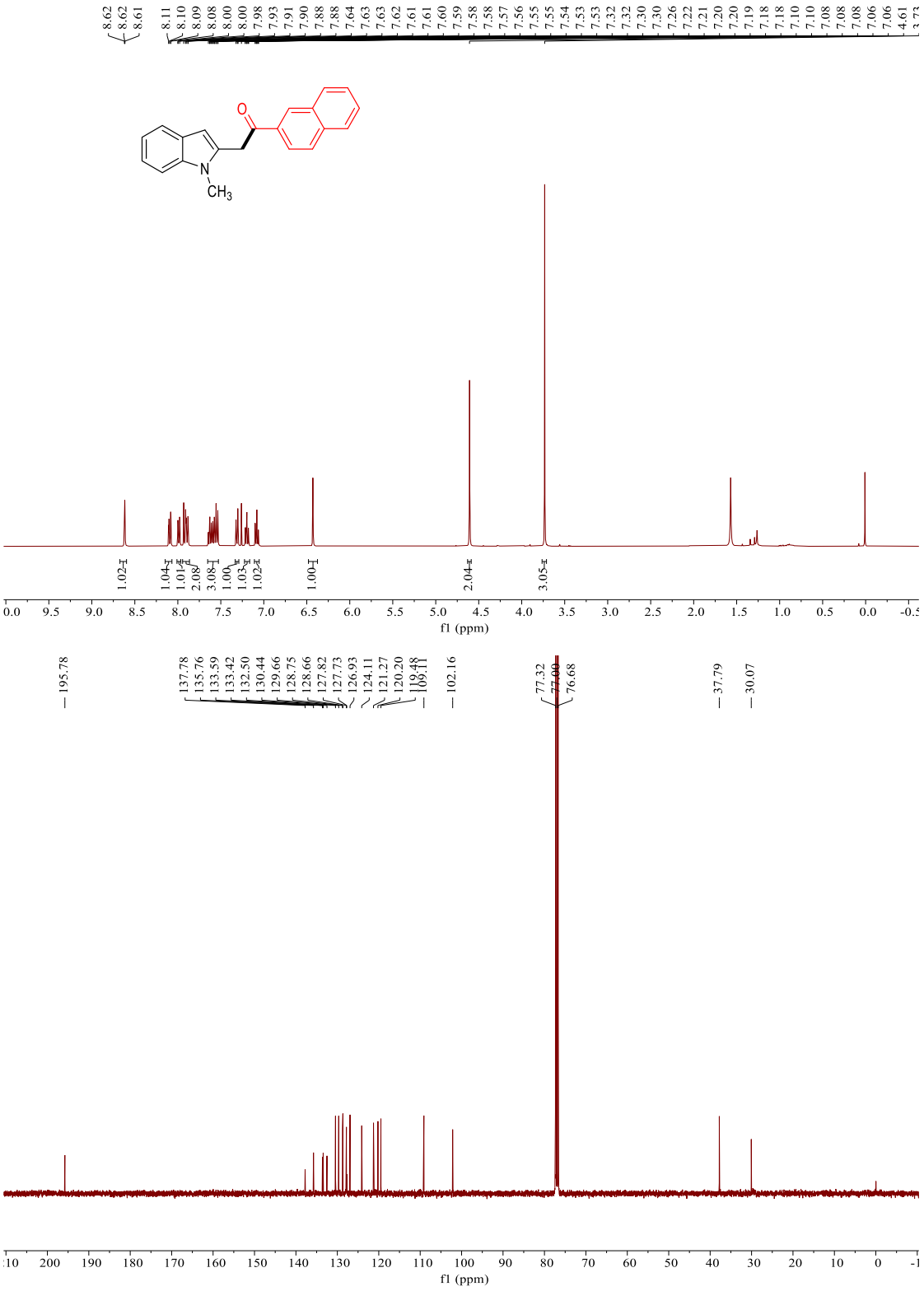
1-(2-chlorophenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4o)



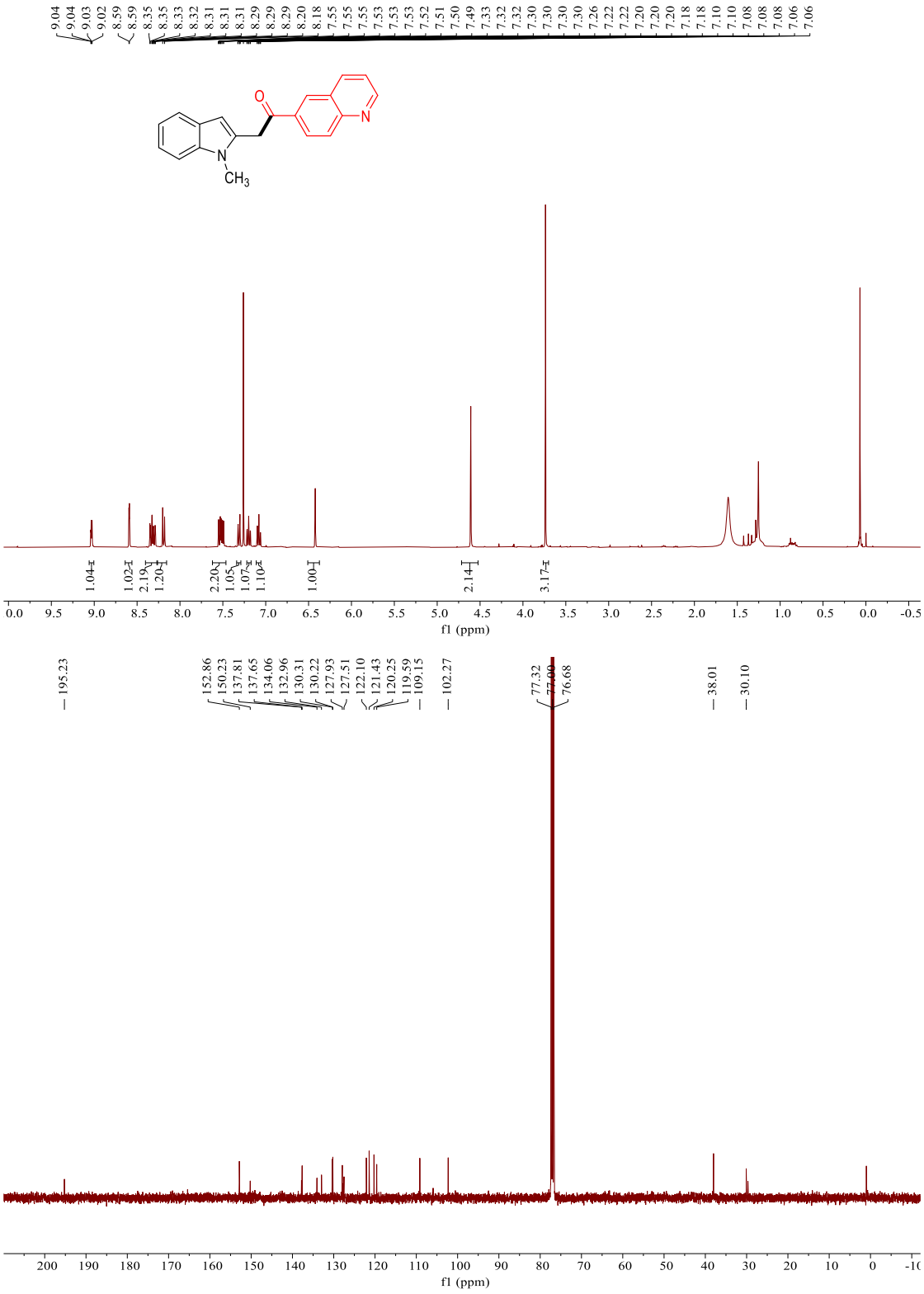




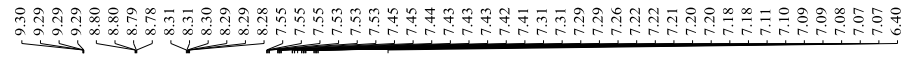
2-(1-methyl-1*H*-indol-2-yl)-1-(naphthalen-2-yl)ethan-1-one(4p)

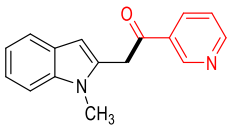


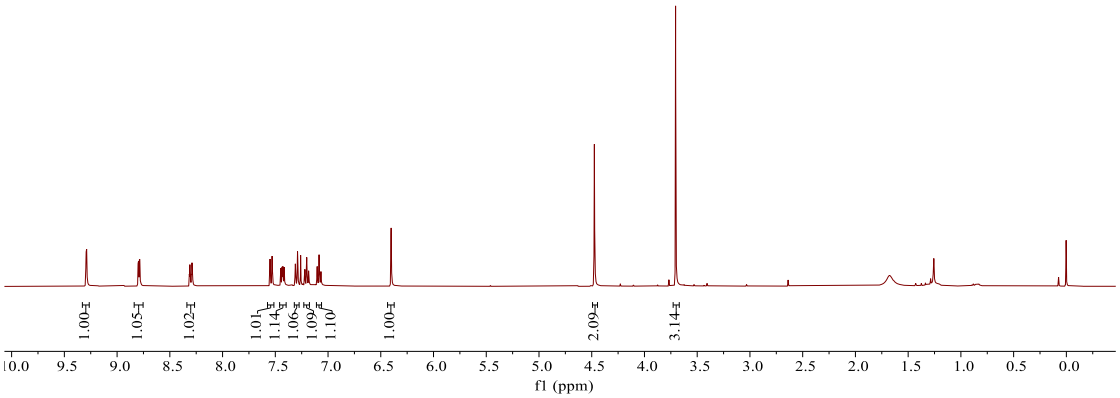
2-(1-methyl-1*H*-indol-2-yl)-1-(quinolin-6-yl)ethan-1-one(4q)

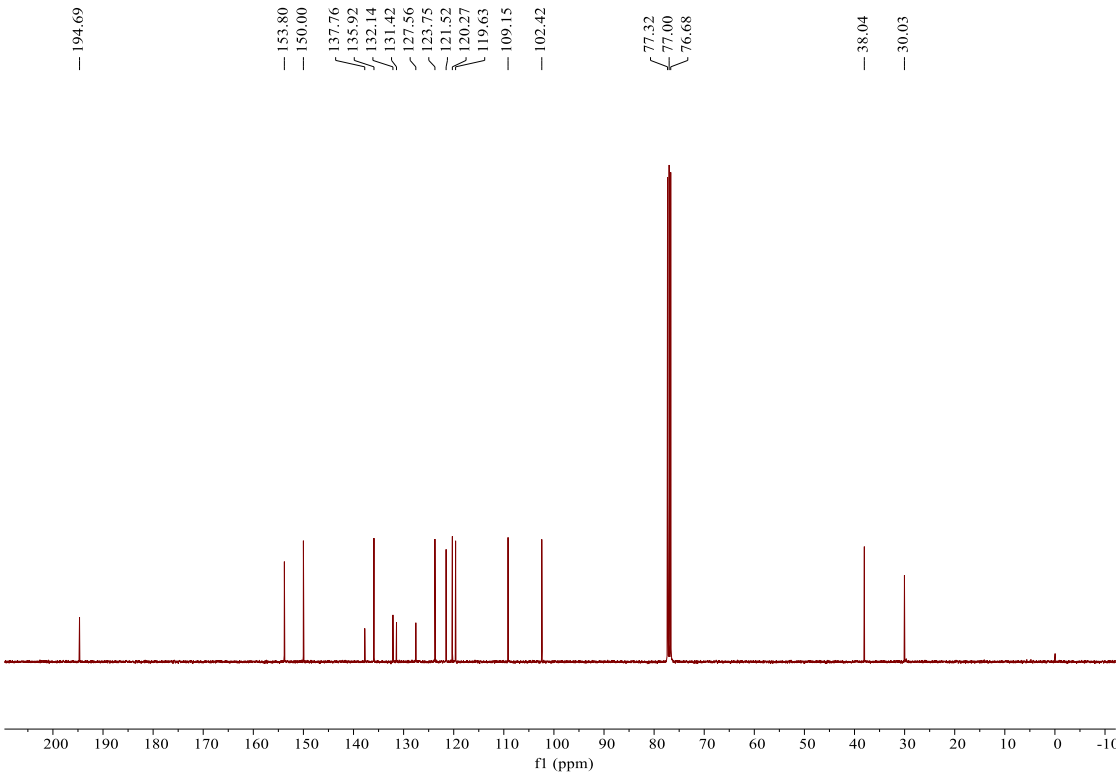


2-(1-methyl-1*H*-indol-2-yl)-1-(pyridin-3-yl)ethan-1-one(4r)

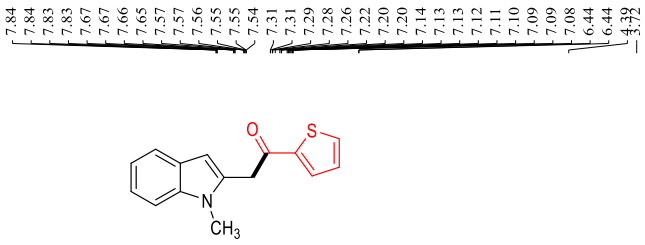


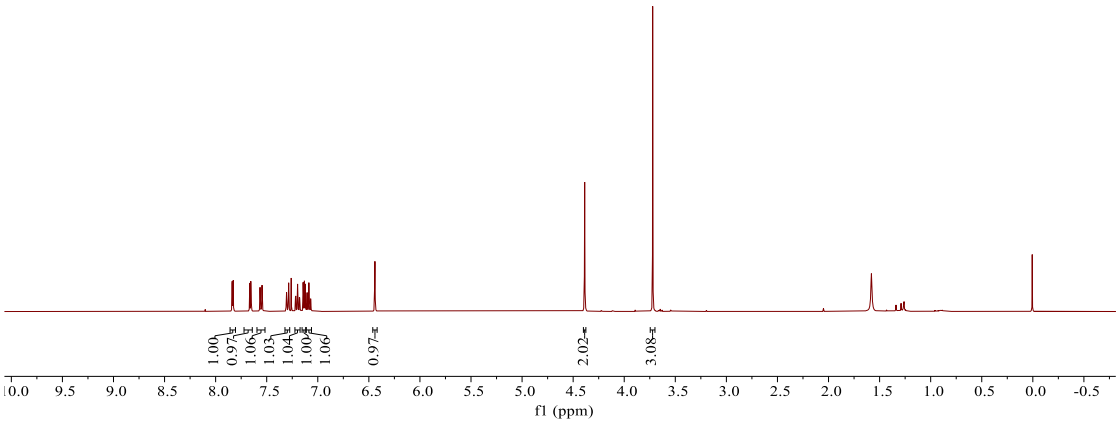


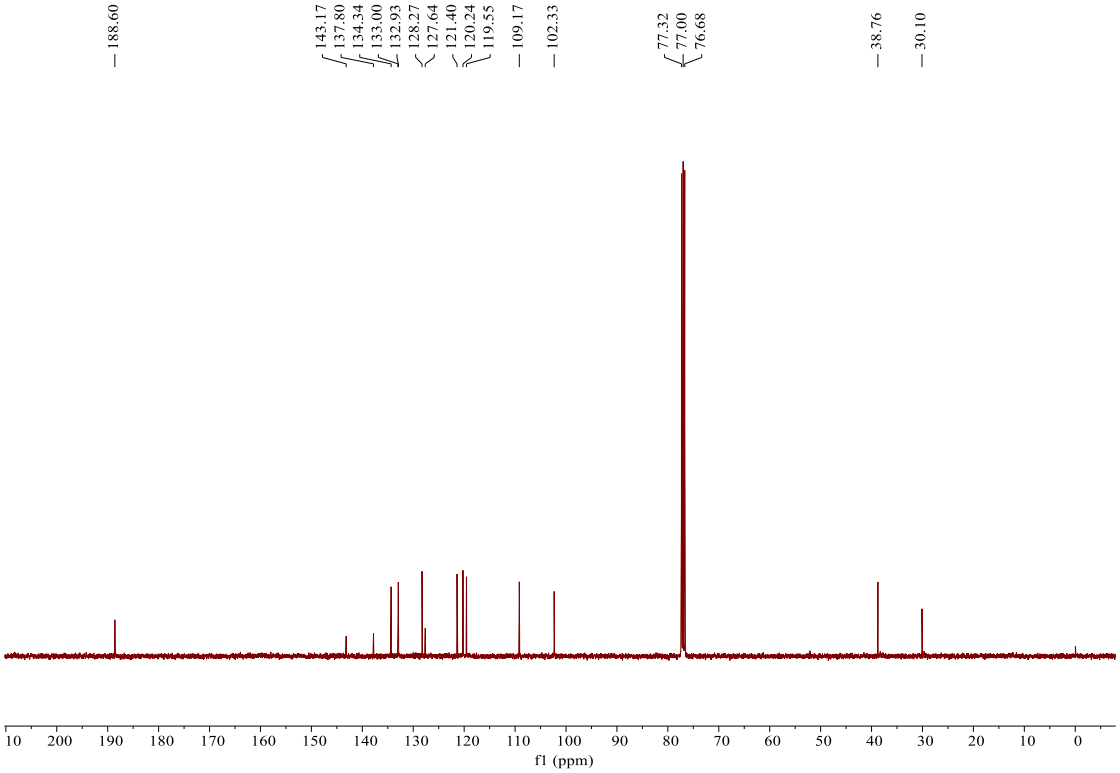




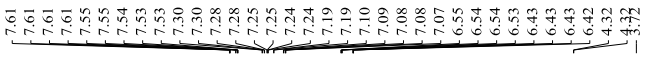
2-(1-methyl-1*H*-indol-2-yl)-1-(thiophen-2-yl)ethan-1-one(4s)

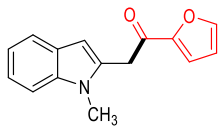


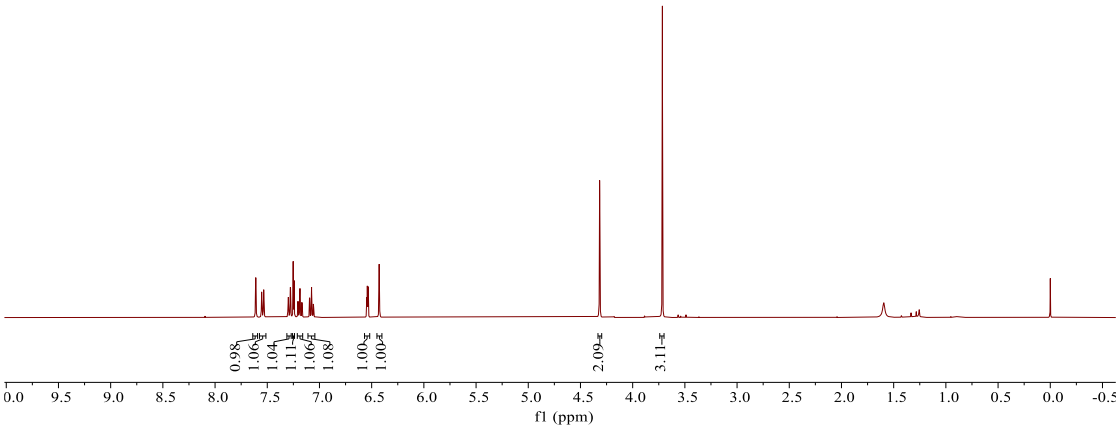


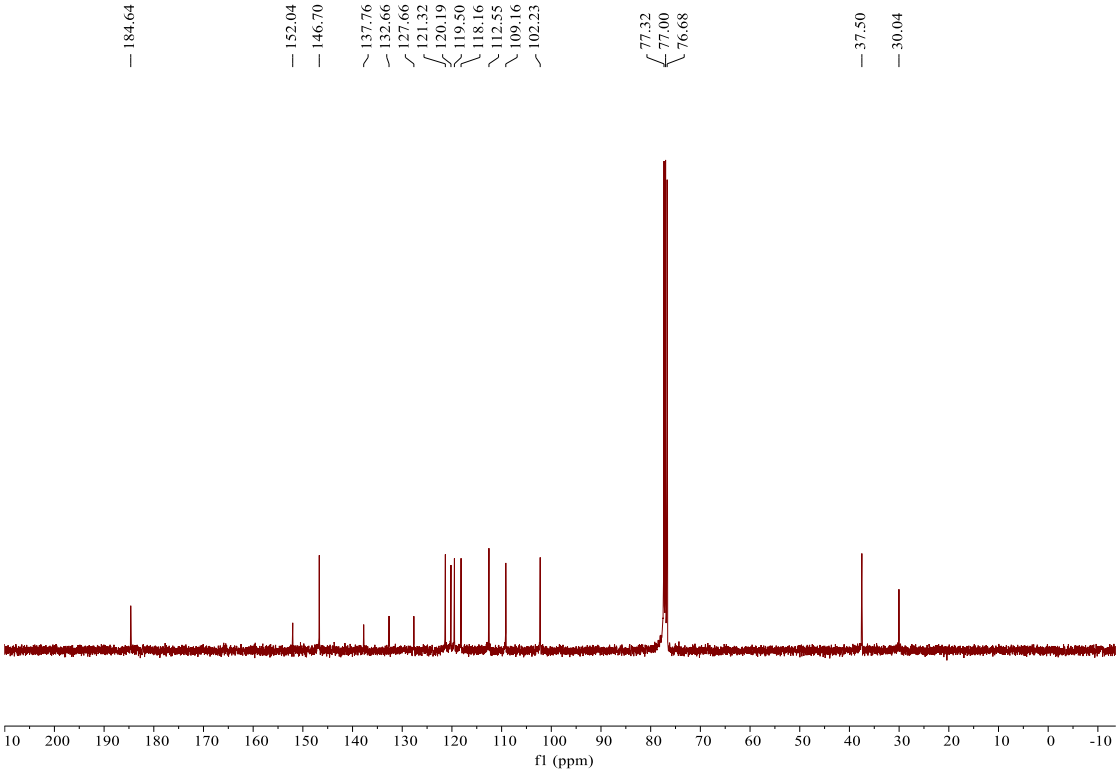


1-(furan-2-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(3t)

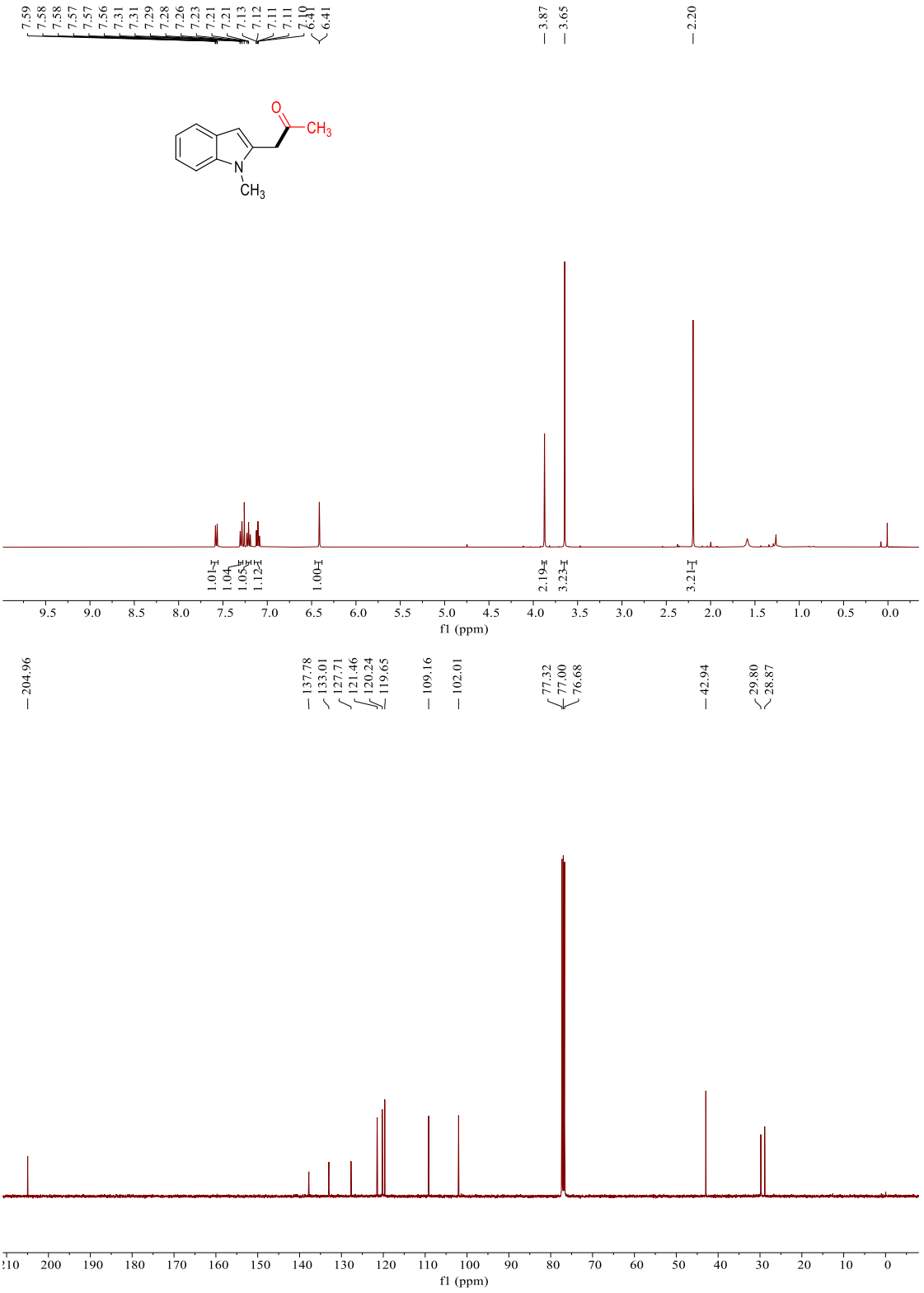




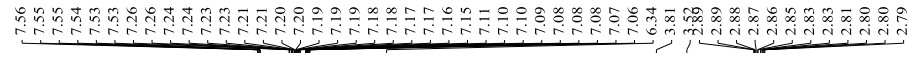


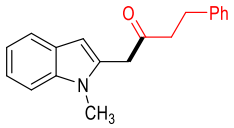


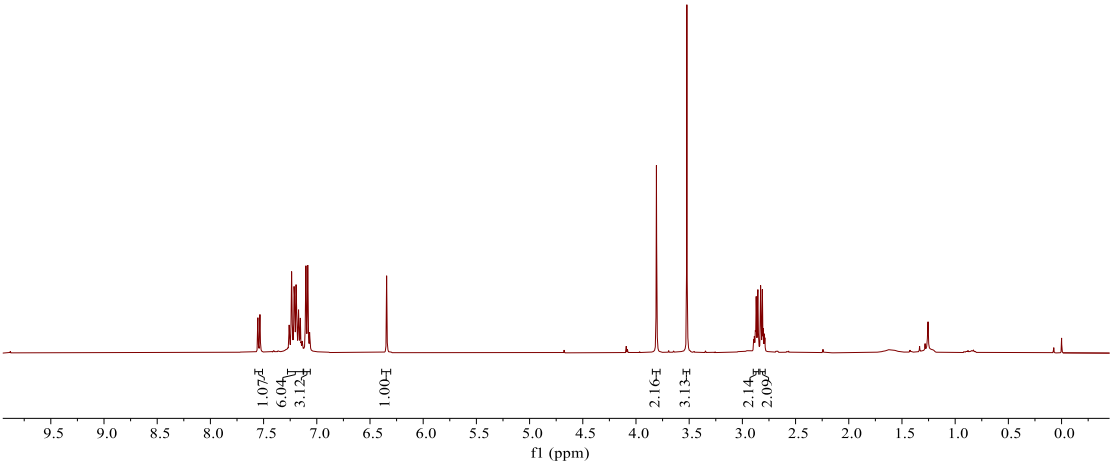
1-(1-methyl-1*H*-indol-2-yl)propan-2-one(4u)

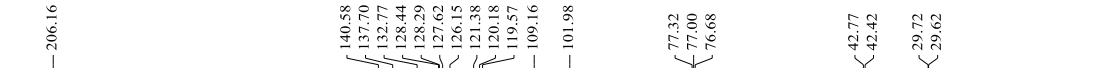


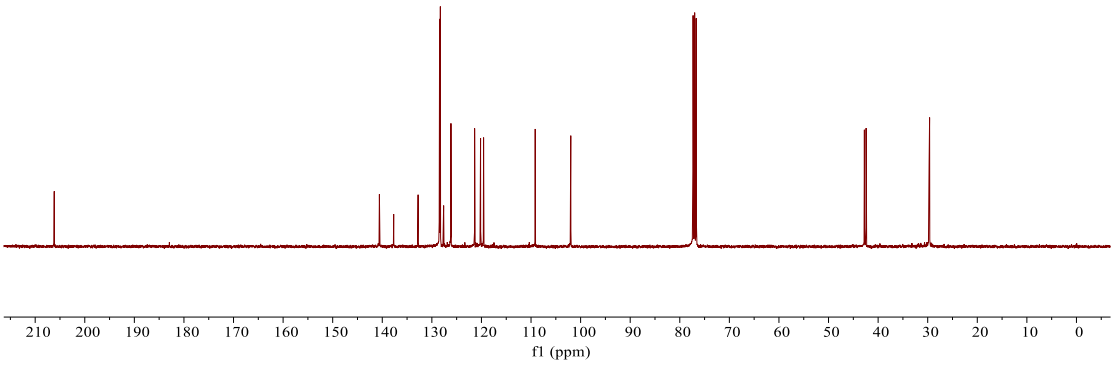
1-(1-methyl-1H-indol-2-yl)-4-phenylbutan-2-one(4v)



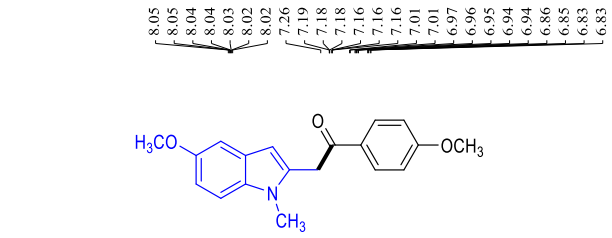


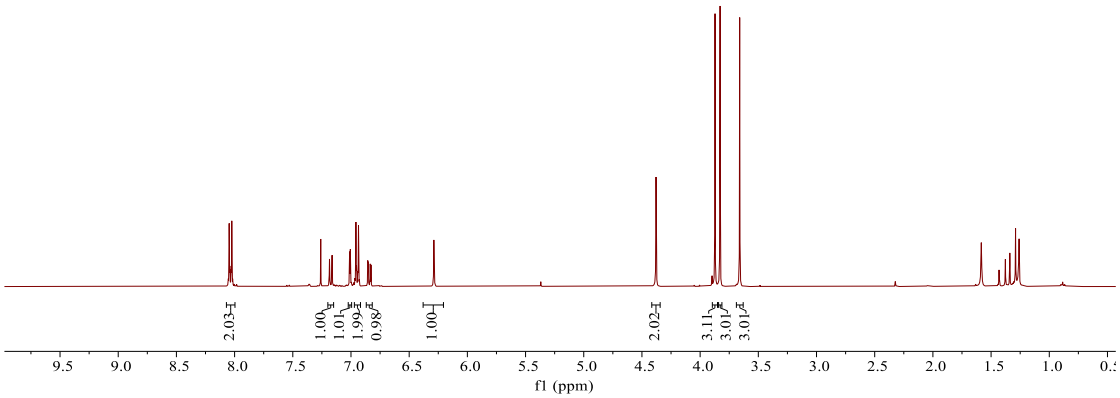


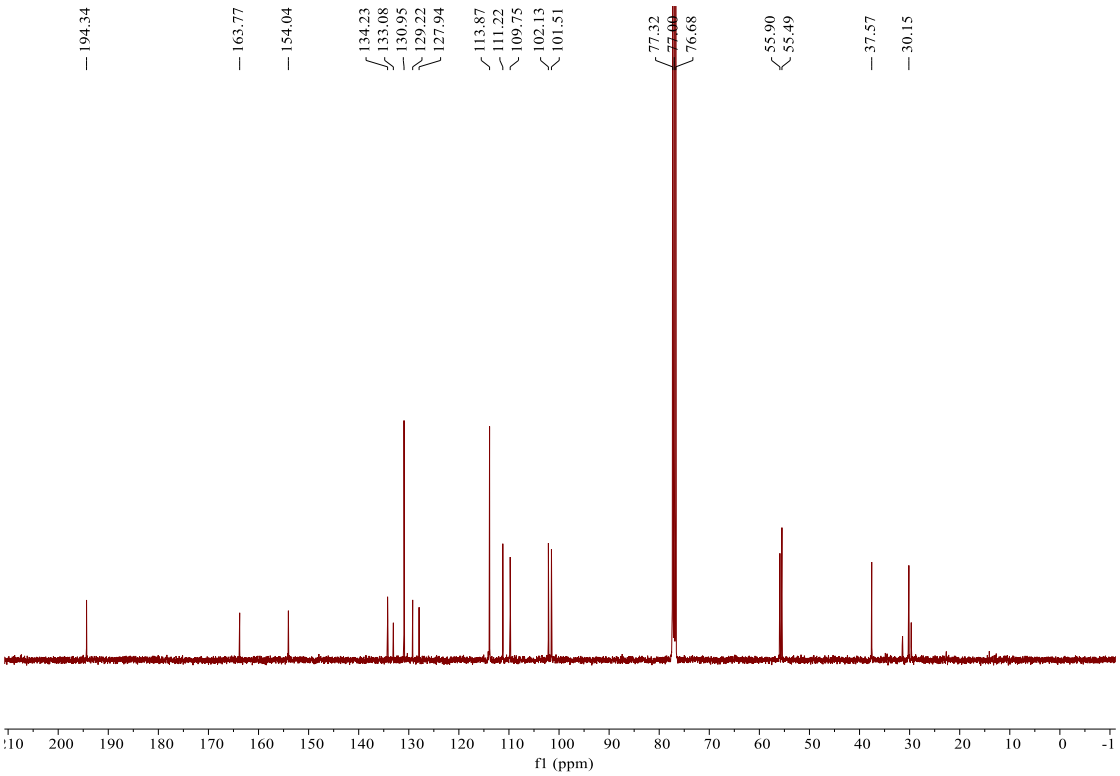




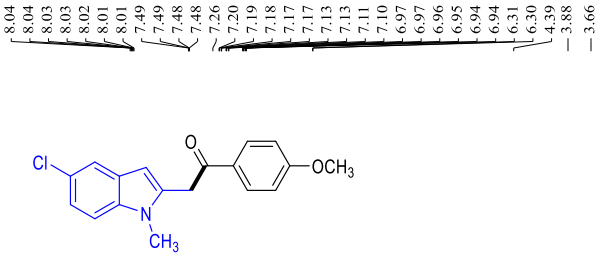
2-(5-methoxy-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4aa)

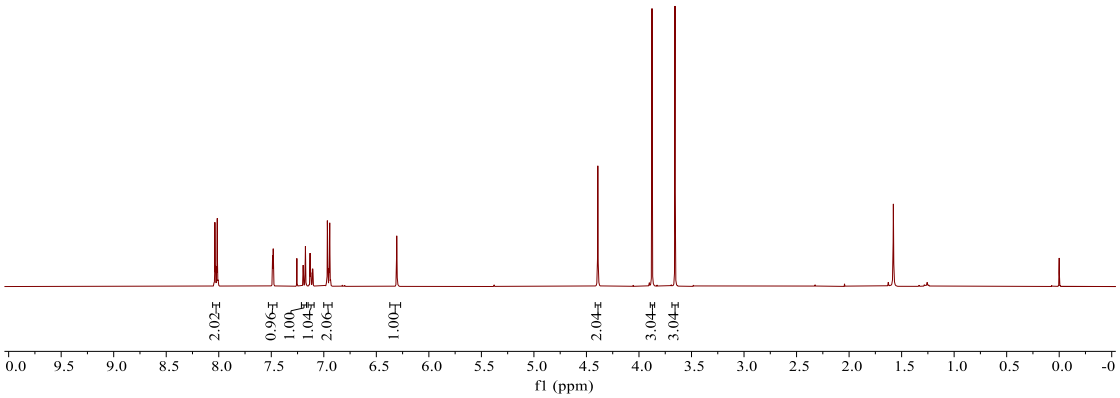


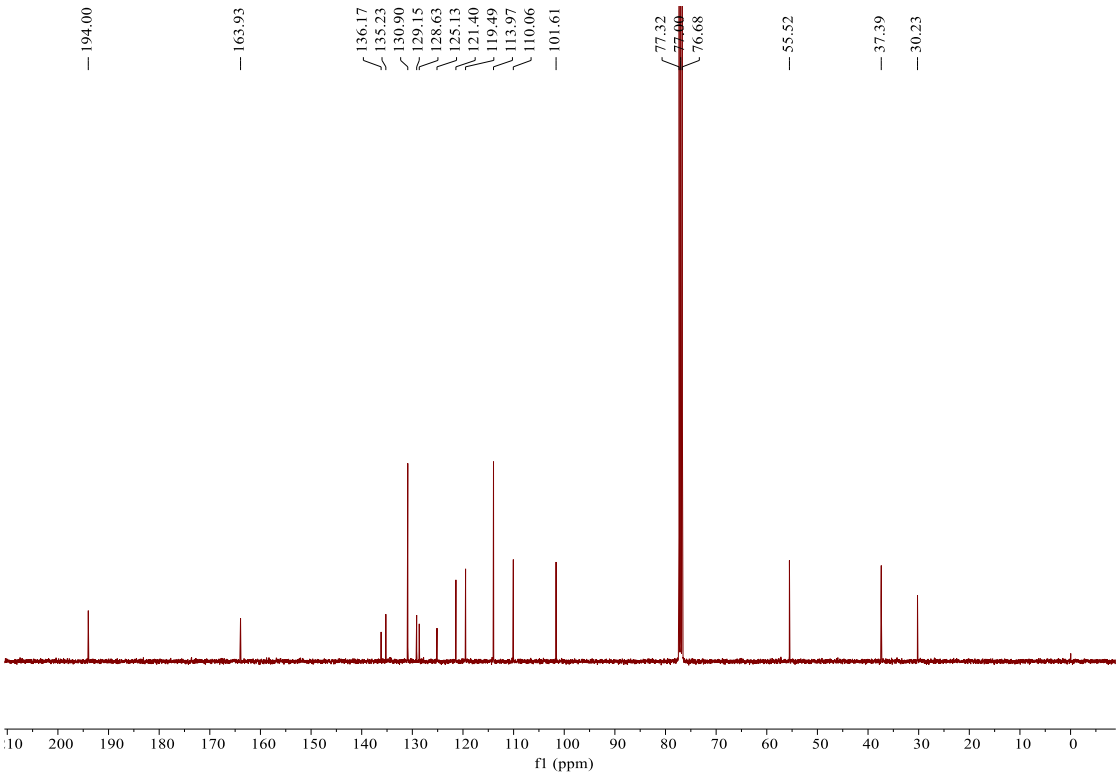




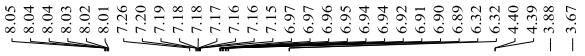
2-(5-chloro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ab)

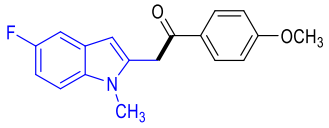


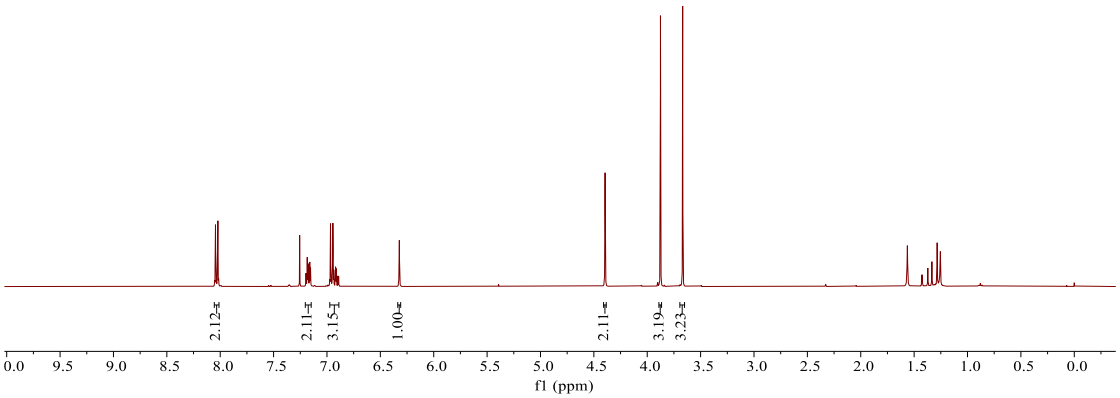


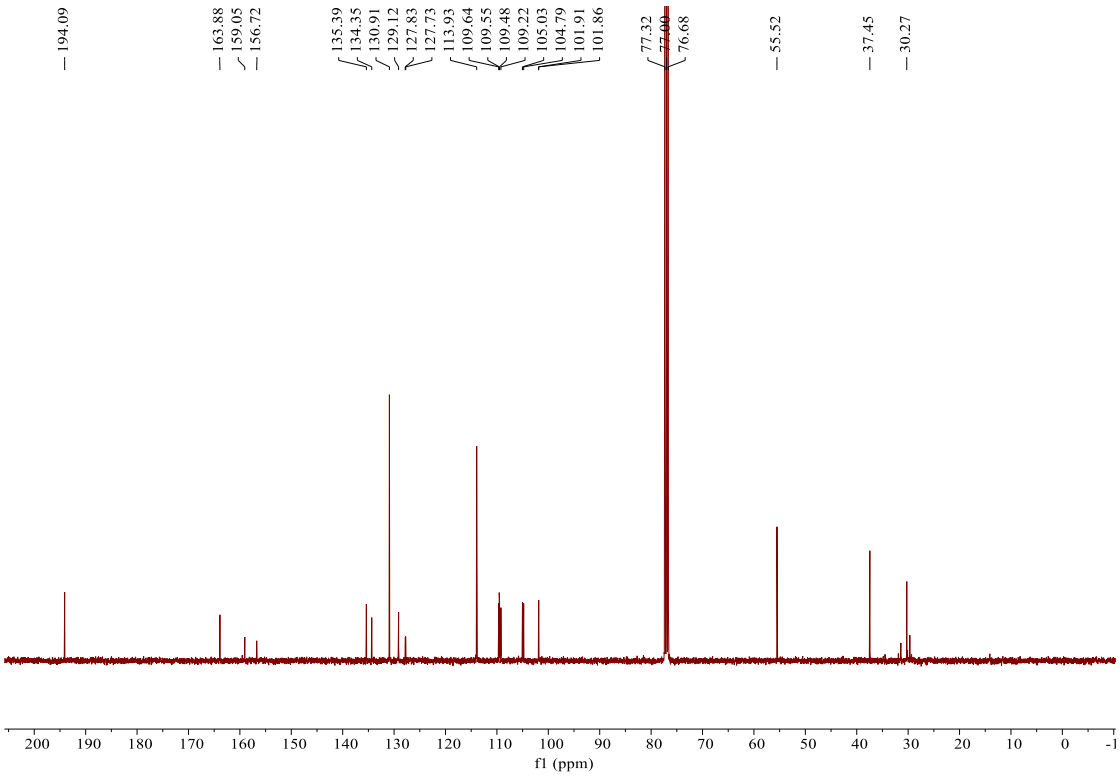


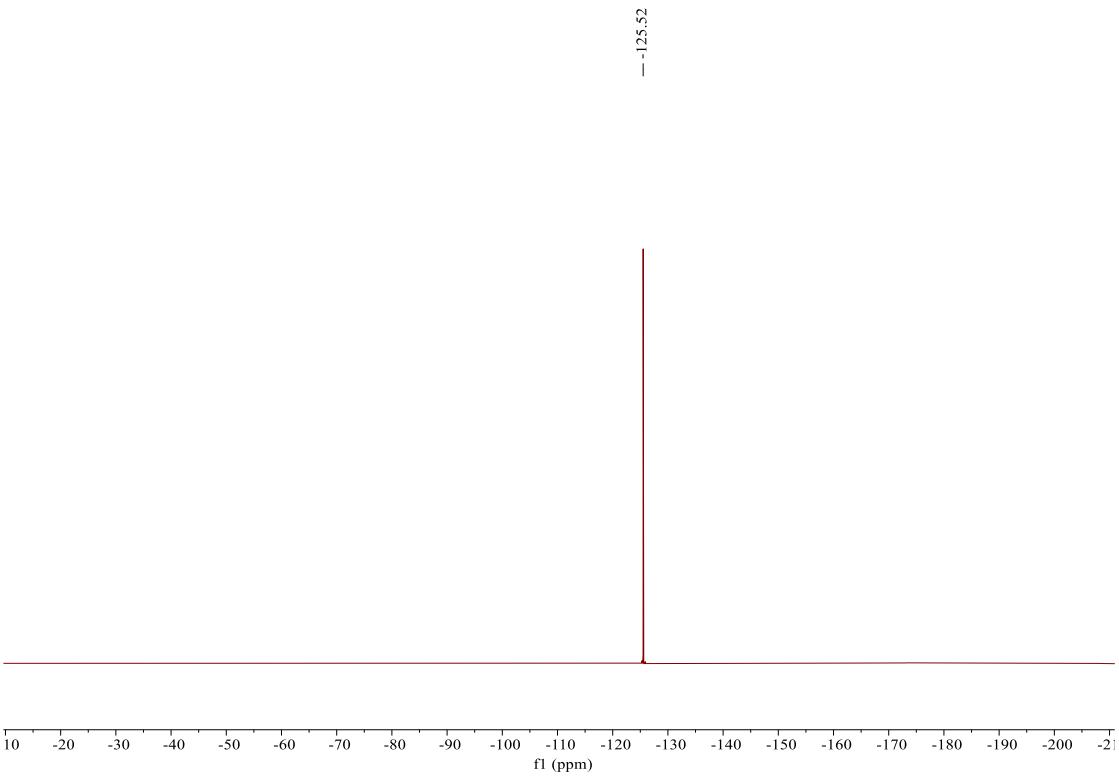
2-(5-fluoro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ac)







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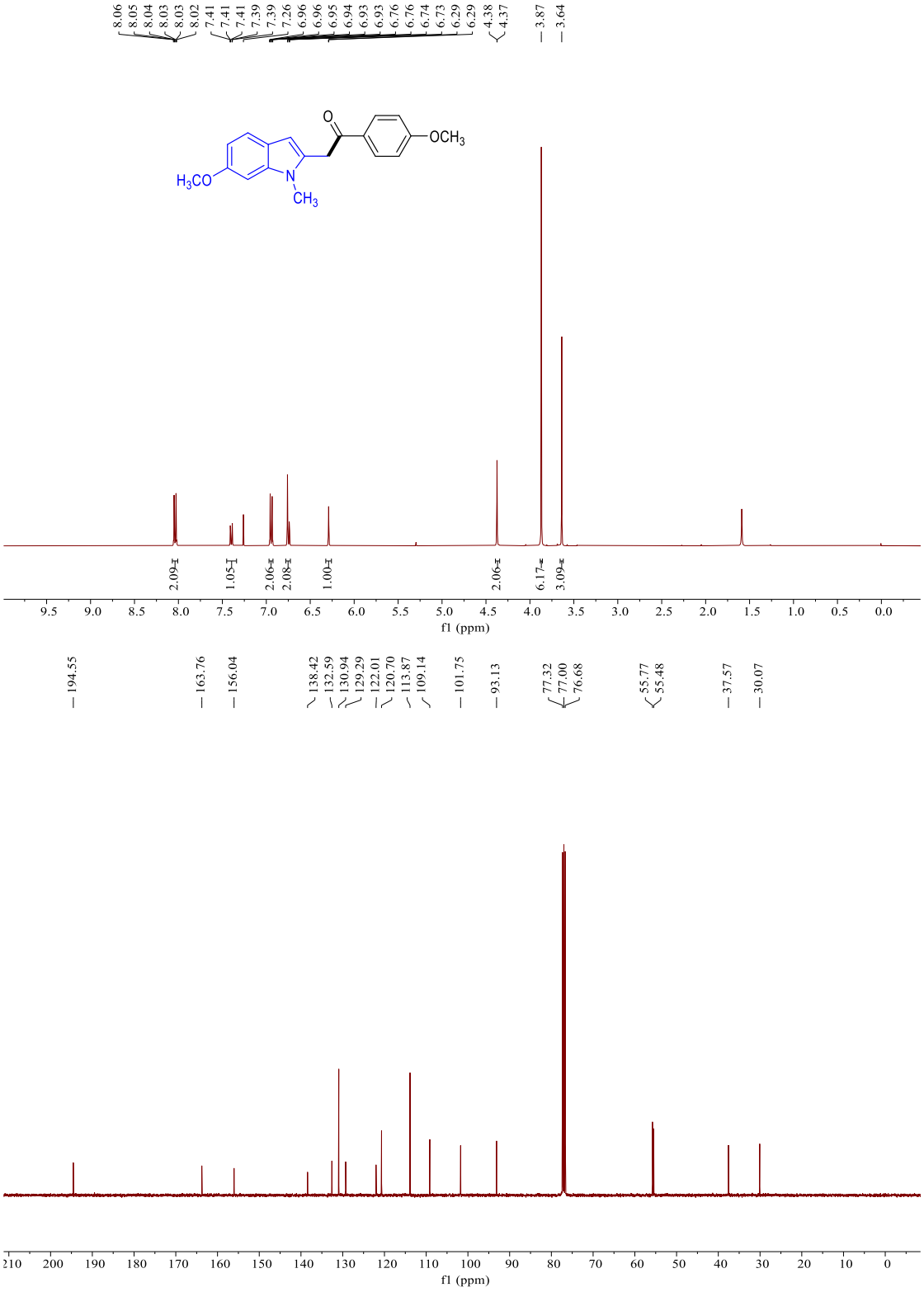
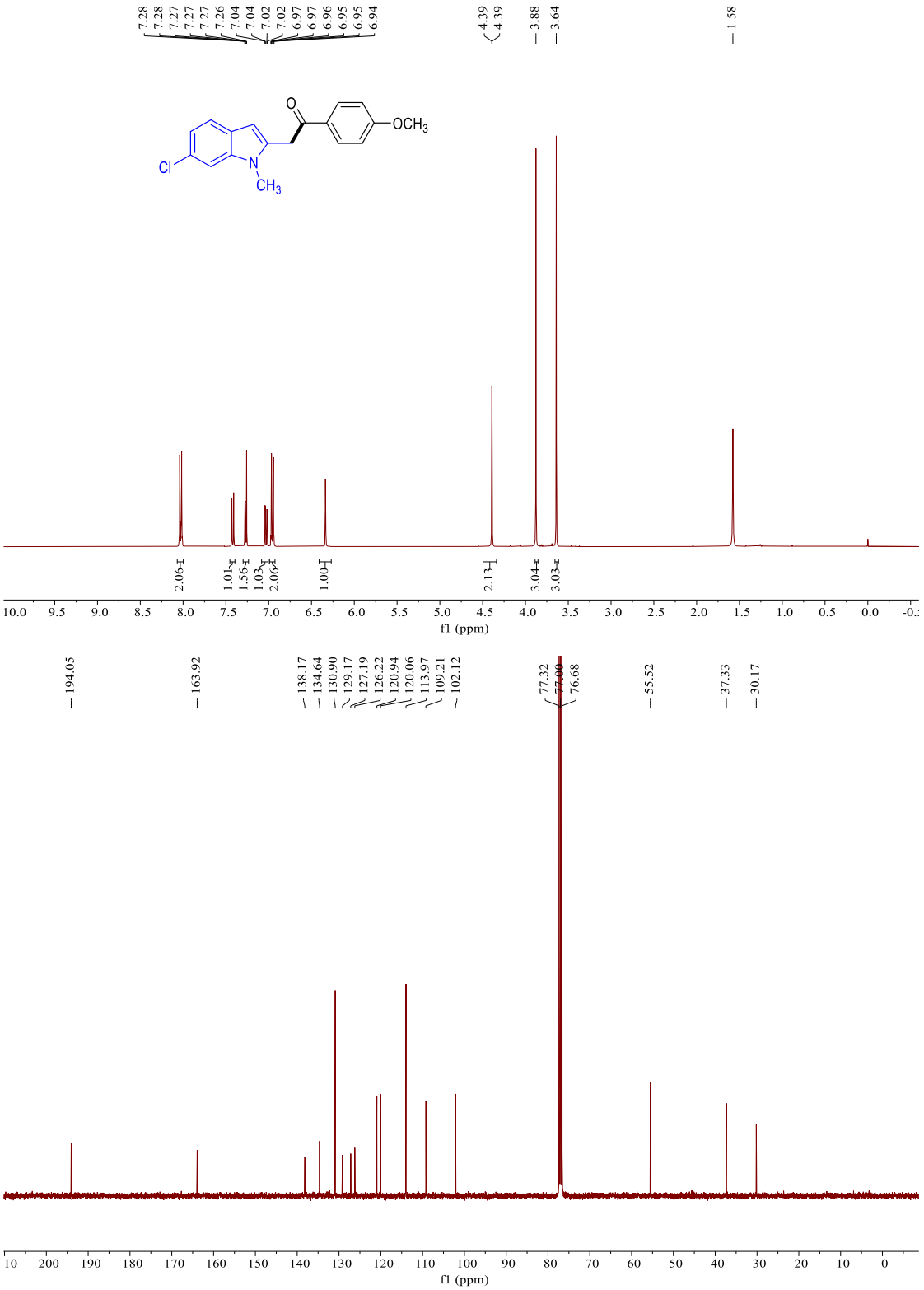
10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

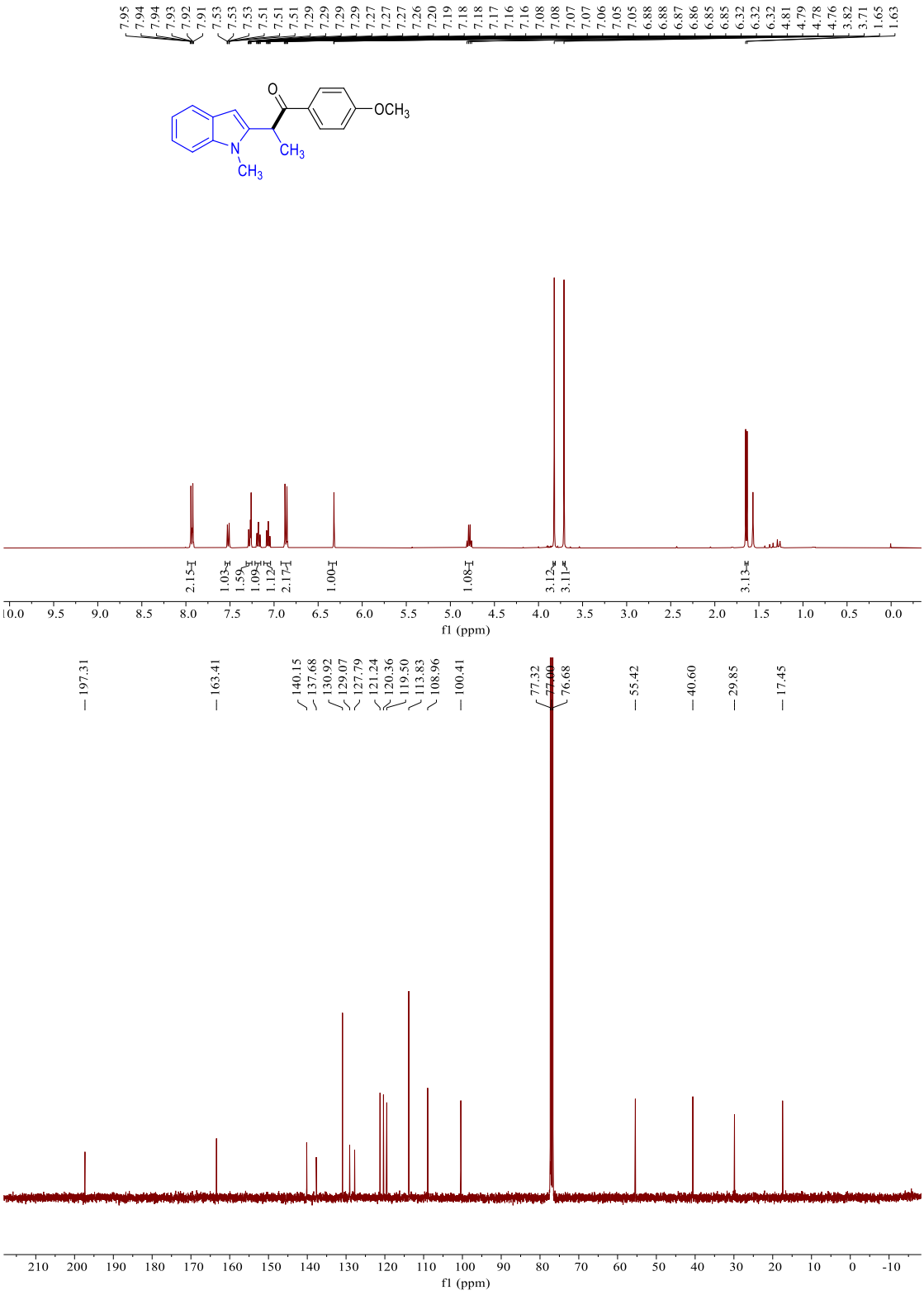
2-(6-methoxy-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ad)



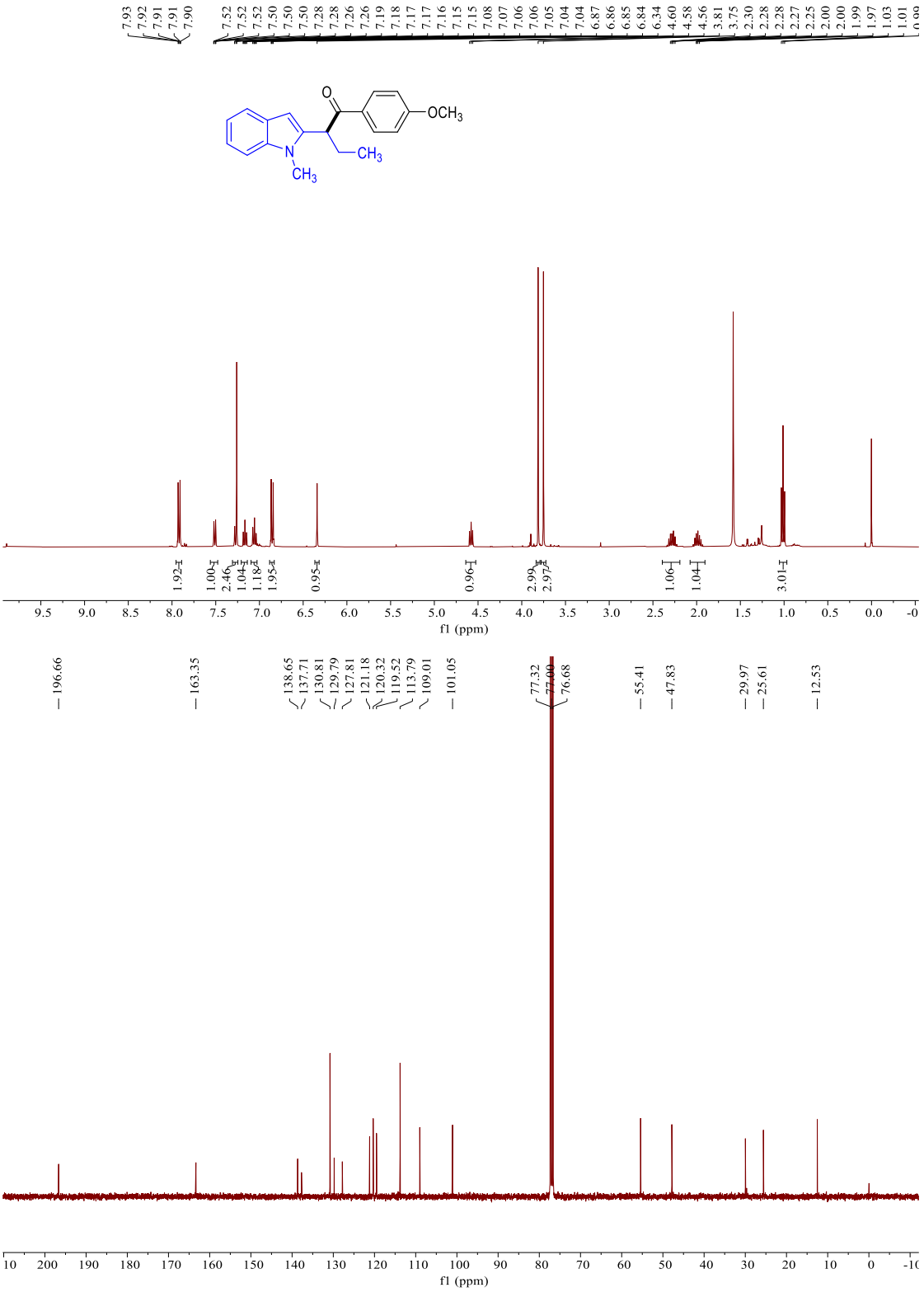
2-(6-chloro-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4ae)



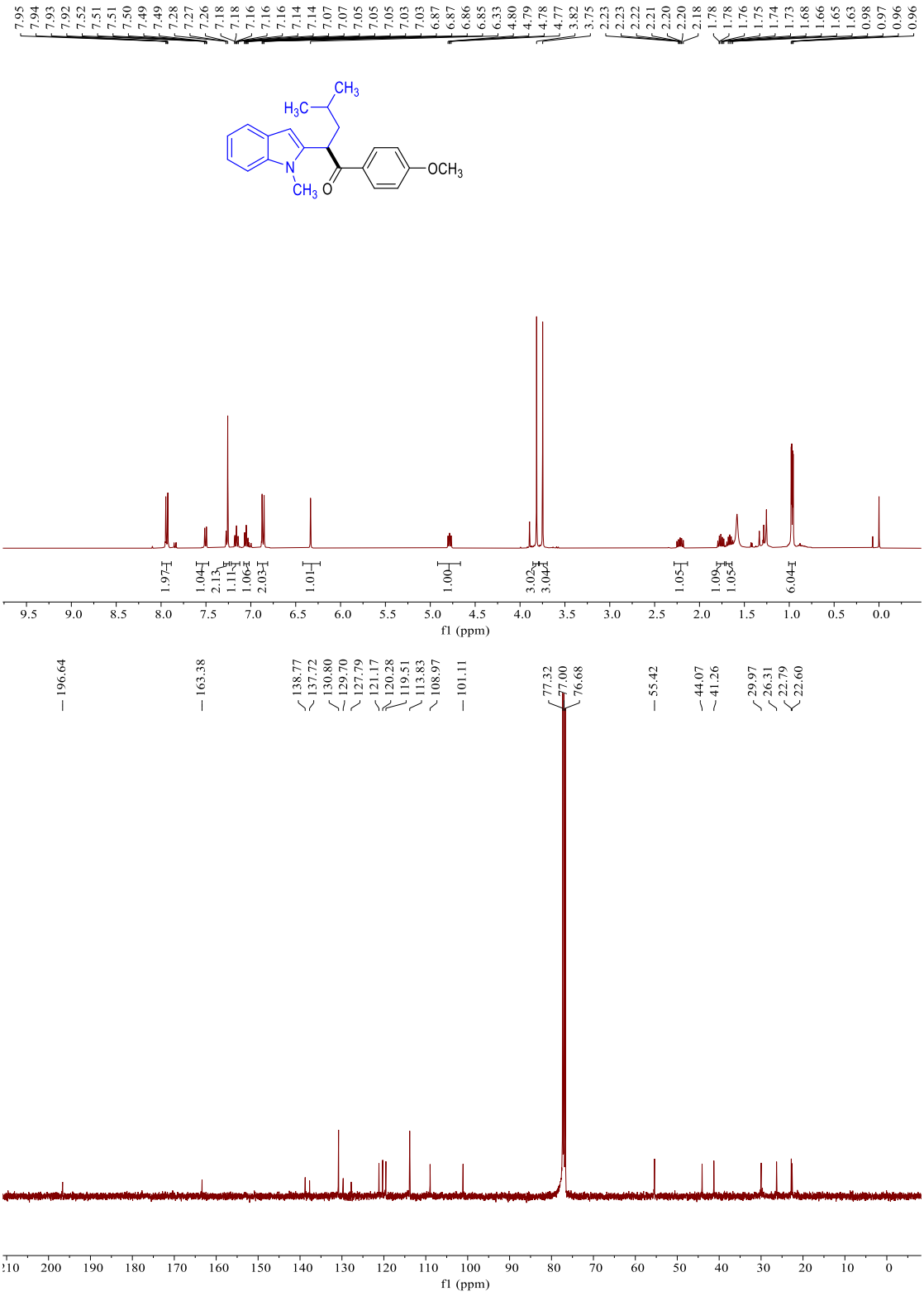
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)propan-1-one(4af)



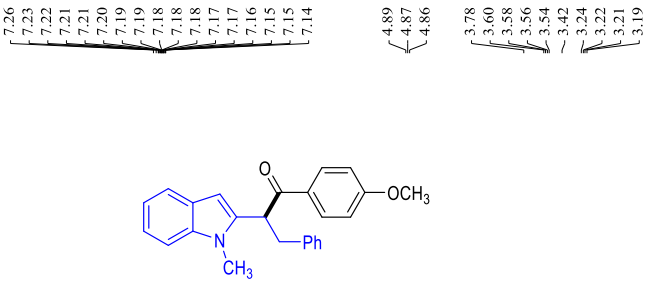
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)butan-1-one(4ag)

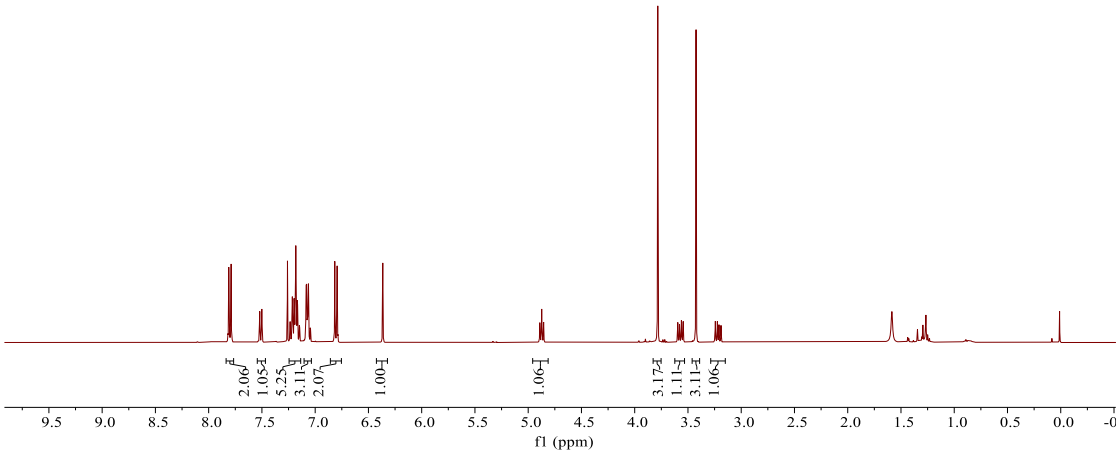


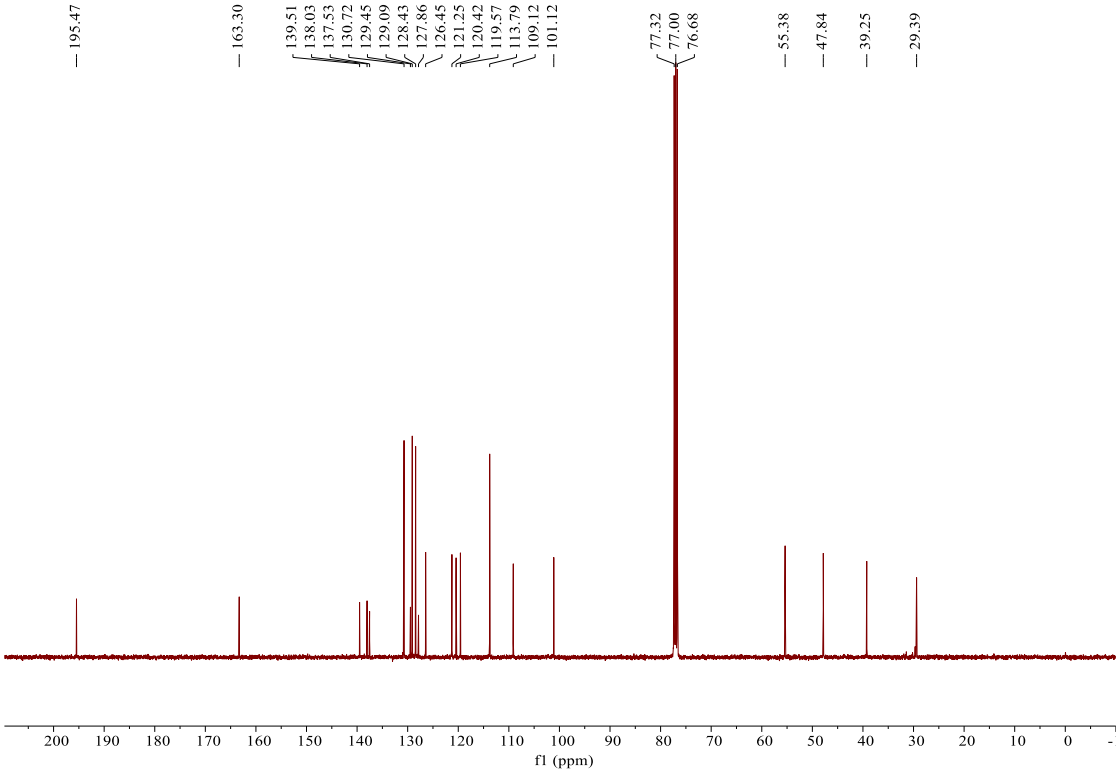
1-(4-methoxyphenyl)-4-methyl-2-(1-methyl-1*H*-indol-2-yl)pentan-1-one(4ah)



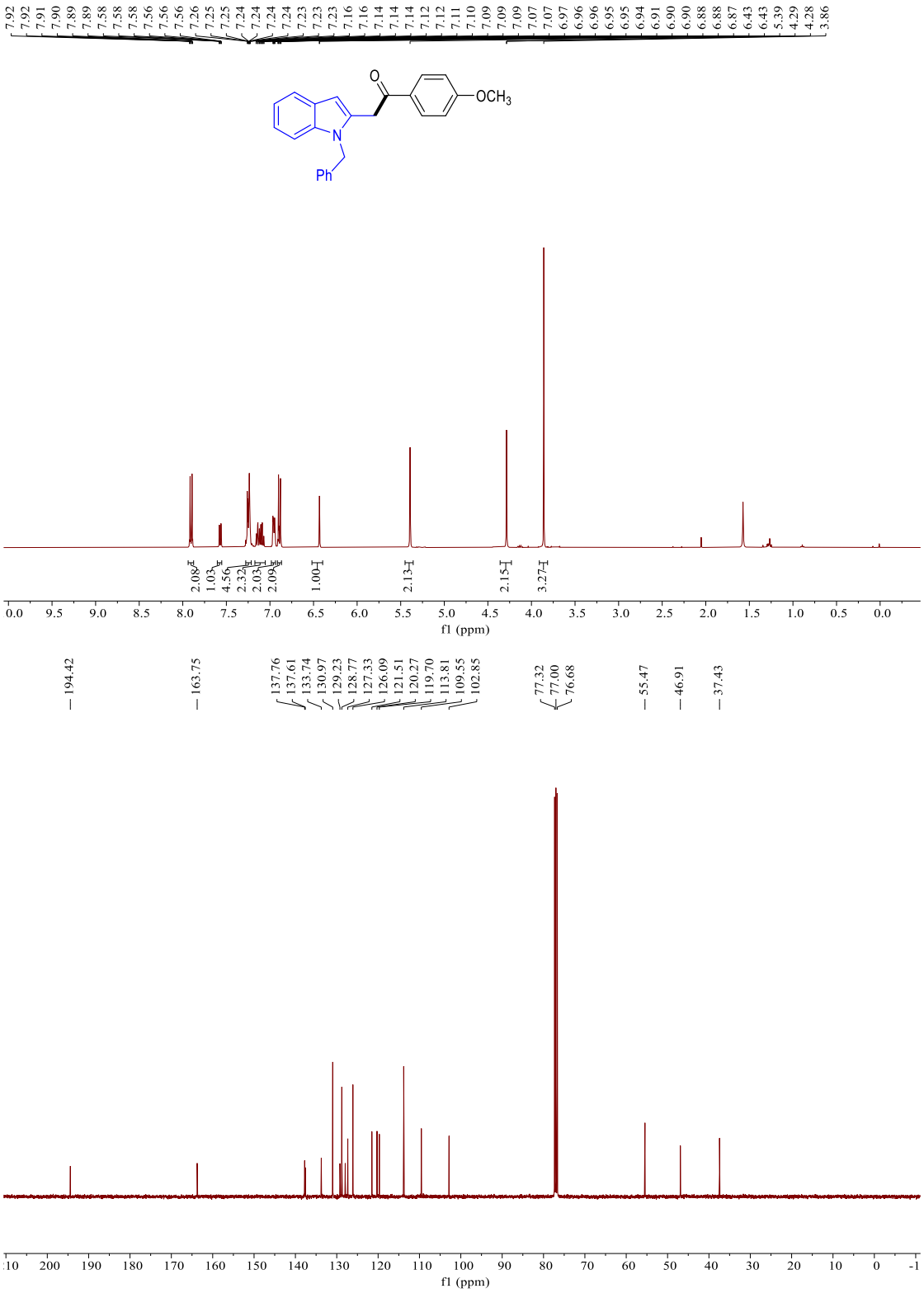
1-(4-methoxyphenyl)-2-(1-methyl-1H-indol-2-yl)-3-phenylpropan-1-one(4ai)



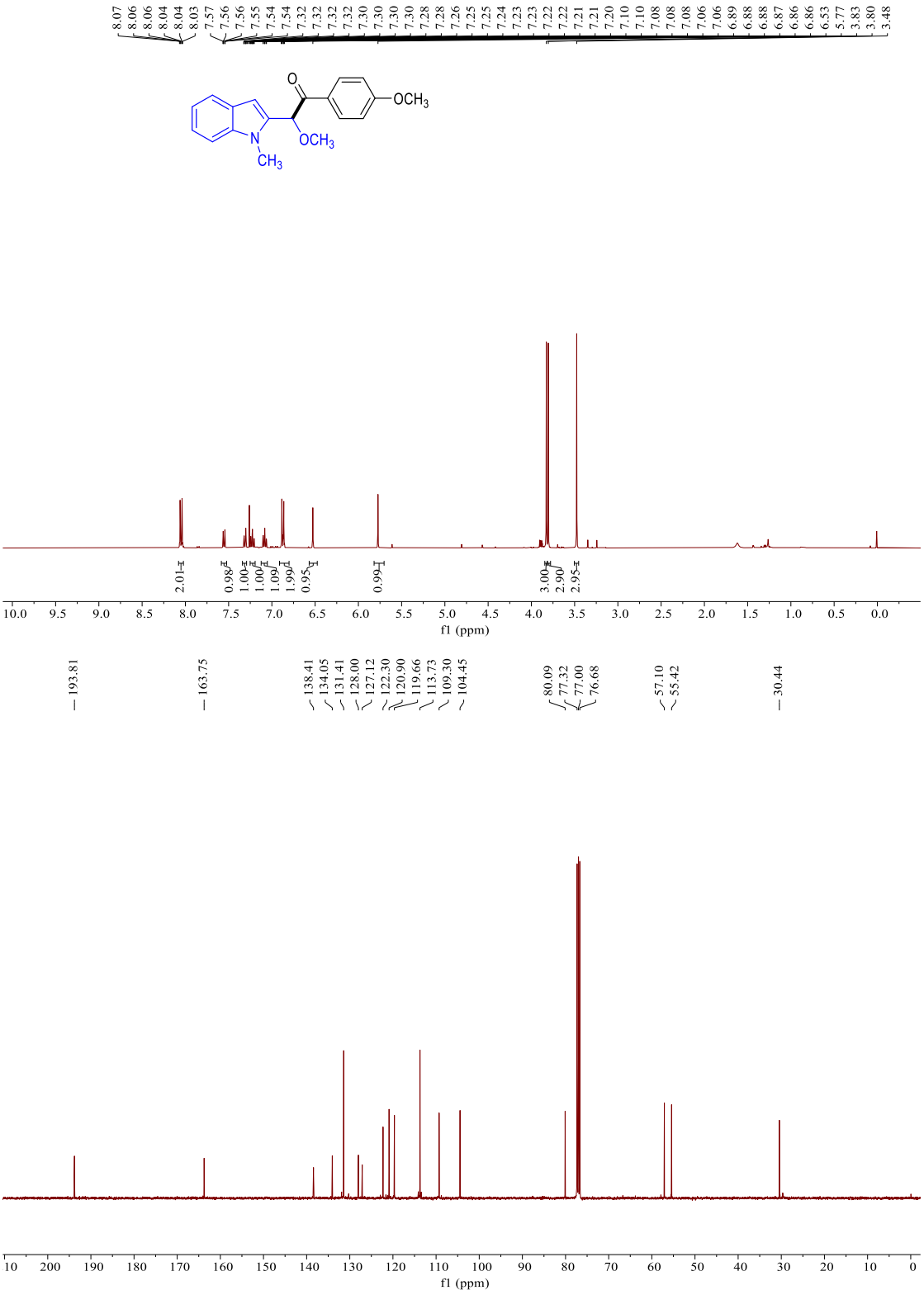




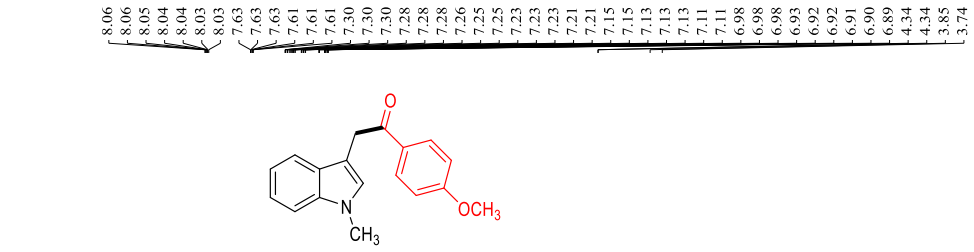
2-(1-benzyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(4aj)

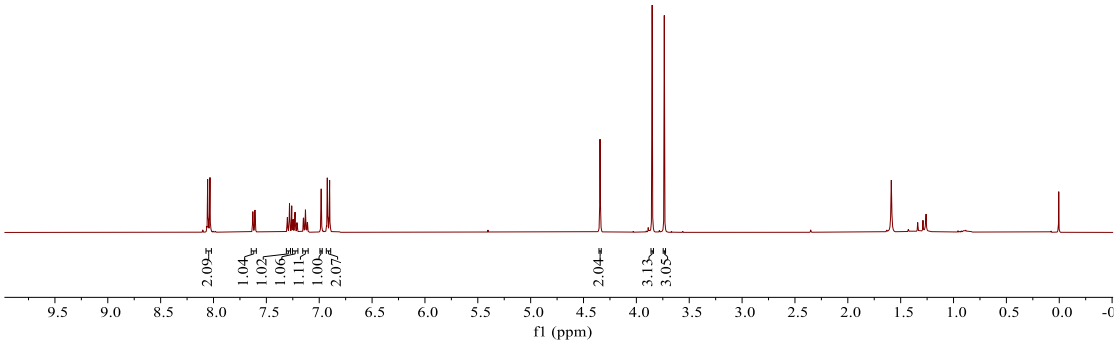


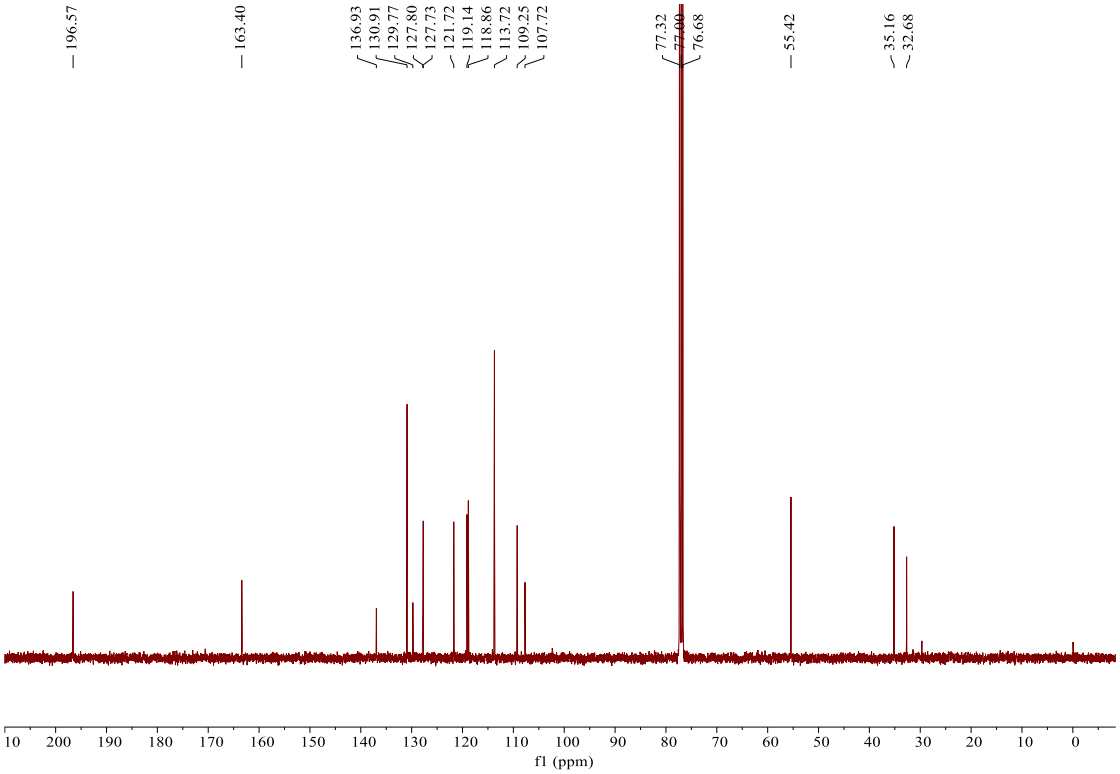
2-methoxy-1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(4ak)



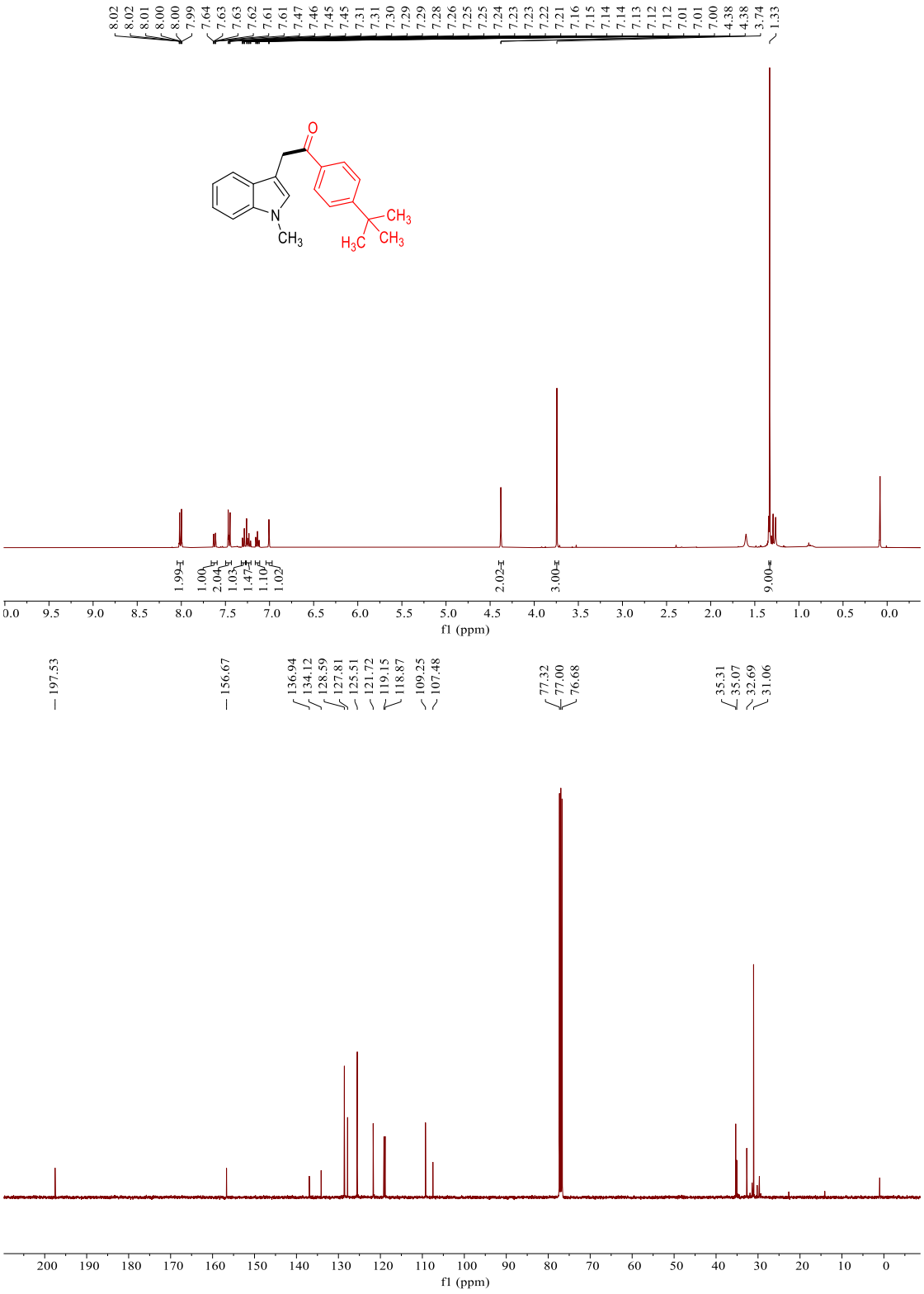
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5a)



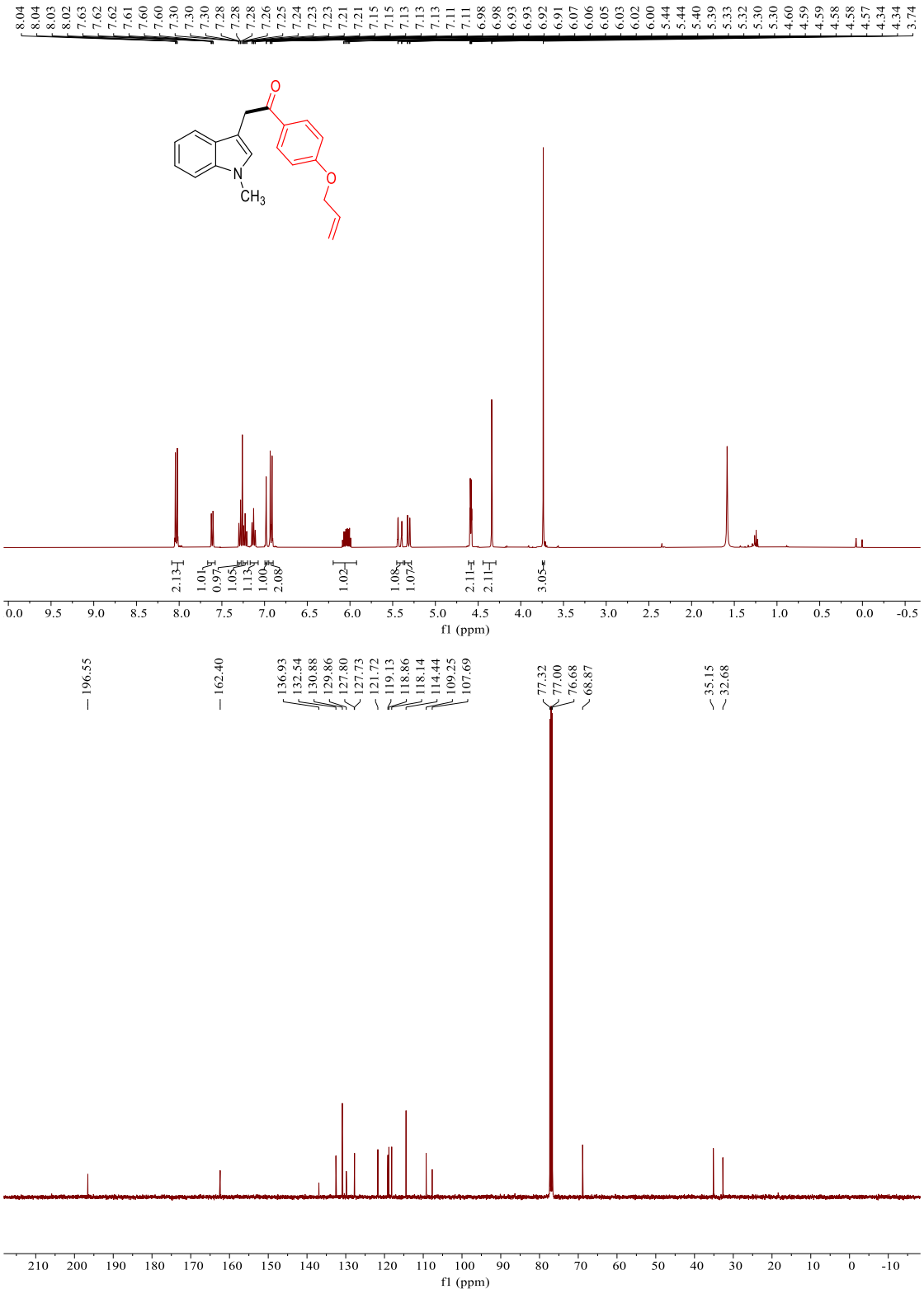




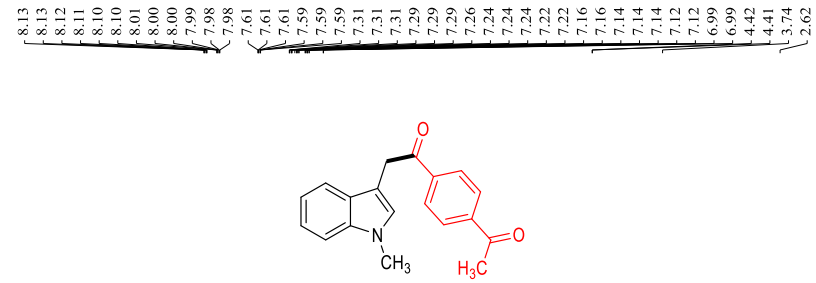
1-(4-(tert-butyl)phenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5b)

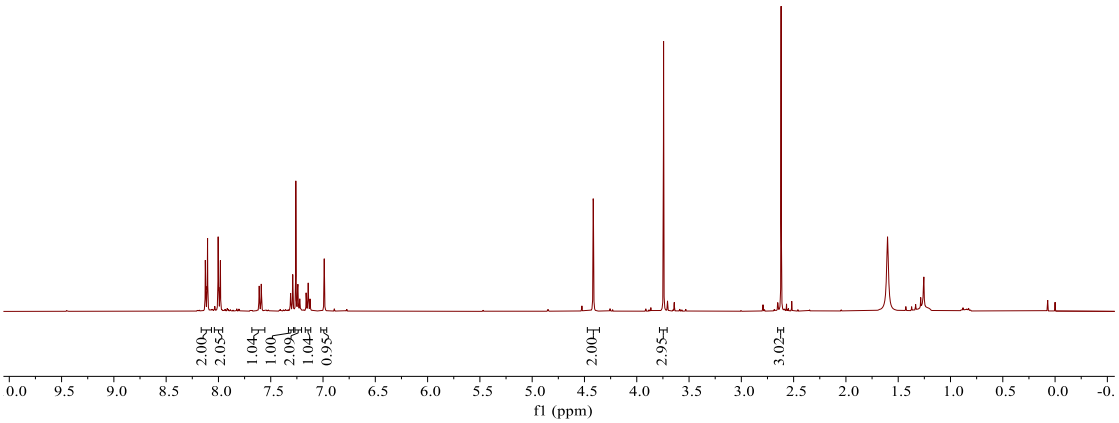


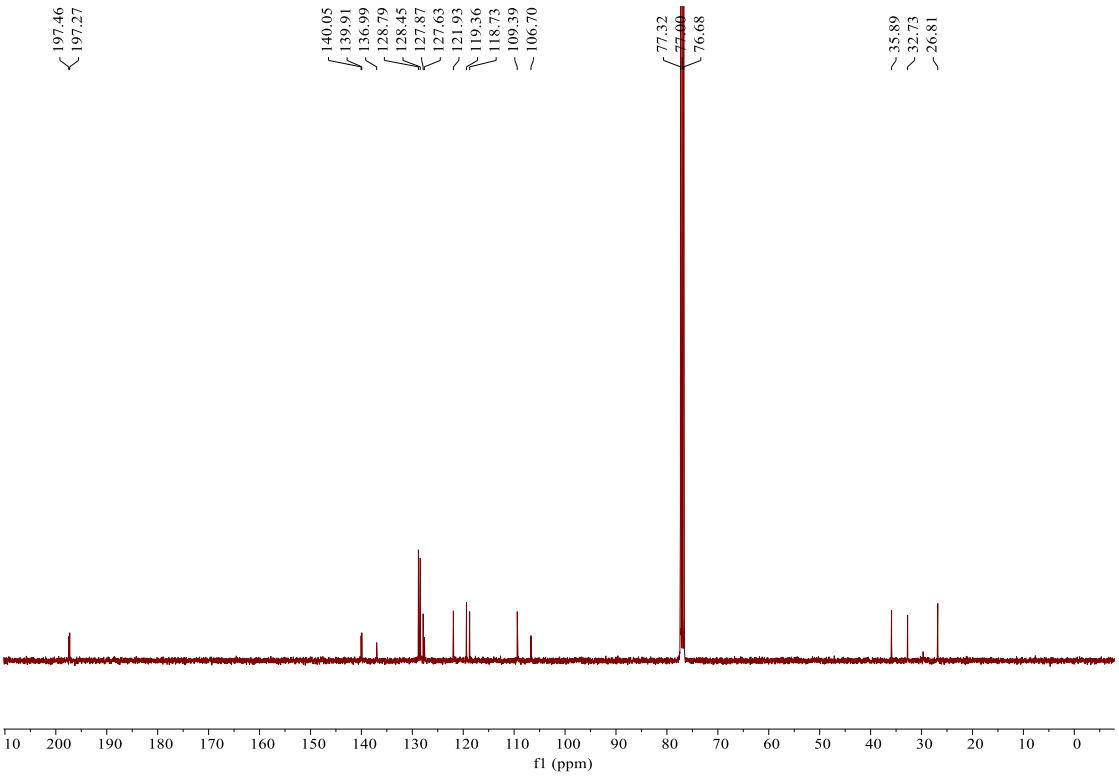
1-(4-(allyloxy)phenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5c)



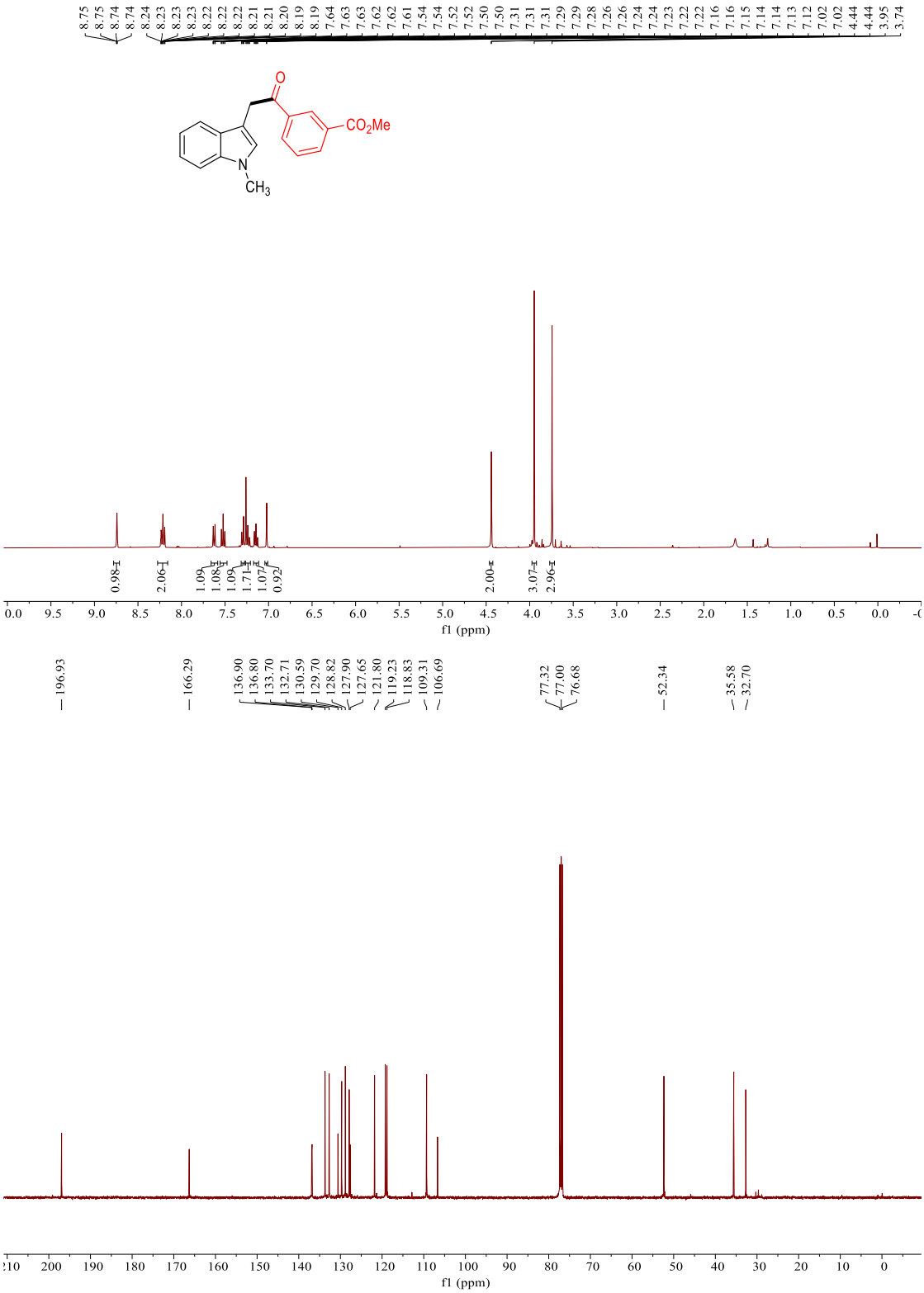
1-(4-acetylphenyl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5d)



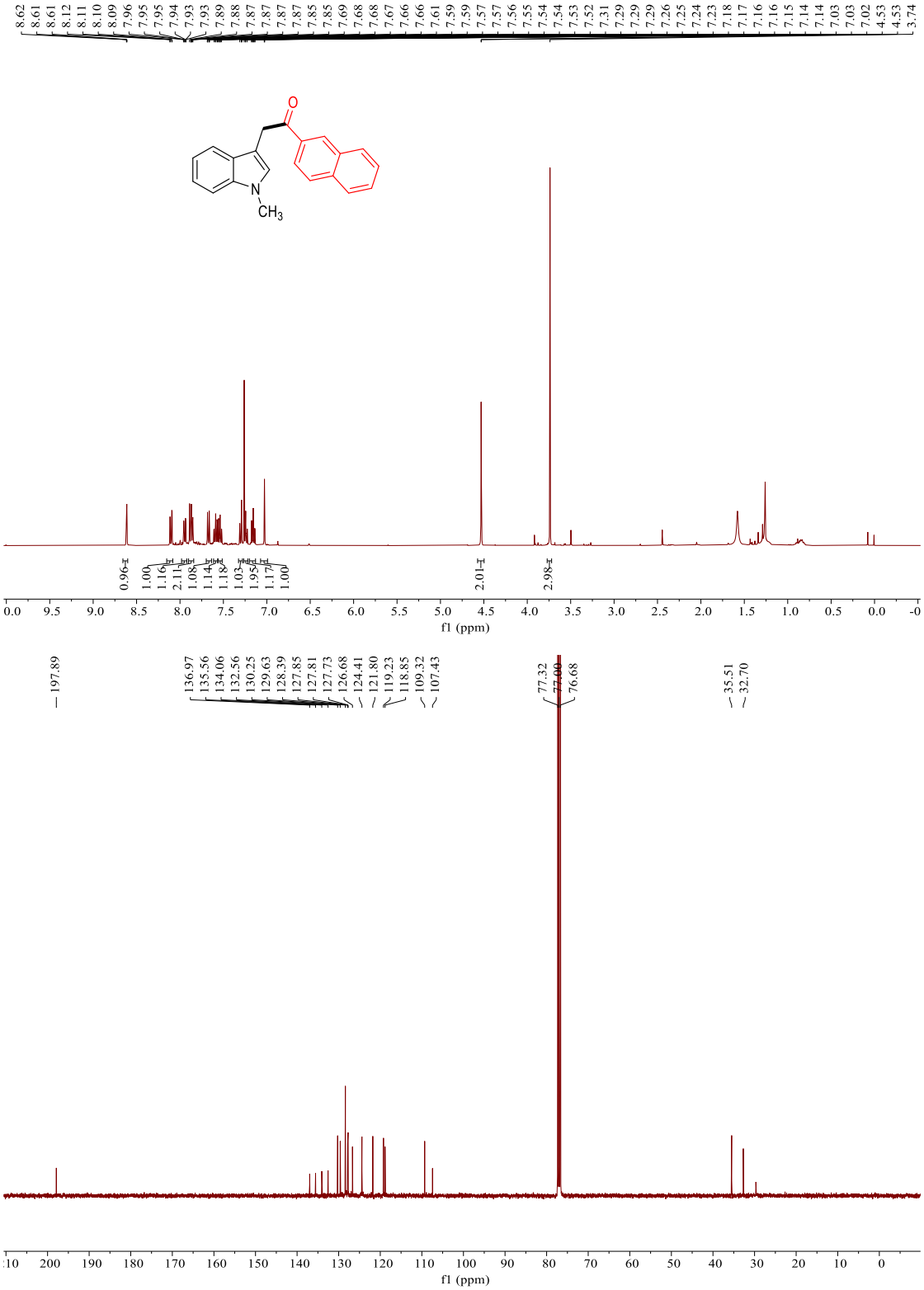




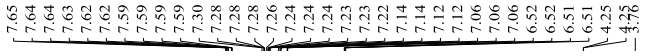
methyl 3-(2-(1-methyl-1*H*-indol-3-yl)acetyl)benzoate(5e)

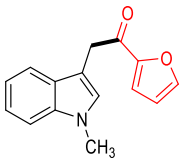


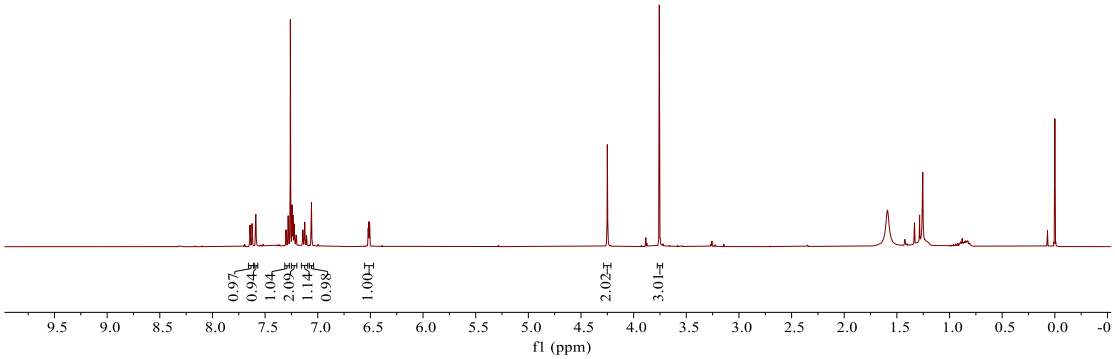
2-(1-methyl-1*H*-indol-3-yl)-1-(naphthalen-2-yl)ethan-1-one(5f)

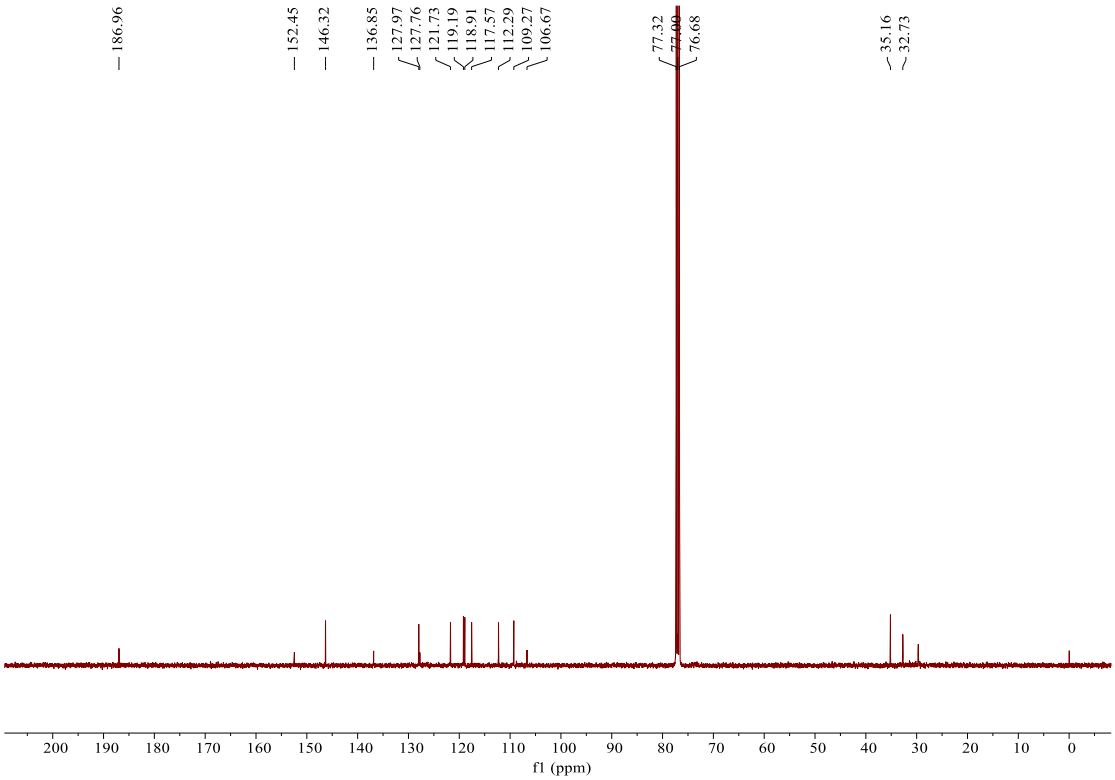


1-(furan-2-yl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(5g)

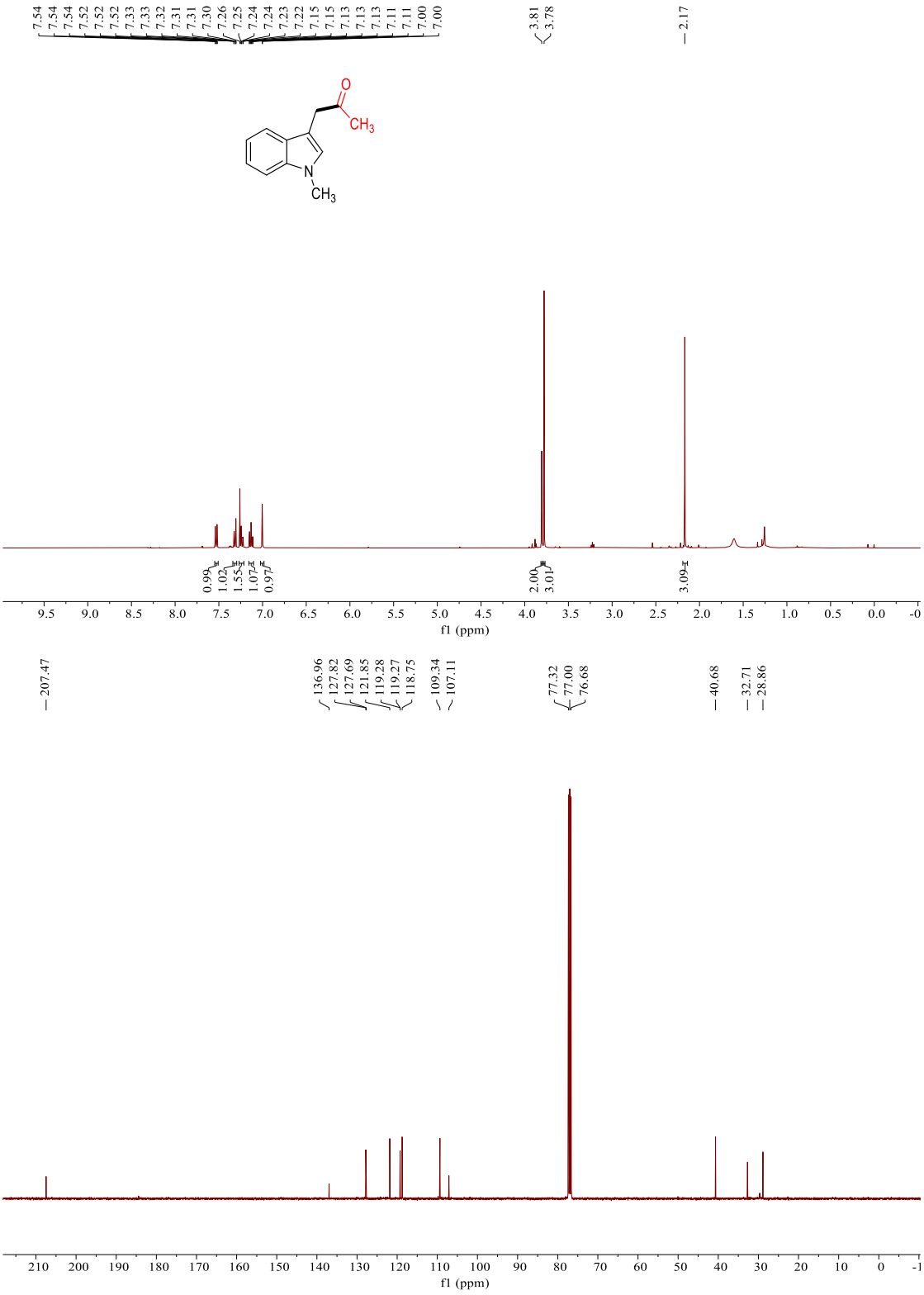




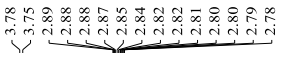


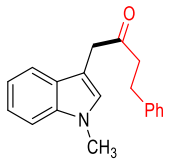


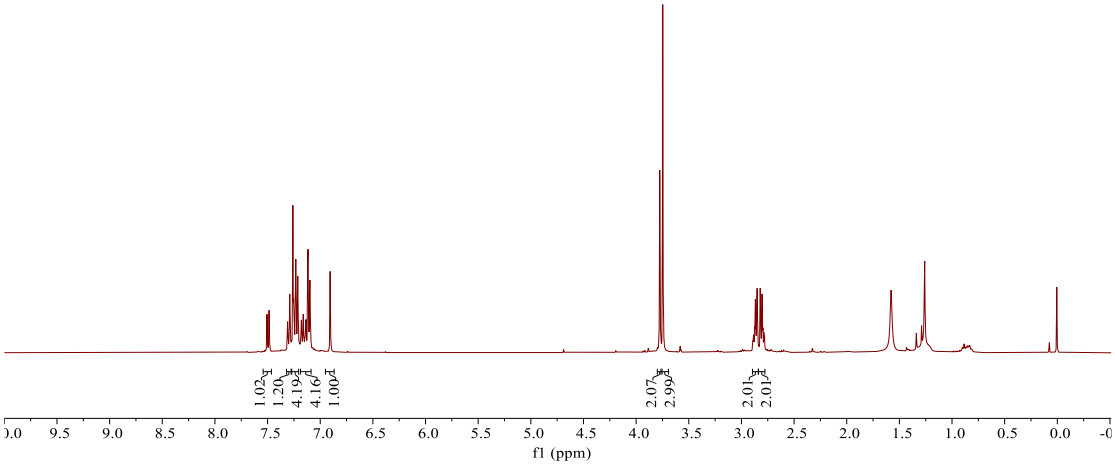
1-(1-methyl-1*H*-indol-3-yl)propan-2-one(5h)

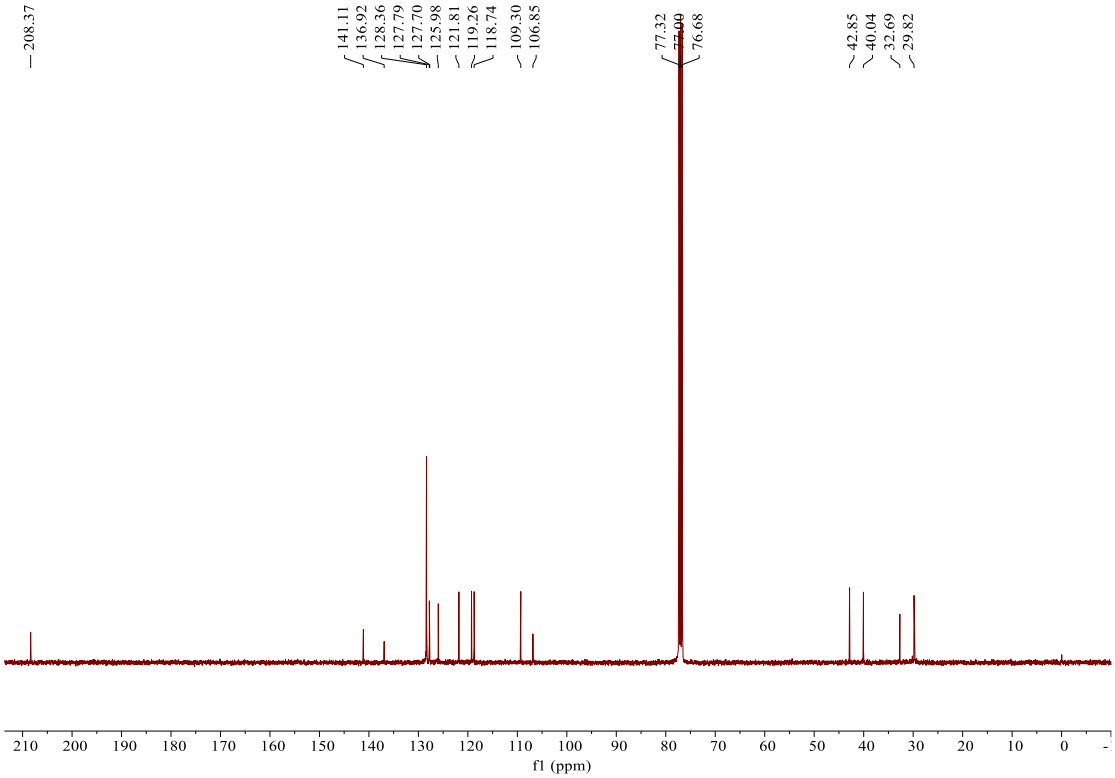


1-(1-methyl-1*H*-indol-3-yl)-4-phenylbutan-2-one(5i)

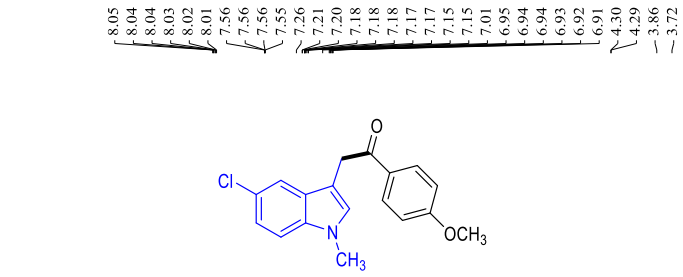


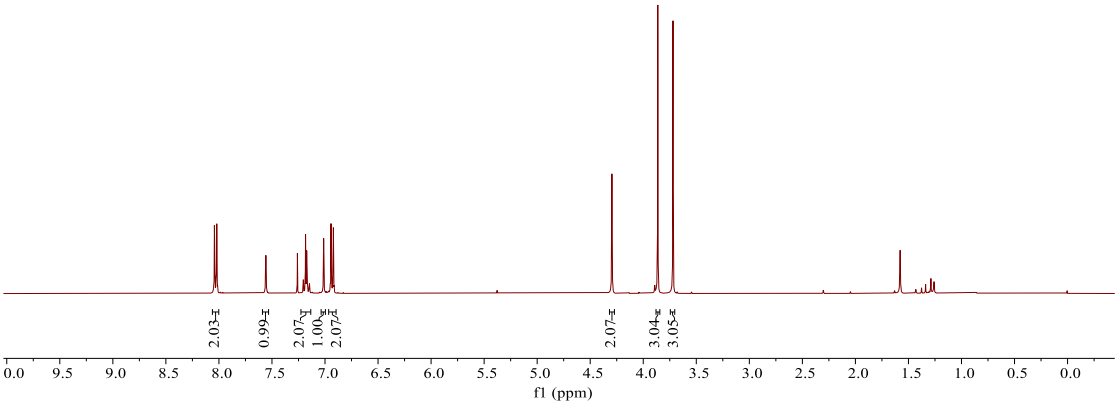


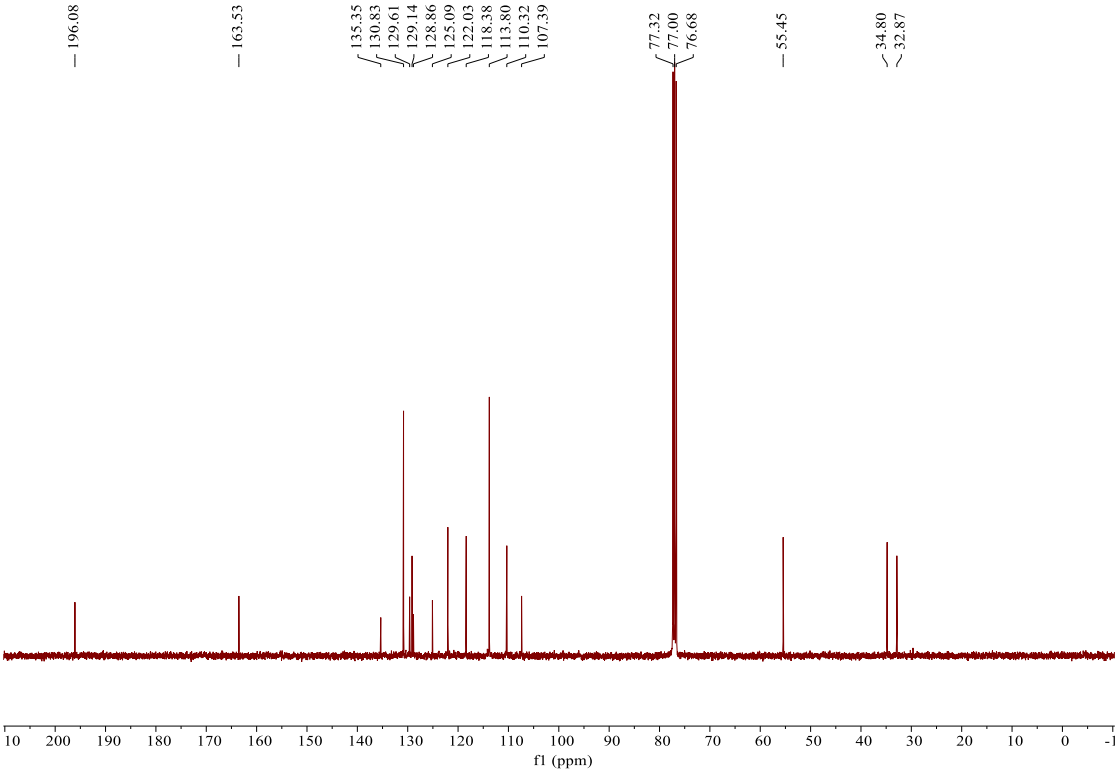




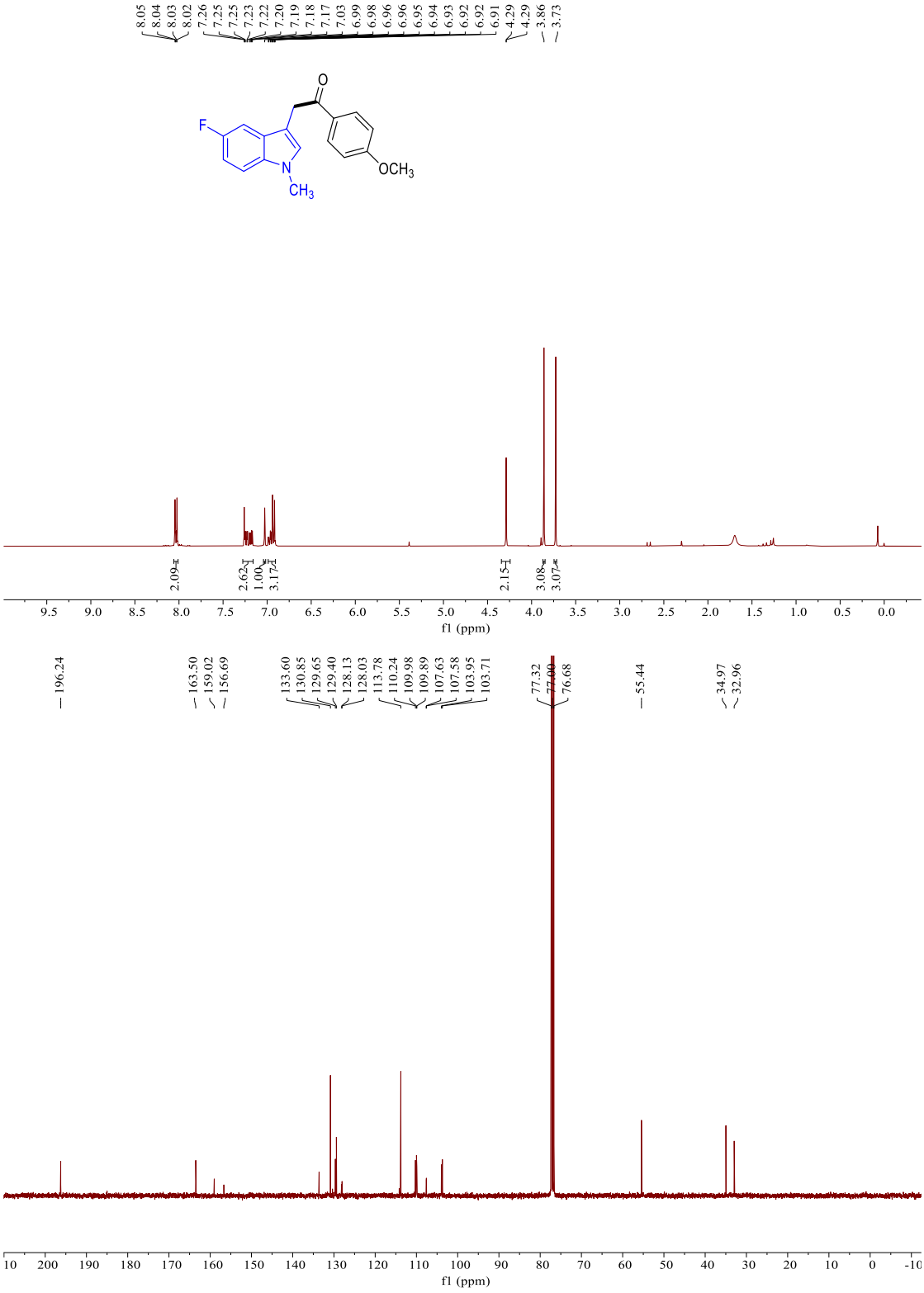
2-(5-chloro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5j)

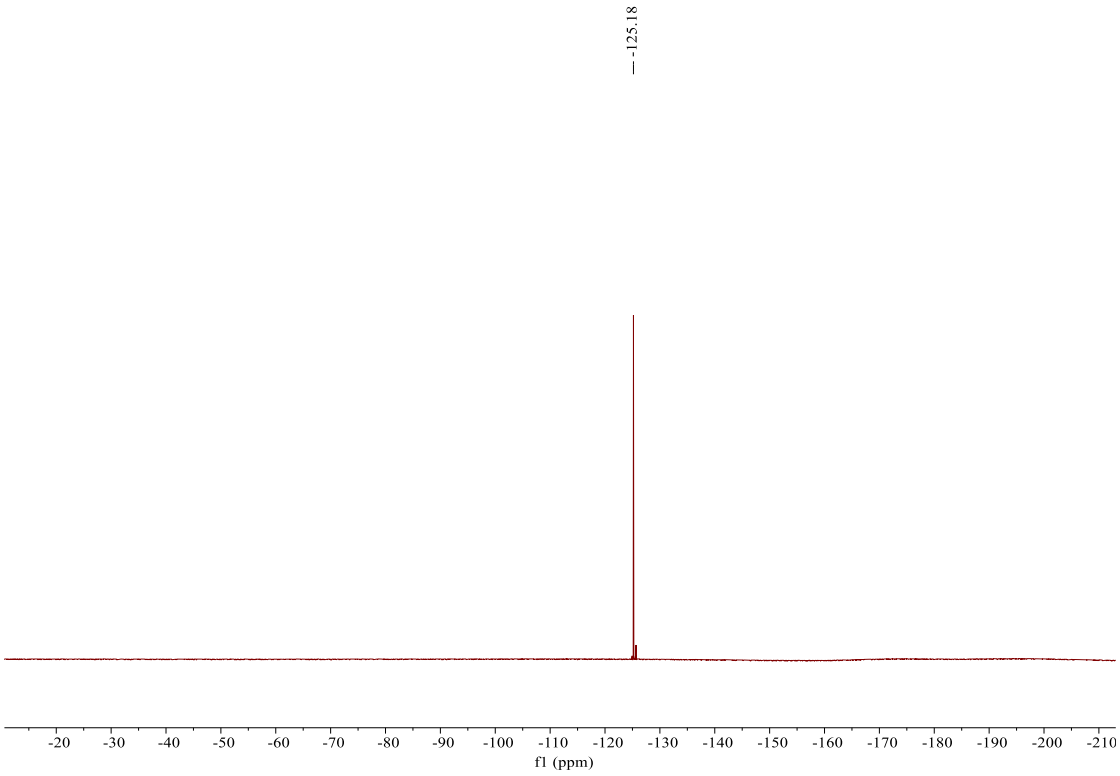




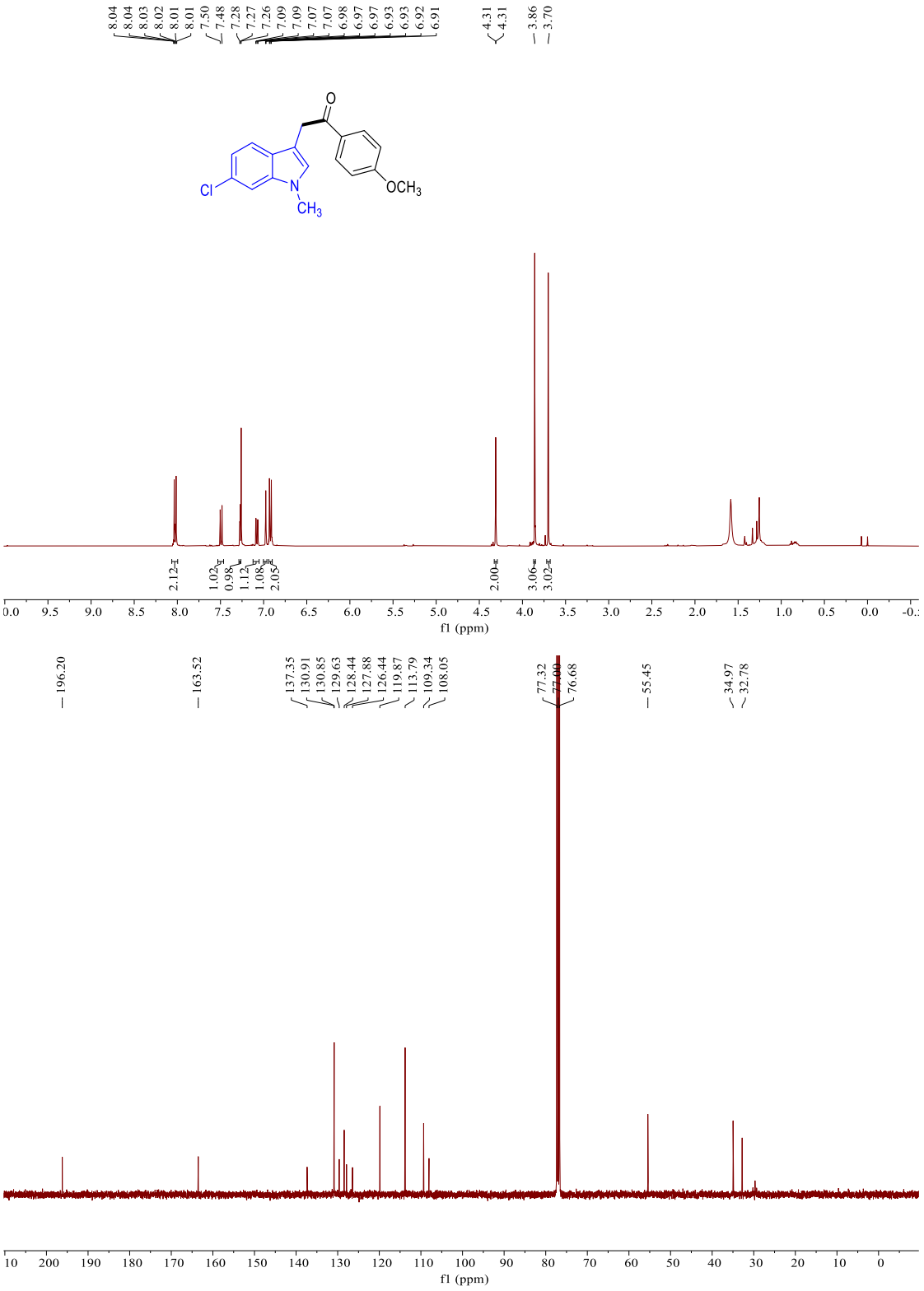


2-(5-fluoro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5k)

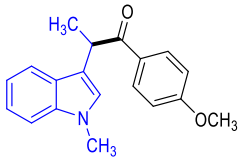


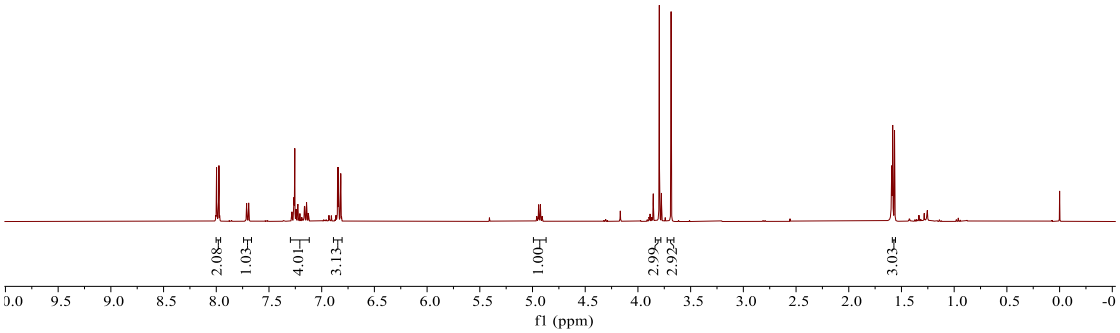

-125.18
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

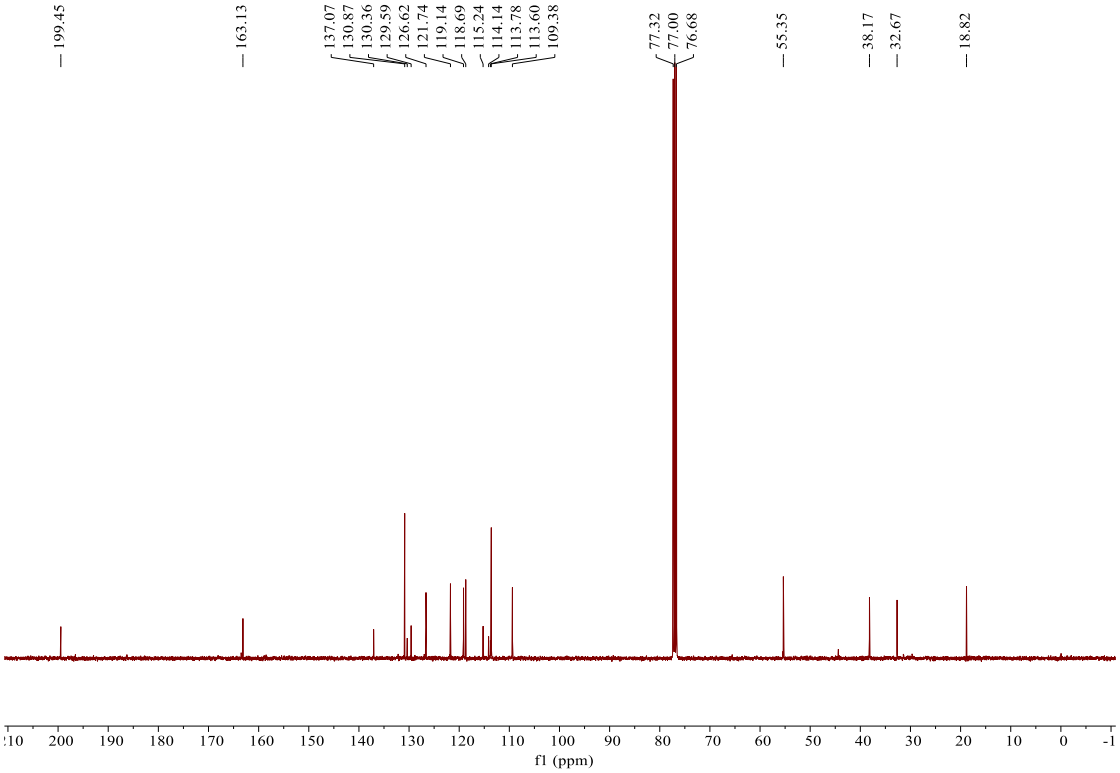
2-(6-chloro-1-methyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5l)



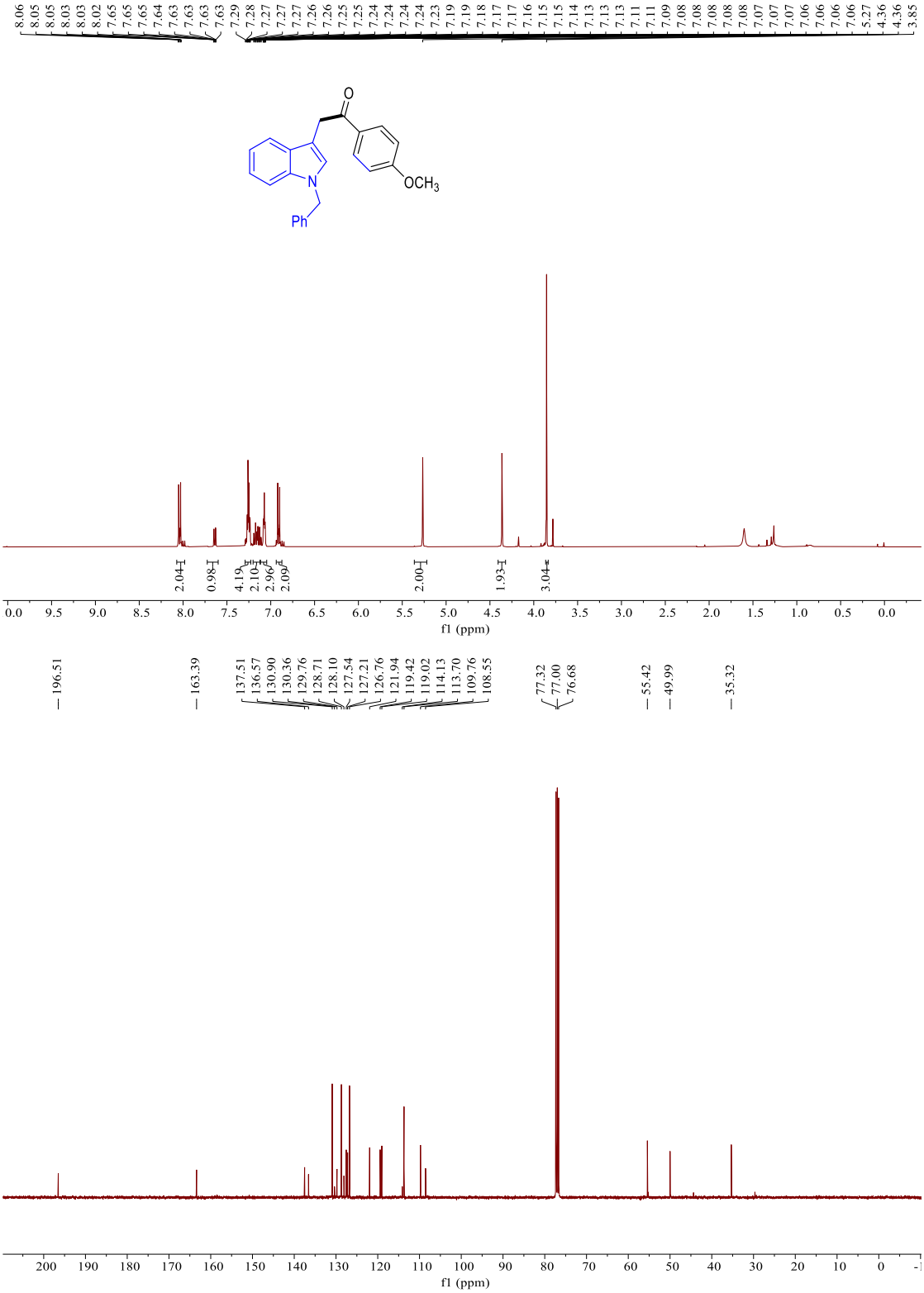
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)propan-1-one(5m)



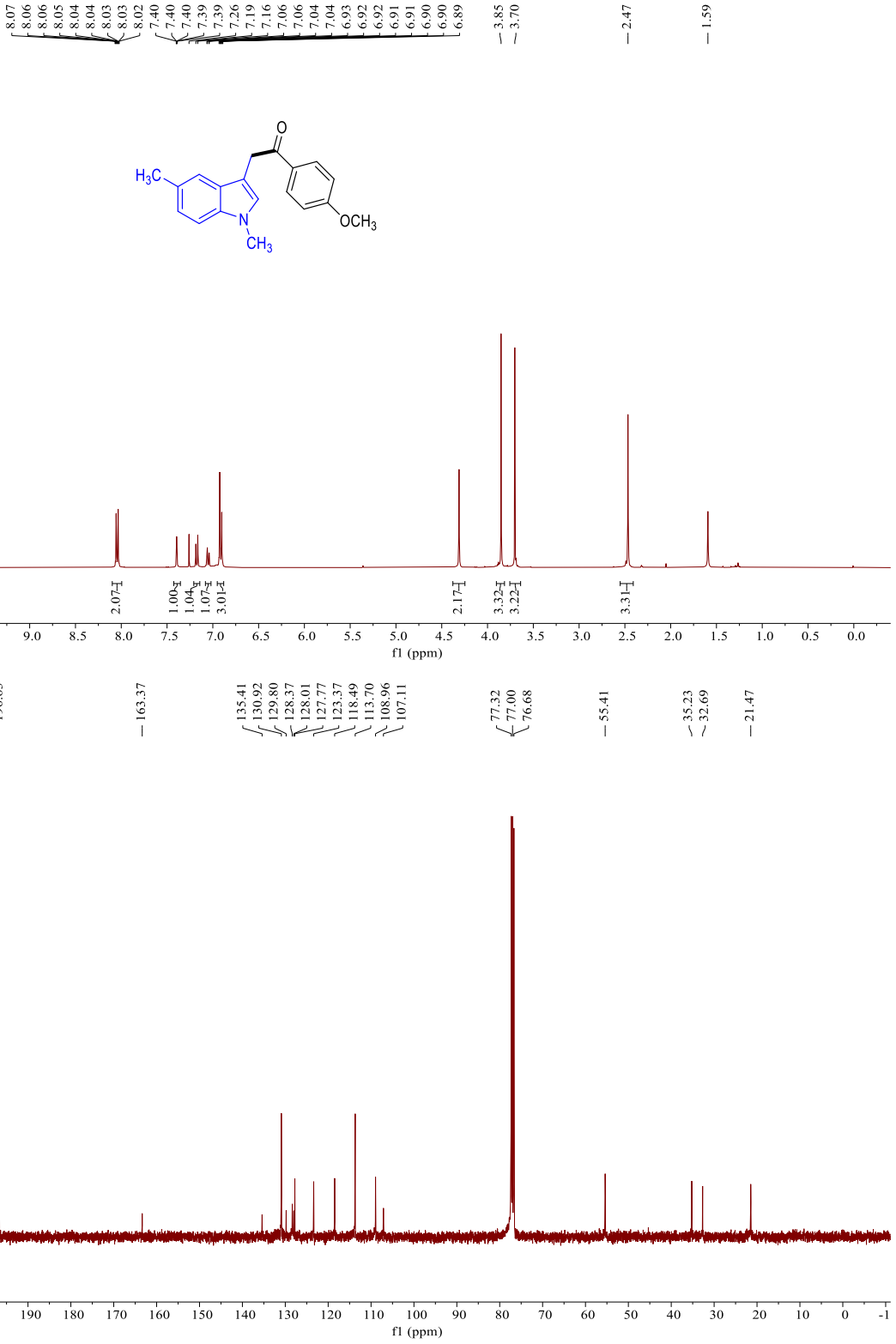




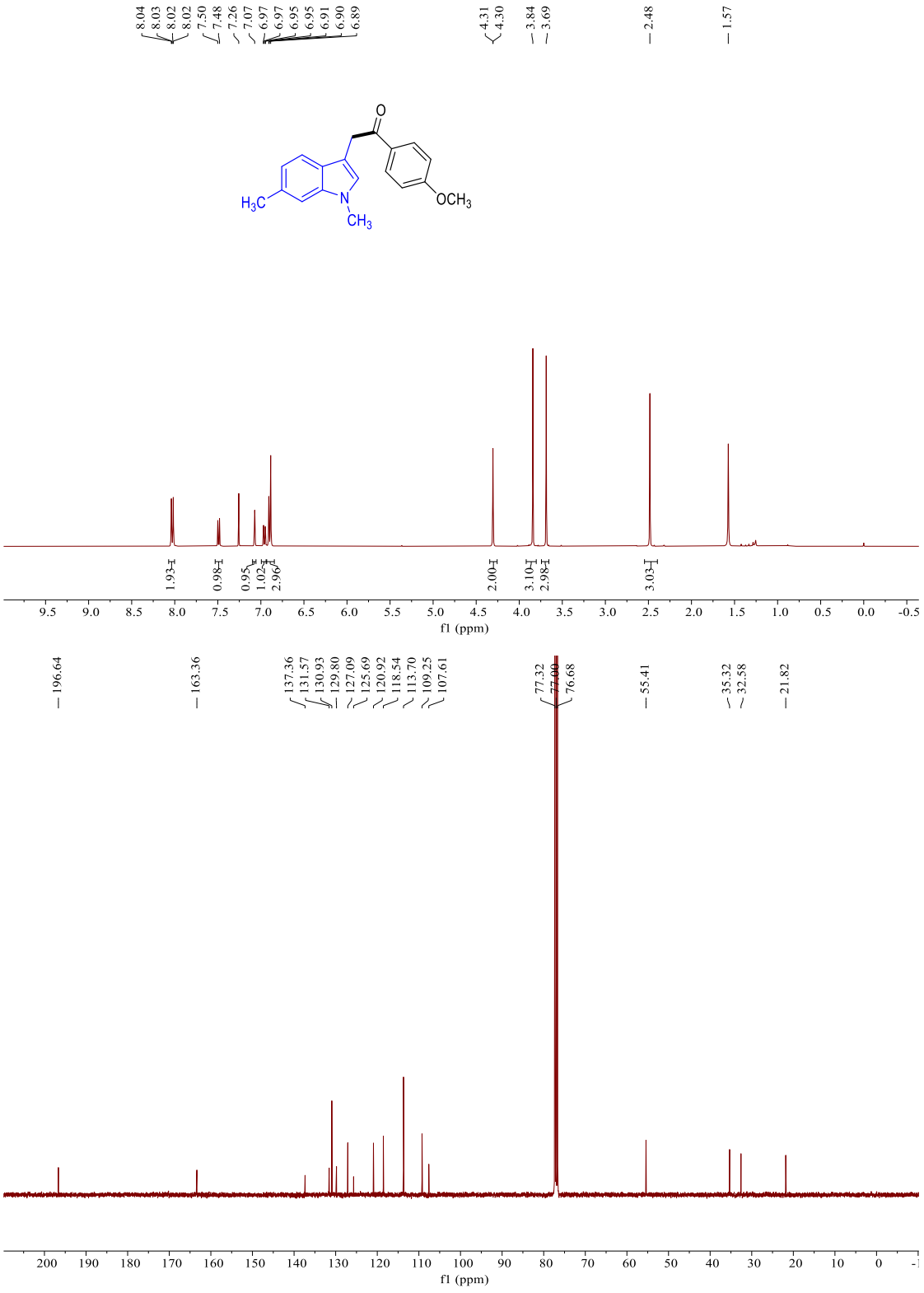
2-(1-benzyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5n)



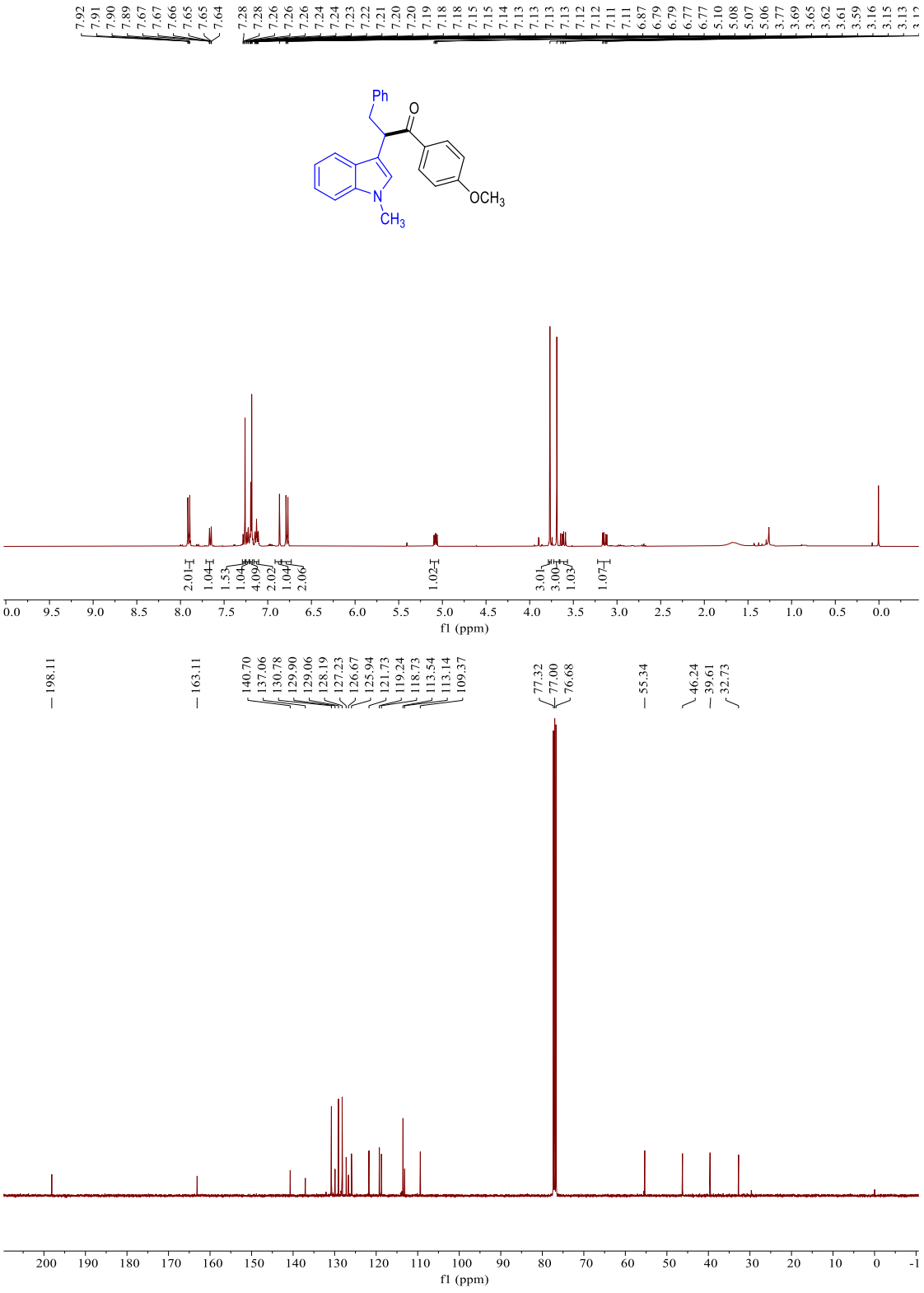
2-(1,5-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5o)



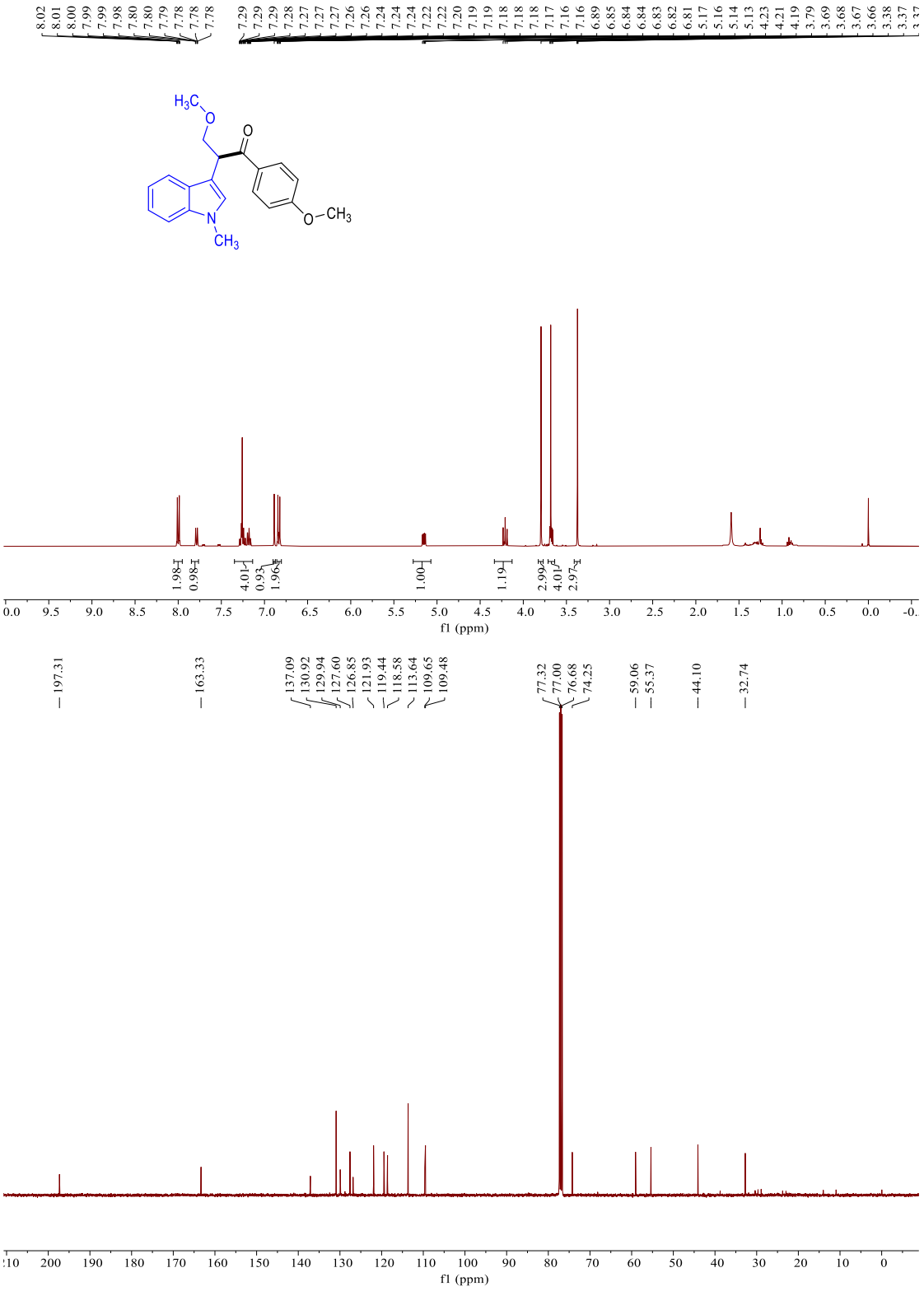
2-(1,6-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(5p)



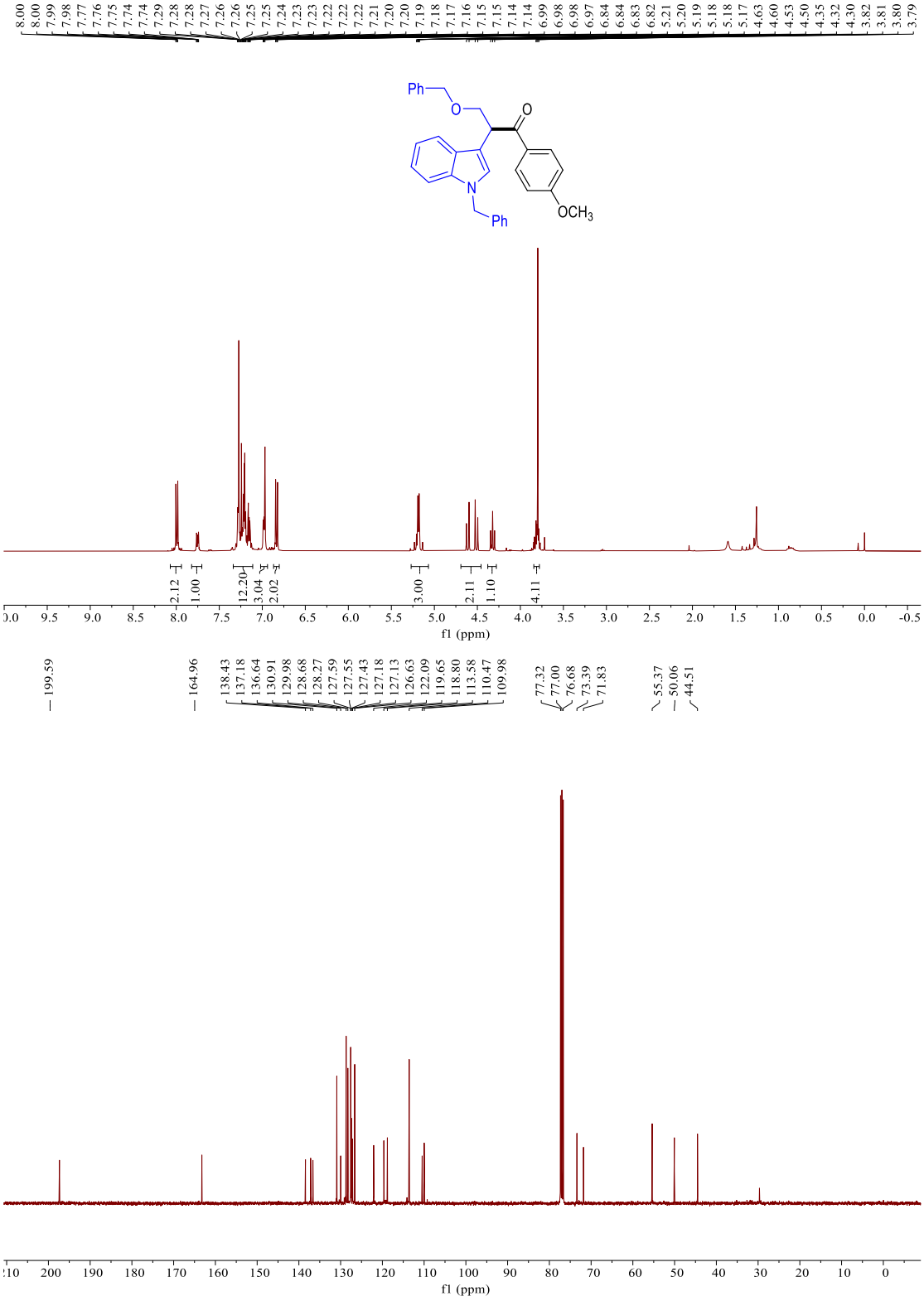
1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)-3-phenylpropan-1-one(5q)



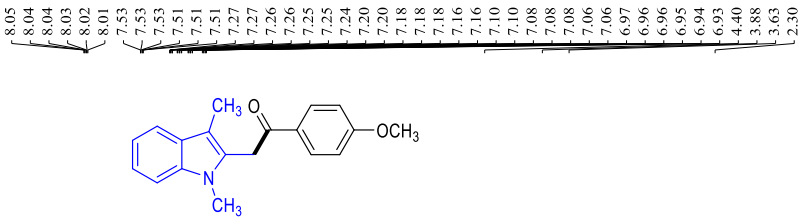
3-methoxy-1-(4-methoxyphenyl)-2-(1-methyl-1*H*-indol-3-yl)propan-1-one(5r)

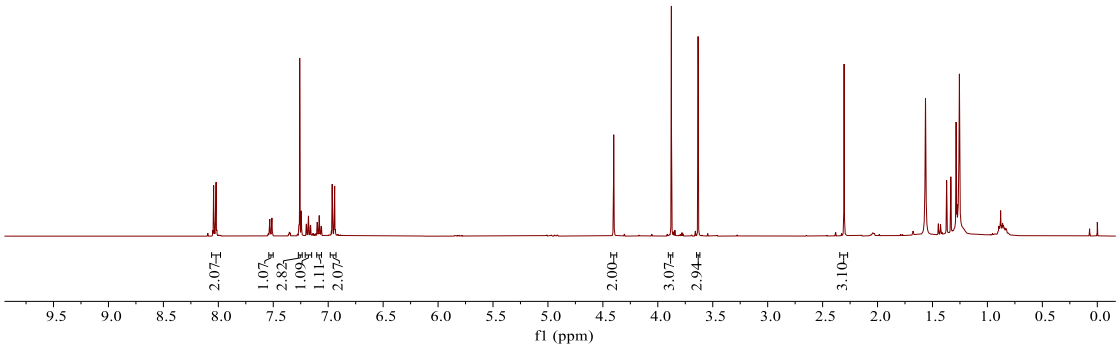


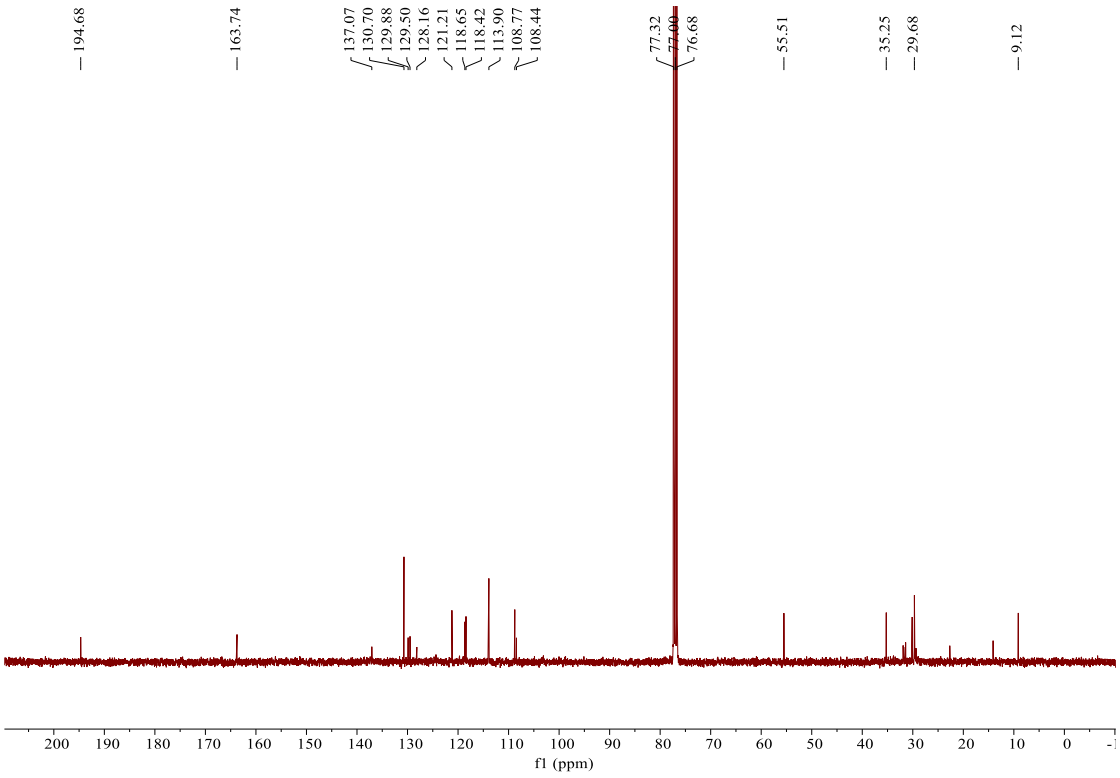
2-(1-benzyl-1*H*-indol-3-yl)-3-(benzyloxy)-1-(4-methoxyphenyl)propan-1-one(5s)



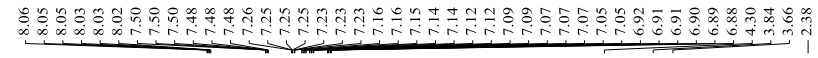
2-(1,3-dimethyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7a)

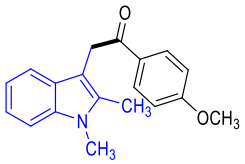


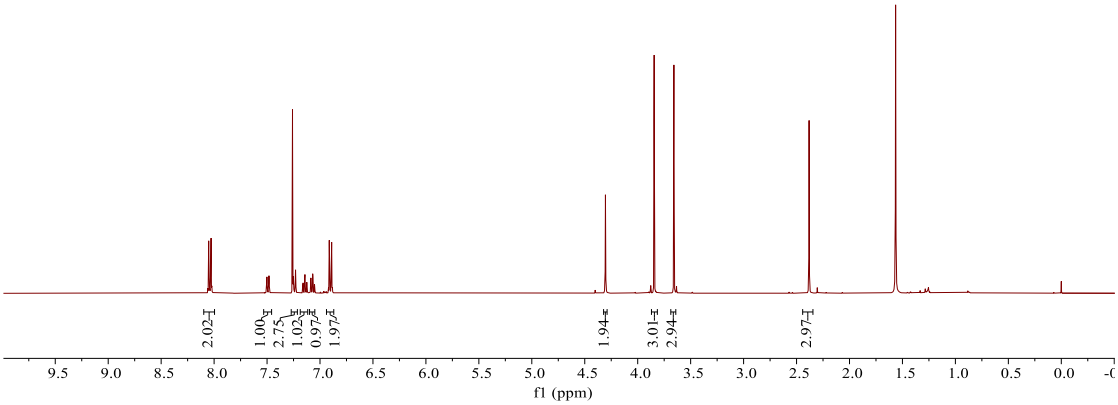


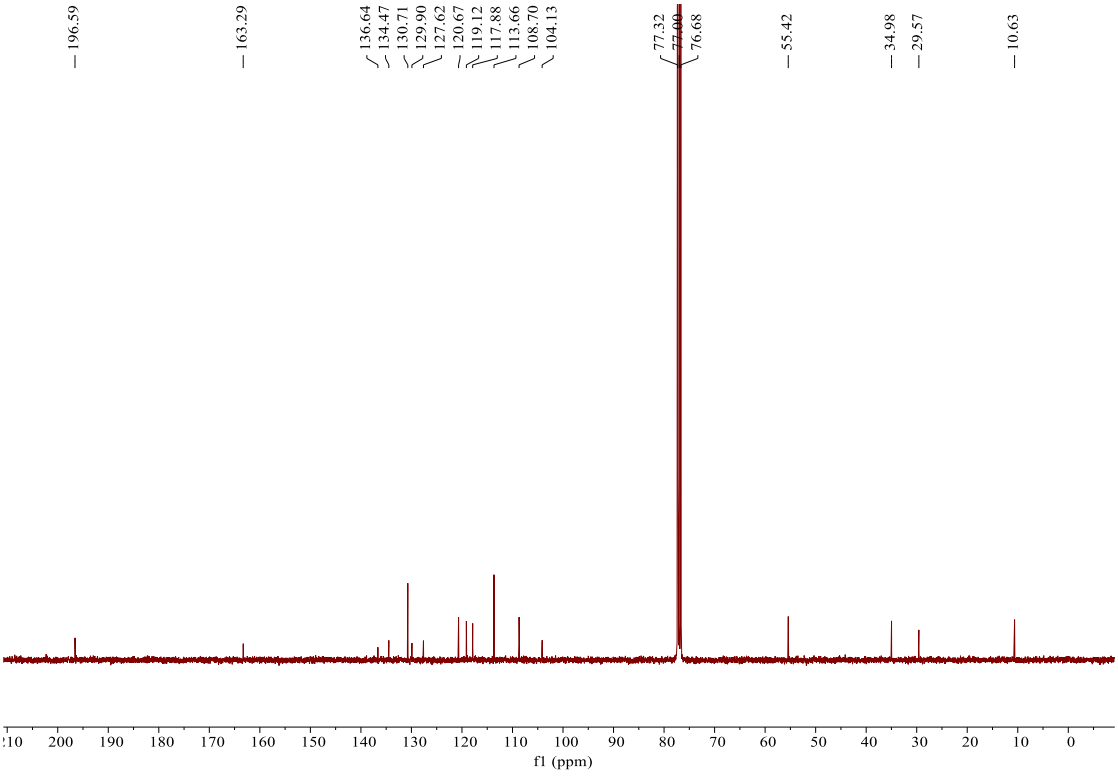


2-(1,2-dimethyl-1*H*-indol-3-yl)-1-(4-methoxyphenyl)ethan-1-one(7a')

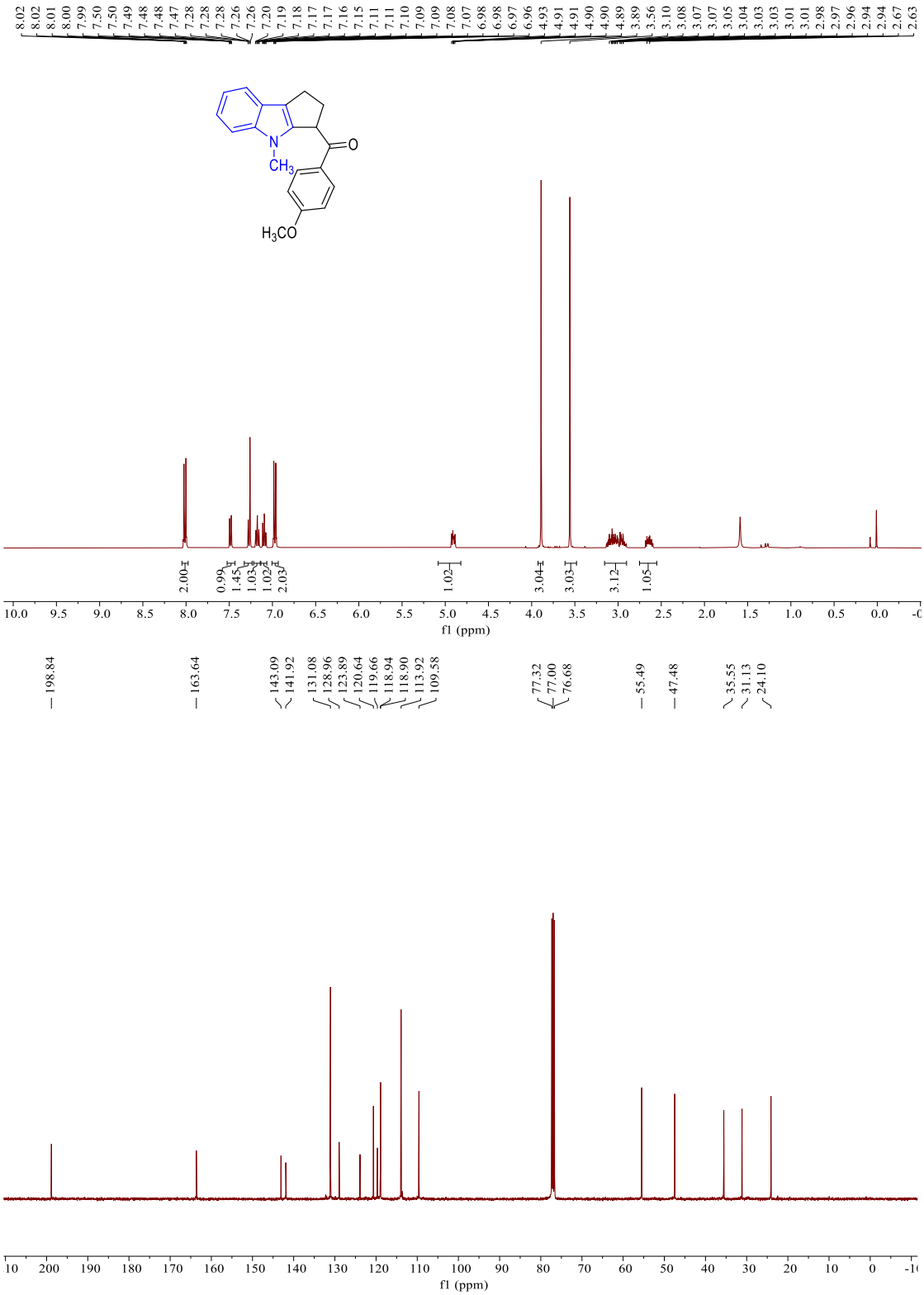




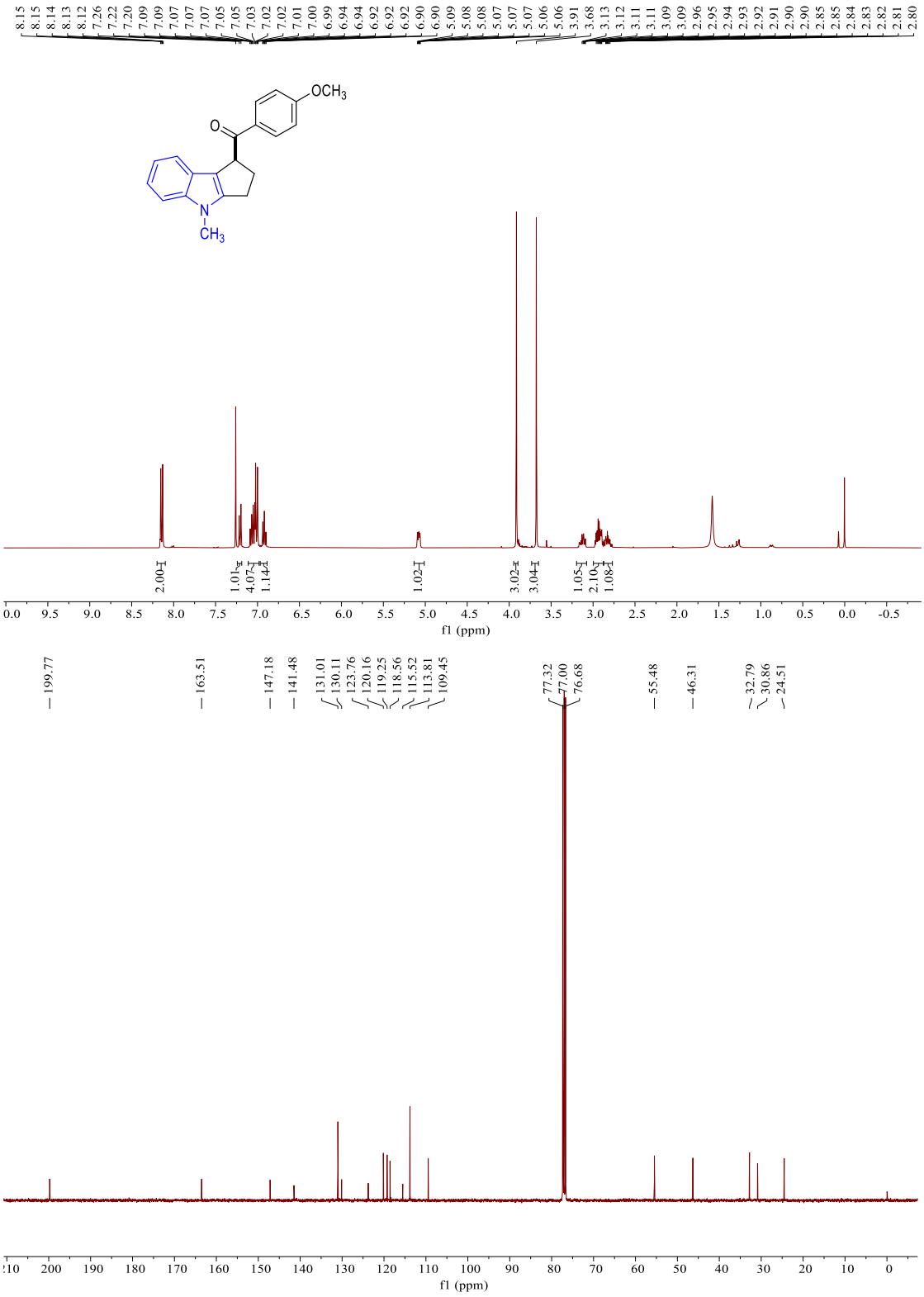




(4-methoxyphenyl)(4-methyl-1,2,3,4-tetrahydrocyclopenta[*b*]indol-3-yl)methanone(7b)

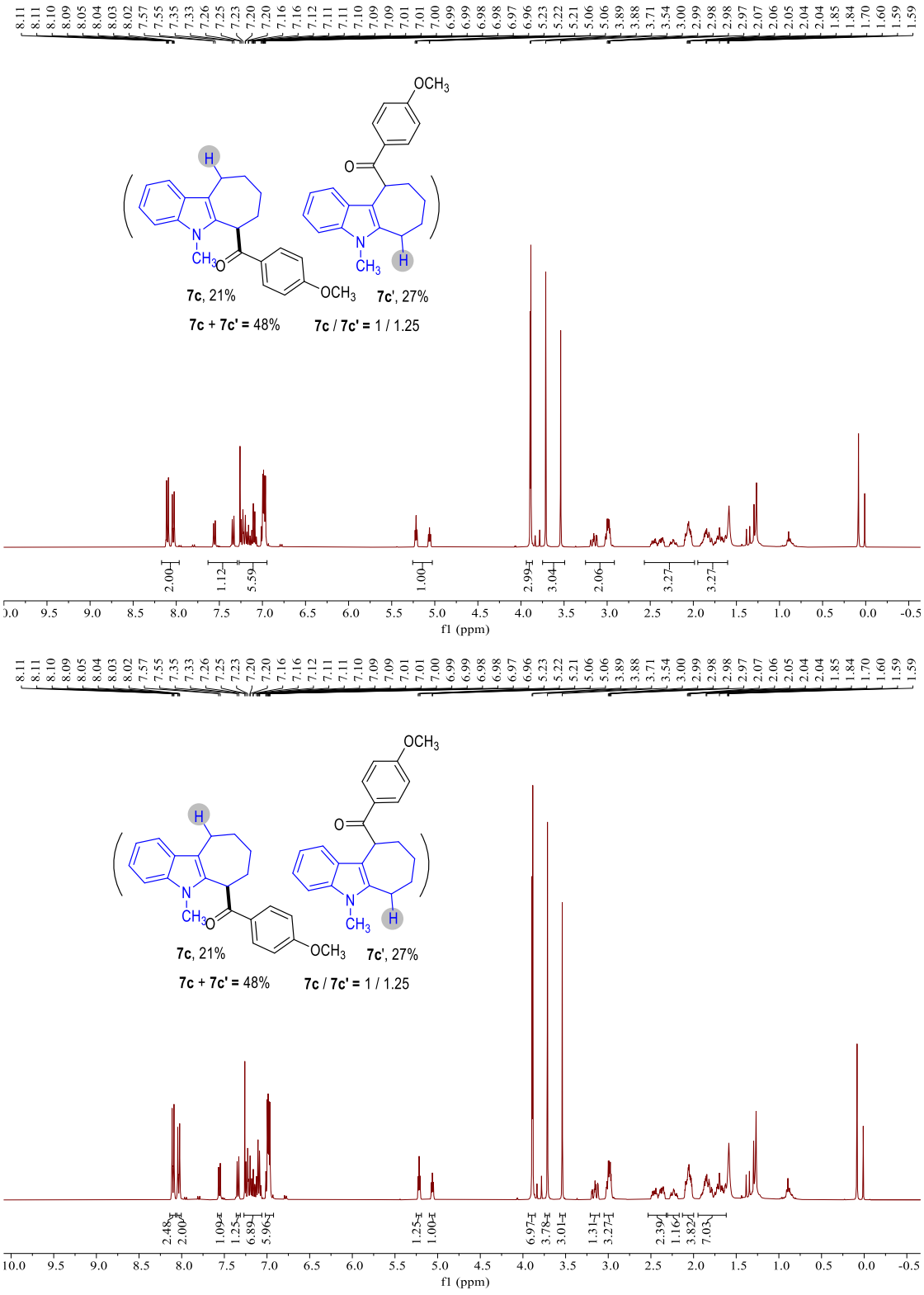


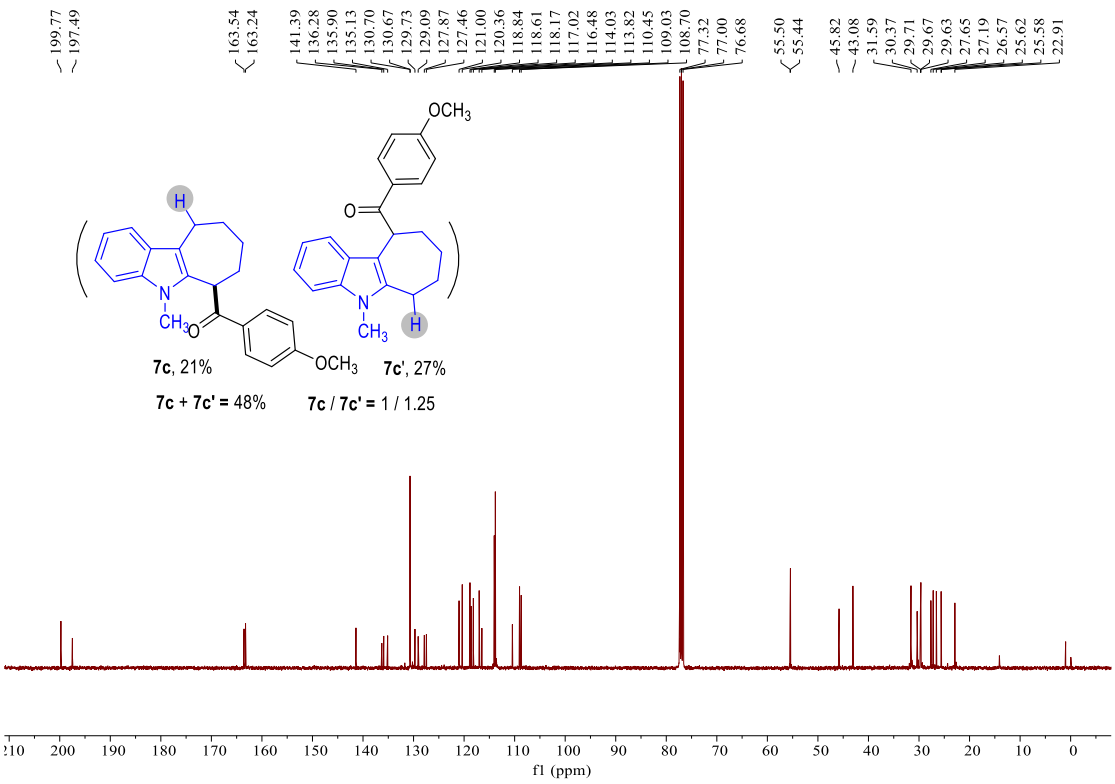
(4-methoxyphenyl)(4-methyl-1,2,3,4-tetrahydrocyclopenta[b]indol-1-yl)methanone(7b')



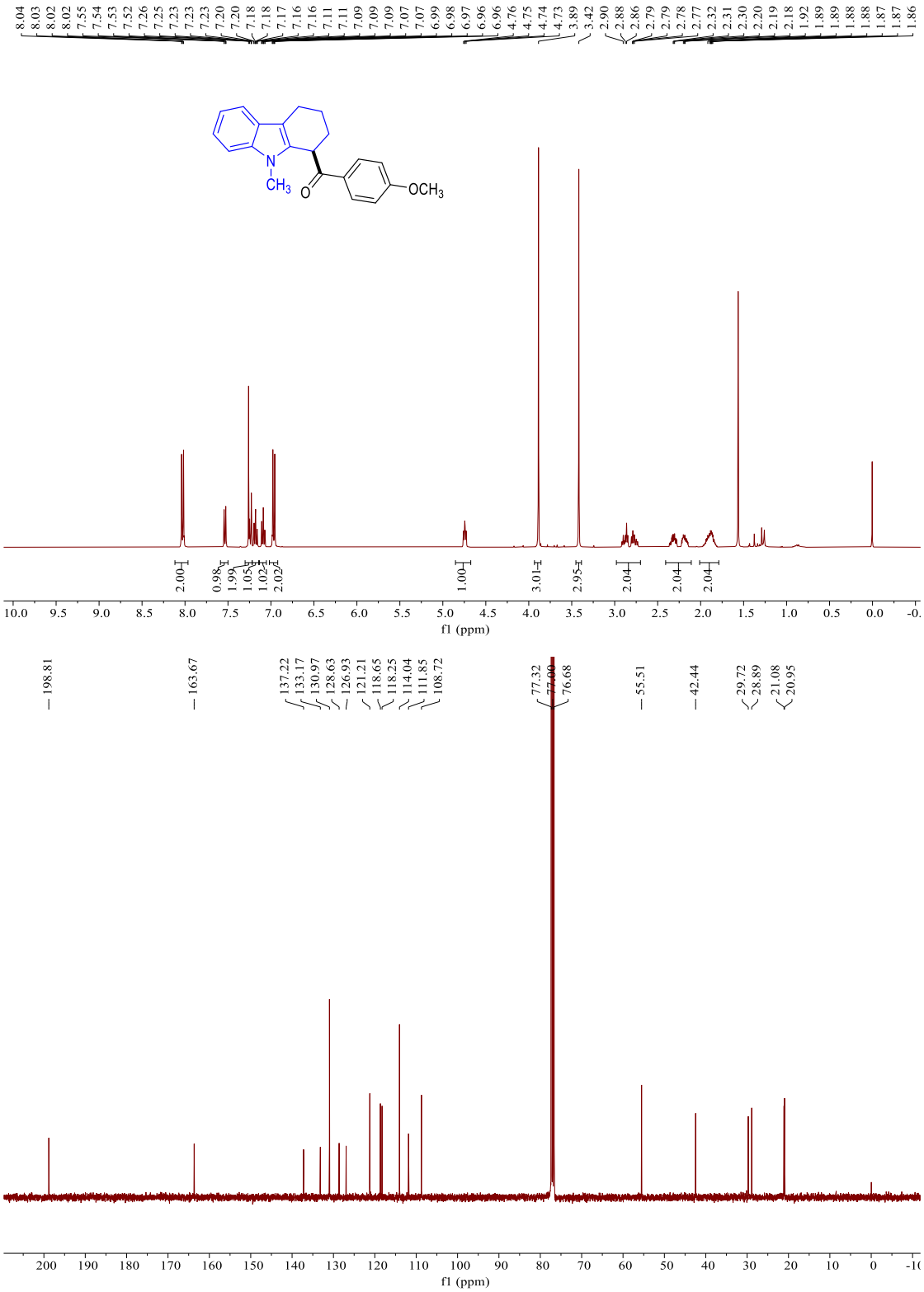
(4-methoxyphenyl)(5-methyl-5,6,7,8,9,10-hexahydrocyclohepta[*b*]indol-6-yl)methanone(7c)

(4-methoxyphenyl)(5-methyl-5,6,7,8,9,10-hexahydrocyclohepta[*b*]indol-10-yl)methanone(7c')

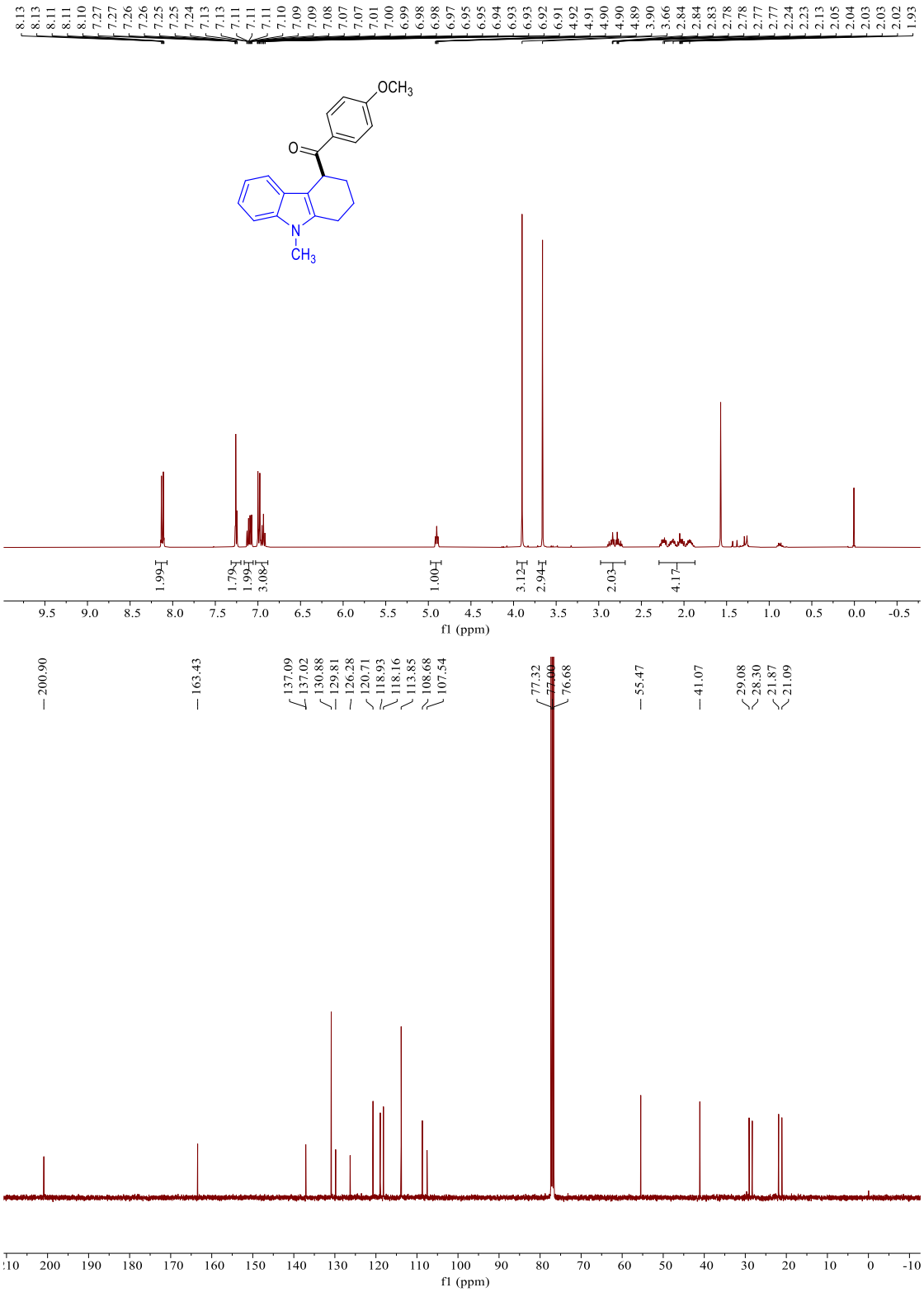



199.77
197.49
163.54
163.24
141.39
136.28
135.90
135.13
130.70
130.67
129.73
129.09
127.87
127.46
121.00
120.36
118.84
118.61
118.17
117.02
116.48
114.03
113.82
110.45
109.03
108.70
77.32
77.00
76.68
55.50
55.44
45.82
43.08
31.59
30.37
29.71
29.67
29.63
27.65
27.19
26.57
25.62
25.58
22.91
OCH3
O
H
N
CH3
O
OCH3
7c, 21%
7c + 7c' = 48%
7c / 7c' = 1 / 1.25
7c', 27%
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

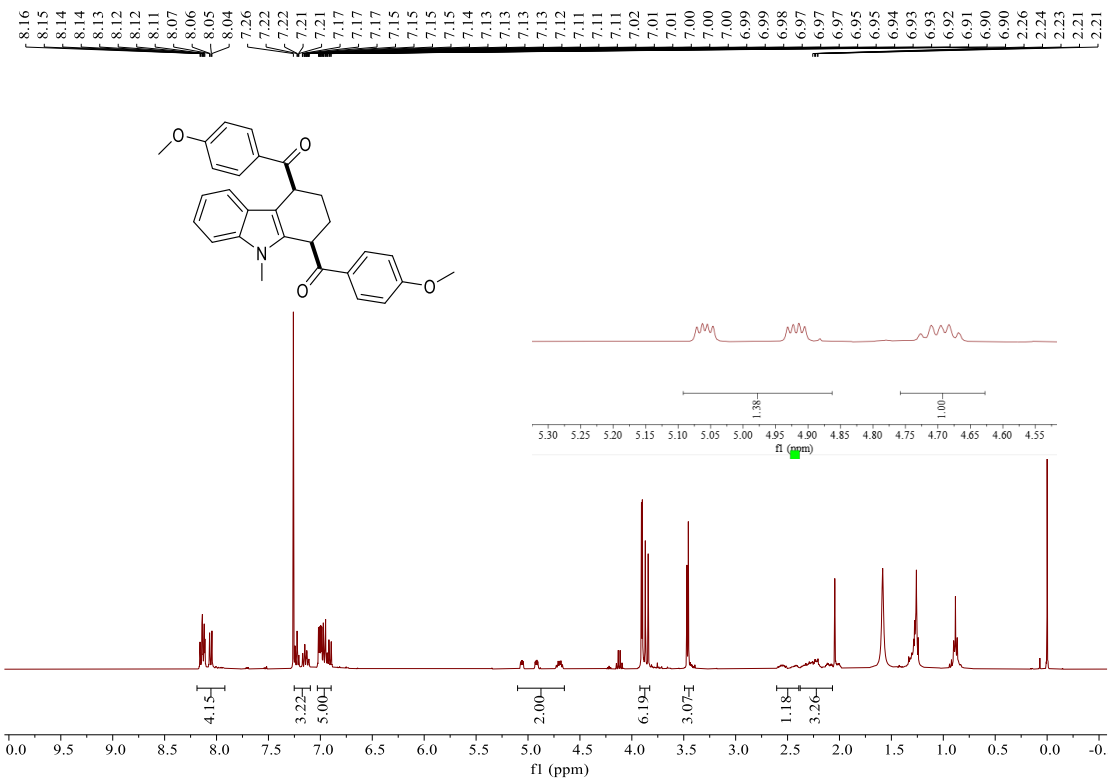
(4-methoxyphenyl)(9-methyl-2,3,4,9-tetrahydro-1*H*-carbazol-1-yl)methanone(7d)



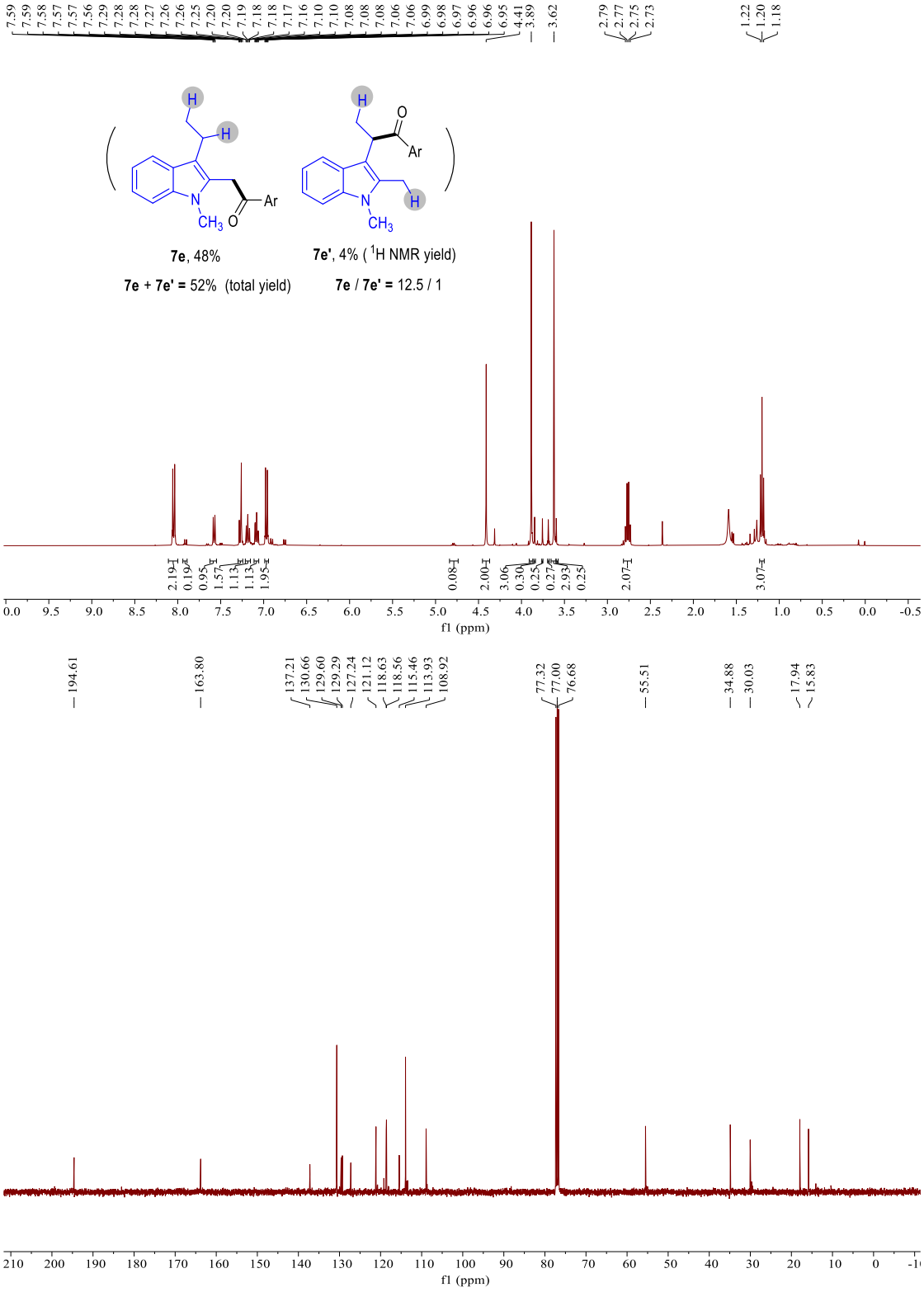
(4-methoxyphenyl)(9-methyl-2,3,4,9-tetrahydro-1*H*-carbazol-4-yl)methanone(7d')



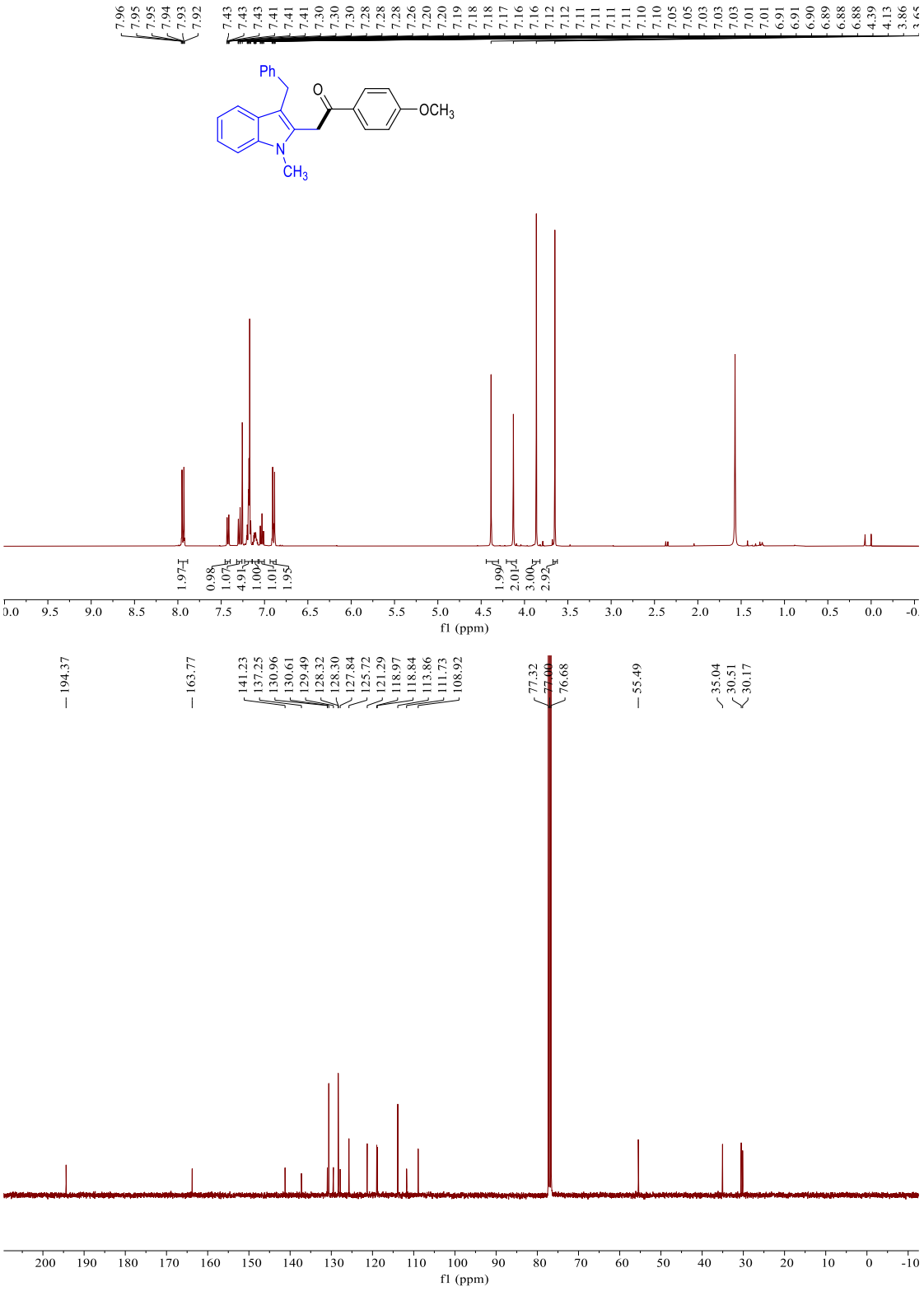
(9-methyl-2,3,4,9-tetrahydro-1H-carbazole-1,4-diyl)bis((4-methoxyphenyl)methanone) (7d")

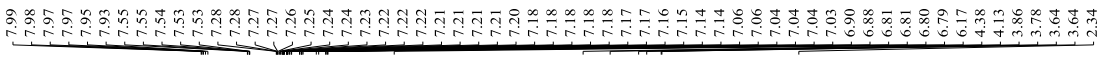


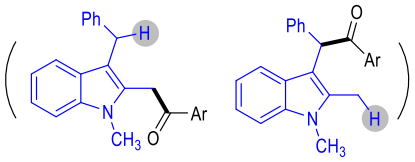
2-(3-ethyl-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7e) (Ar = 4-$OCH_3C_6H_4$)



2-(3-benzyl-1-methyl-1*H*-indol-2-yl)-1-(4-methoxyphenyl)ethan-1-one(7f)





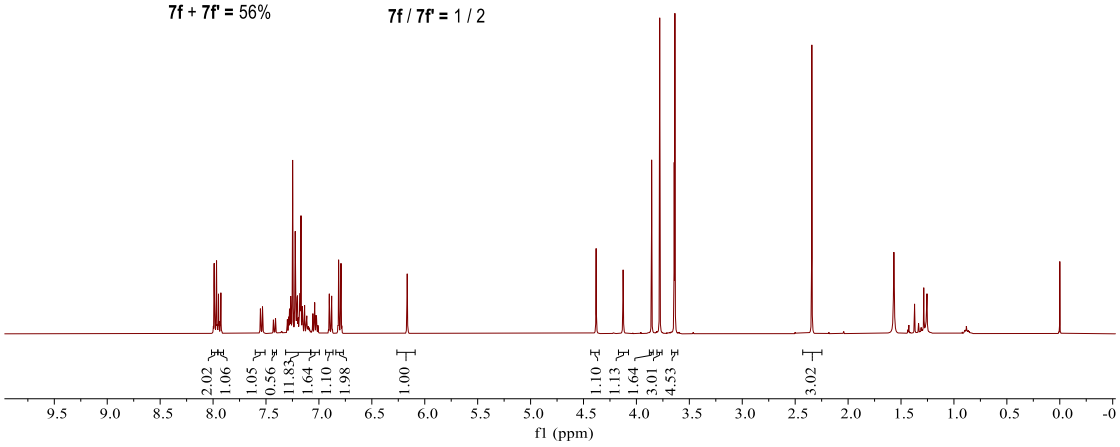


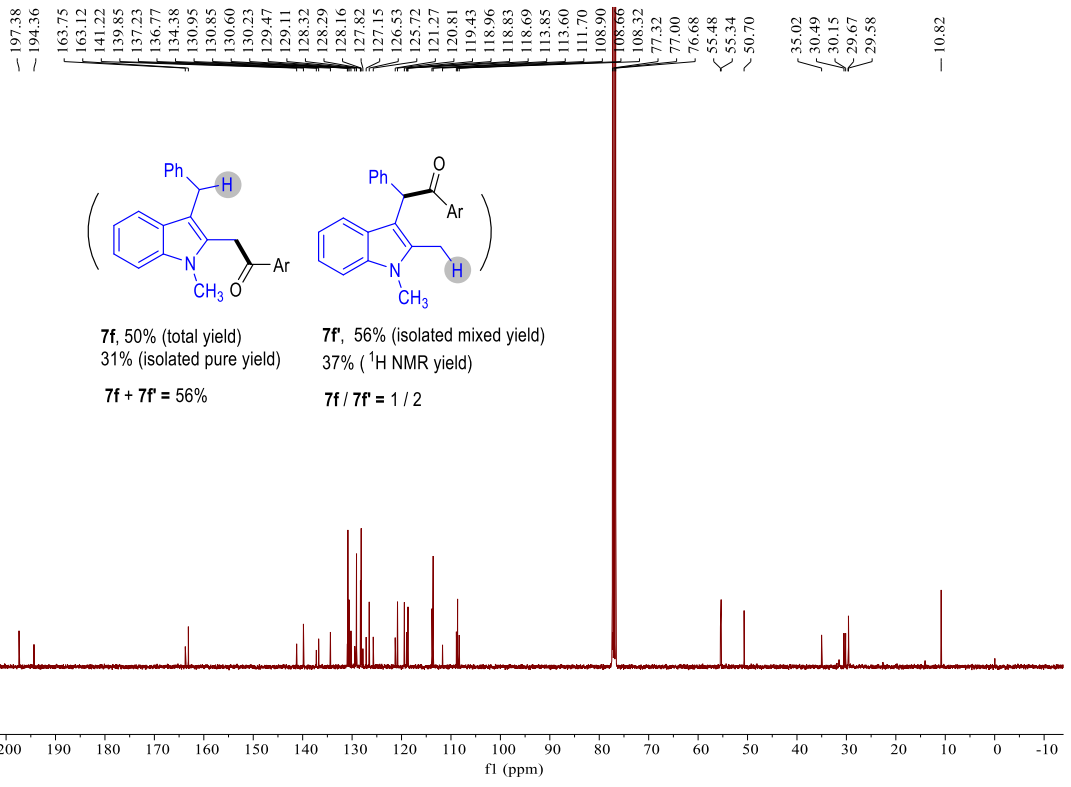
7f, 50% (total yield)
31% (isolated pure yield)

7f + **7f'** = 56%

7f', 56% (isolated mixed yield)
37% (^{1}H NMR yield)

7f / **7f'** = 1 / 2





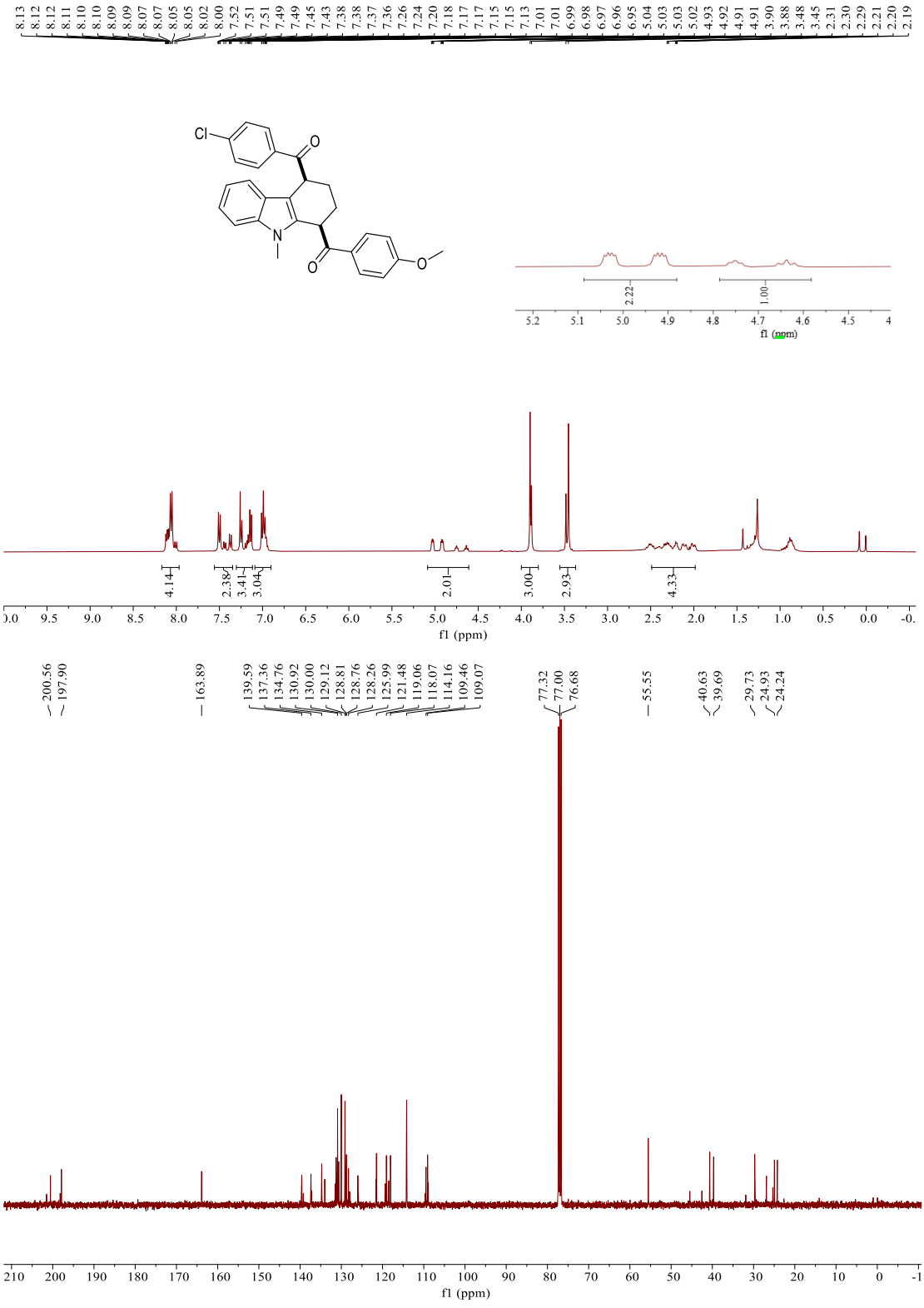
7f, 50% (total yield)
31% (isolated pure yield)

7f + **7f'** = 56%

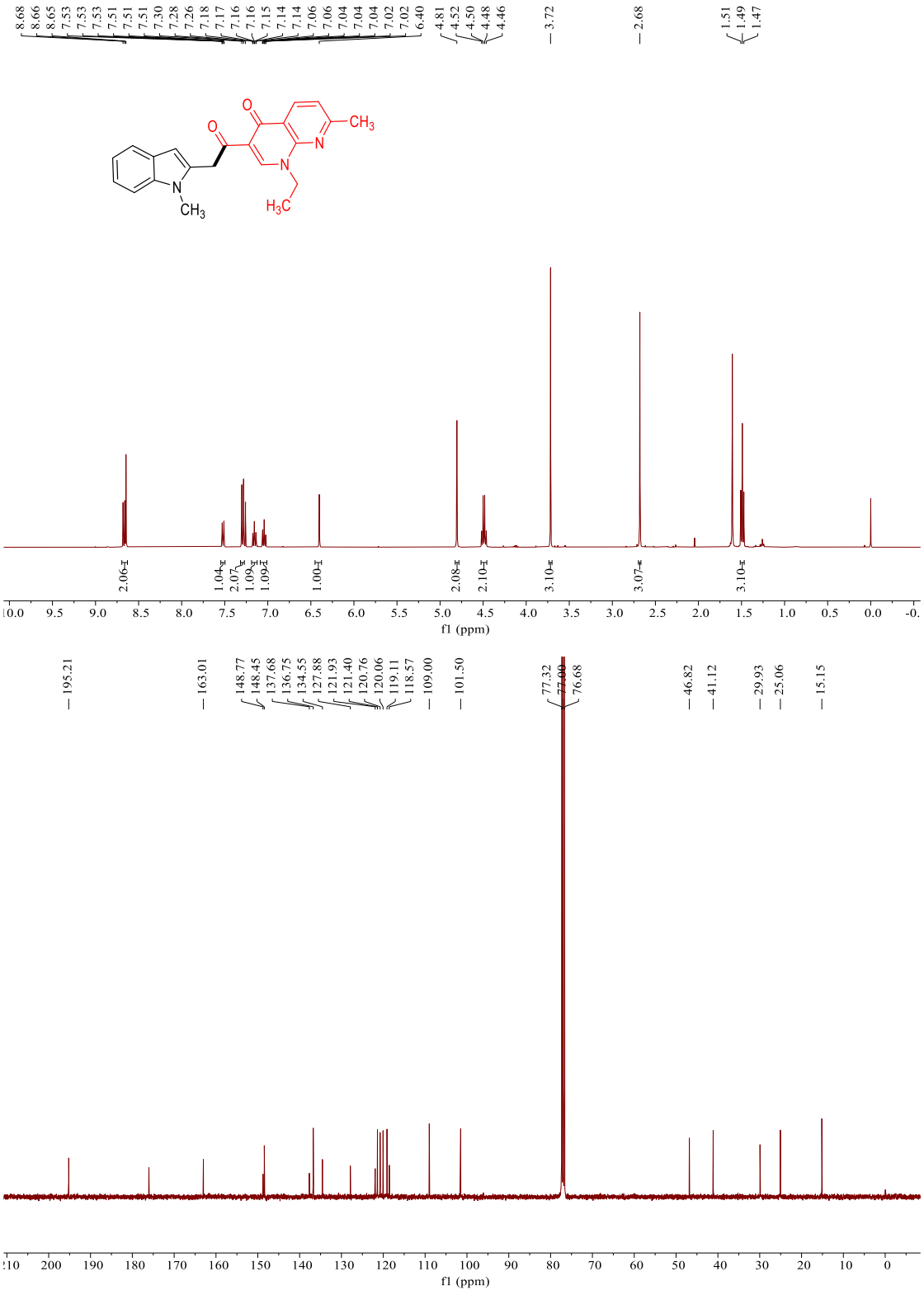
7f', 56% (isolated mixed yield)
37% (^{1}H NMR yield)

7f / **7f'** = 1 / 2

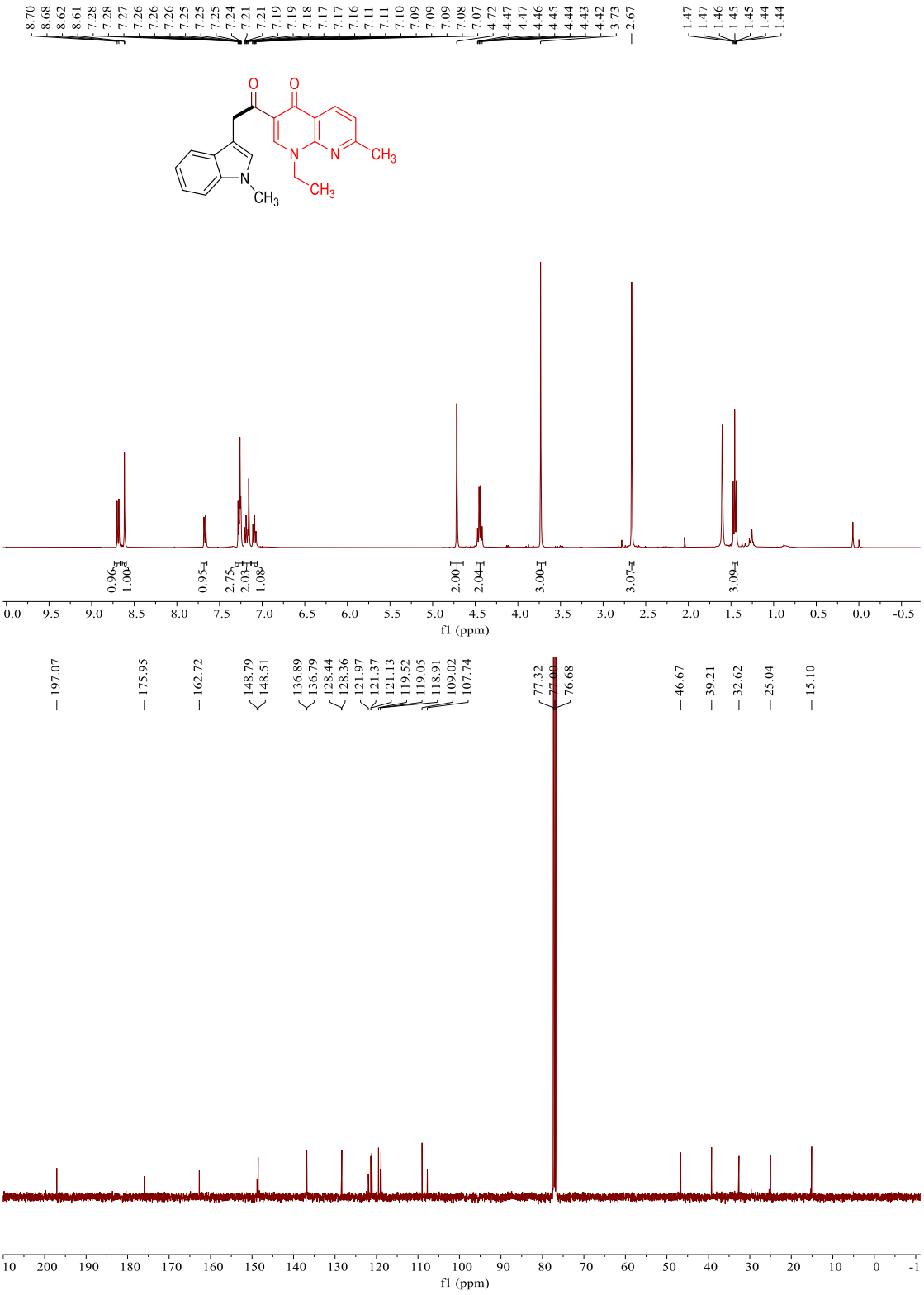
(4-(4-chlorobenzoyl)-9-methyl-2,3,4,9-tetrahydro-1H-carbazol-1-yl)(4-methoxyphenyl)methanone(8)



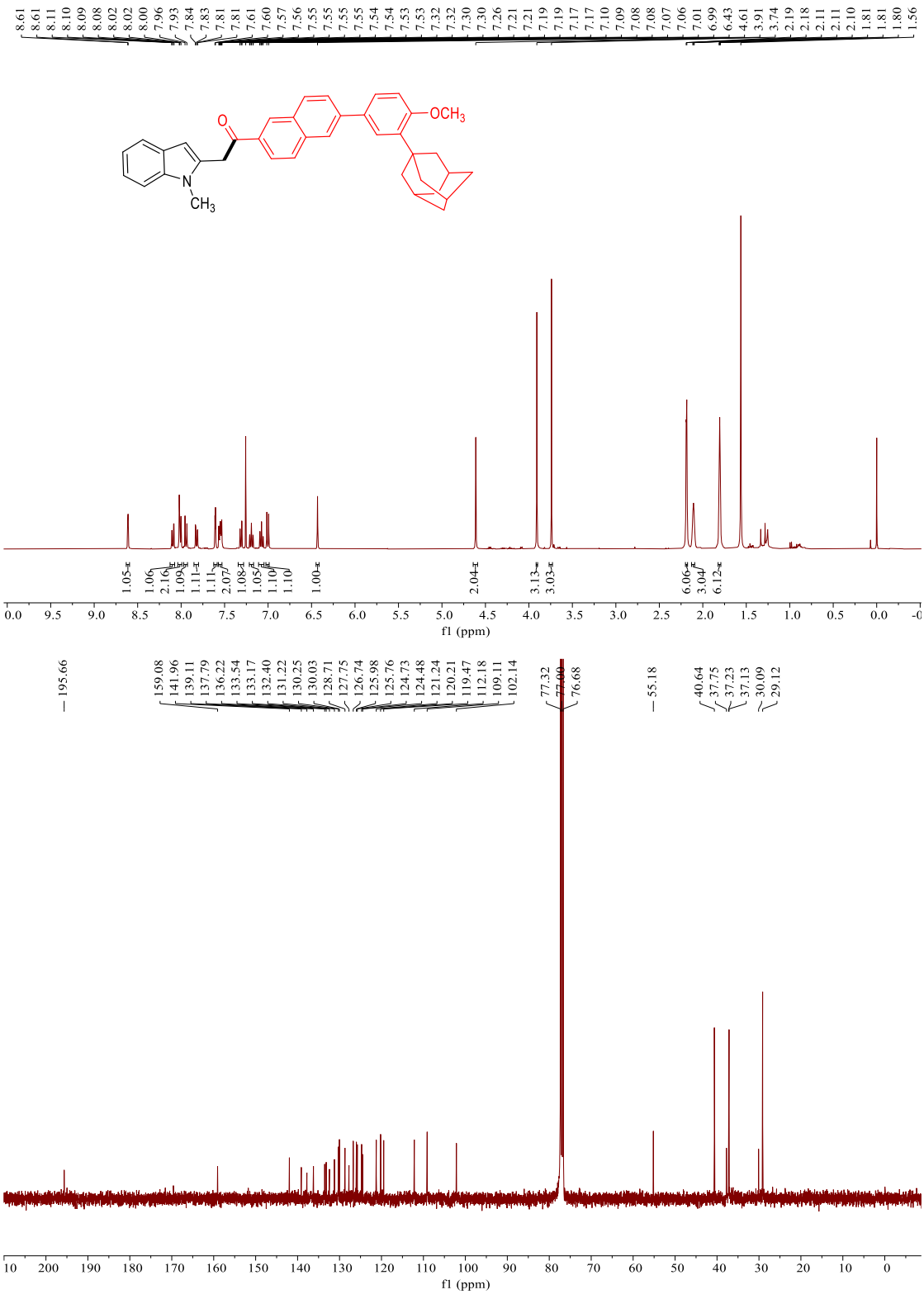
1-ethyl-7-methyl-3-(2-(1-methyl-1*H*-indol-2-yl)acetyl)-1,8-naphthyridin-4(1*H*)-one(9a)



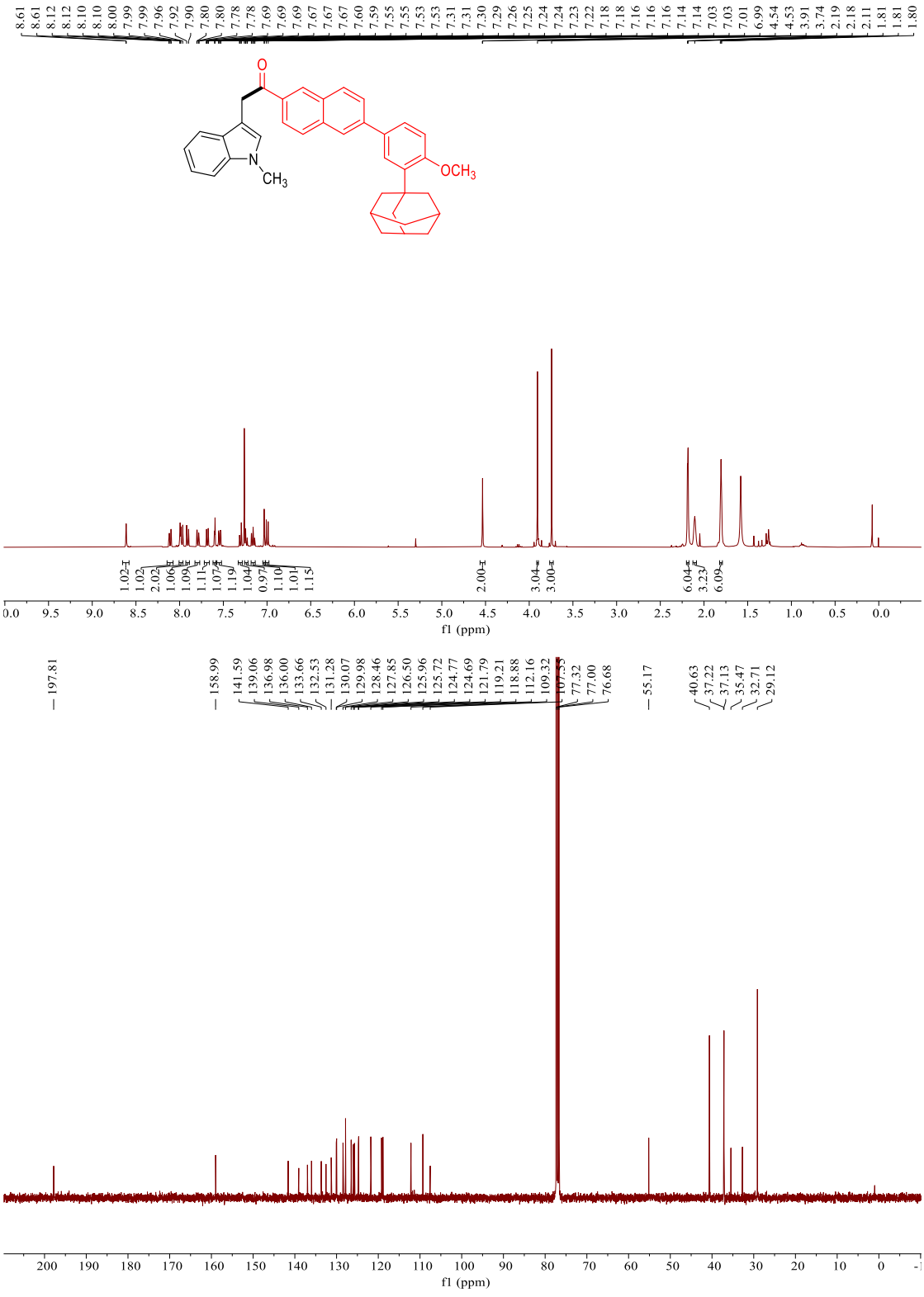
1-ethyl-7-methyl-3-(2-(1-methyl-1*H*-indol-3-yl)acetyl)-1,8-naphthyridin-4(1*H*)-one(9b)



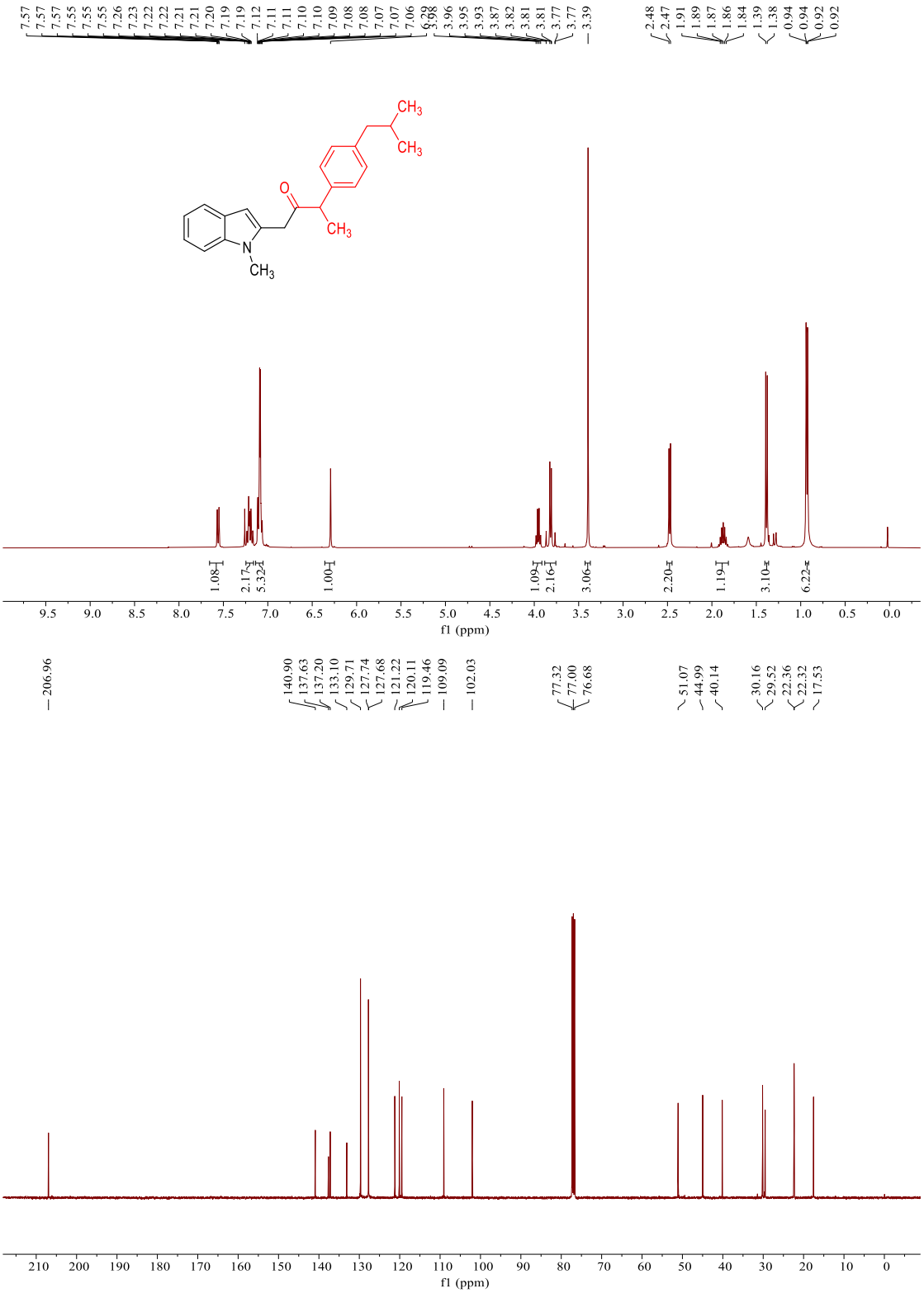
1-(6-(3-((3*r*,5*r*,7*r*)-adamantan-1-yl)-4-methoxyphenyl)naphthalen-2-yl)-2-(1-methyl-1*H*-indol-2-yl)ethan-1-one(9c)



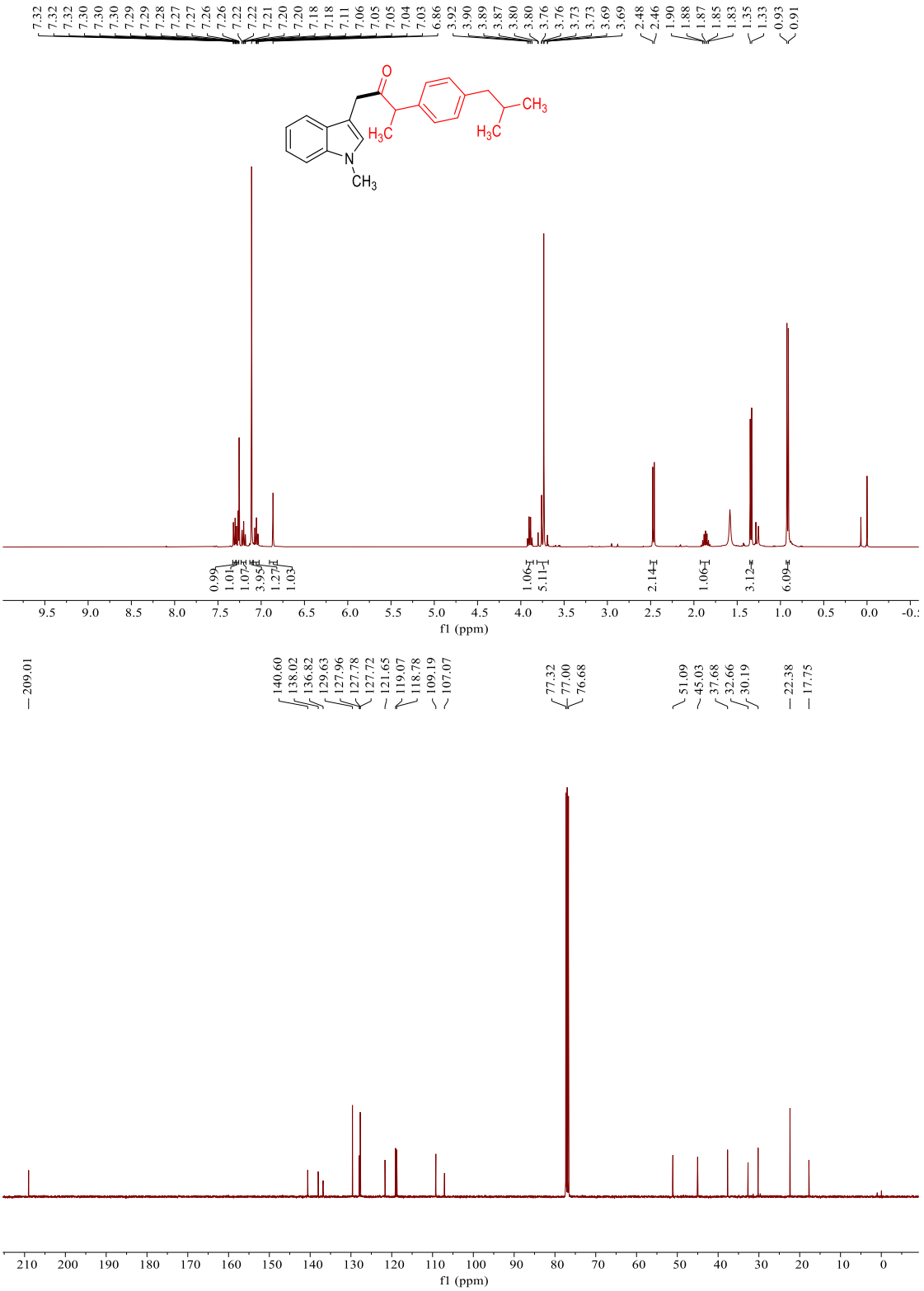
1-(6-(3-((3*r*,5*r*,7*r*)-adamantan-1-yl)-4-methoxyphenyl)naphthalen-2-yl)-2-(1-methyl-1*H*-indol-3-yl)ethan-1-one(9d)



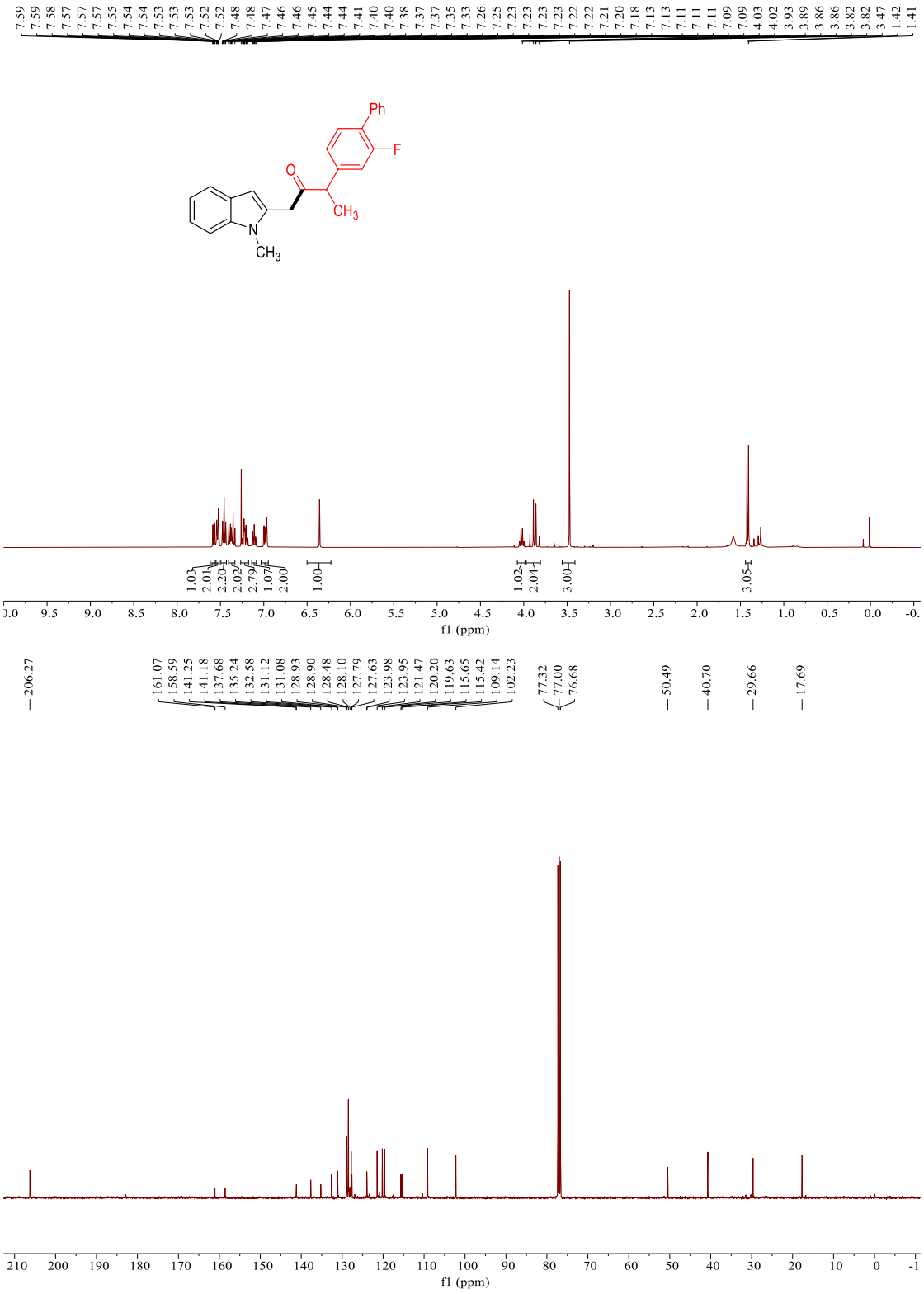
3-(4-isobutylphenyl)-1-(1-methyl-1*H*-indol-2-yl)butan-2-one(9e)

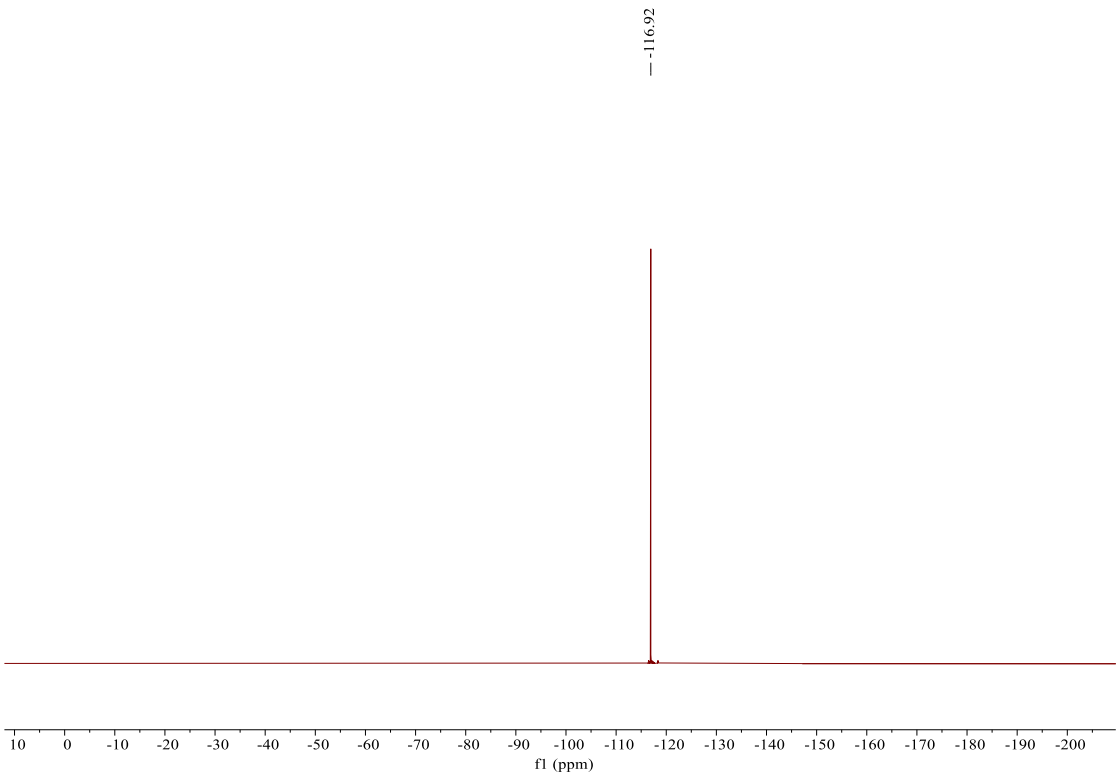


3-(4-isobutylphenyl)-1-(1-methyl-1*H*-indol-3-yl)butan-2-one(9f)

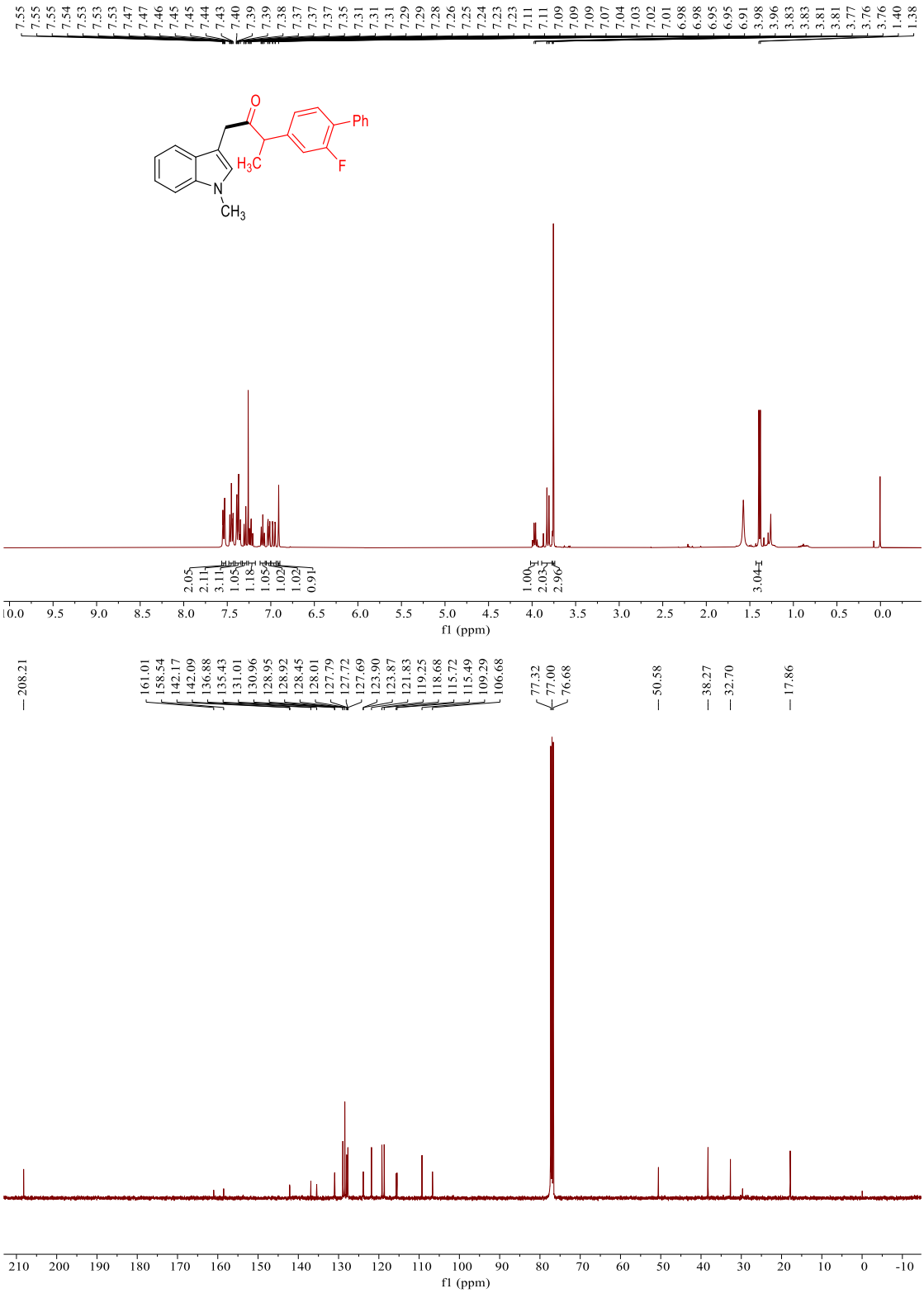


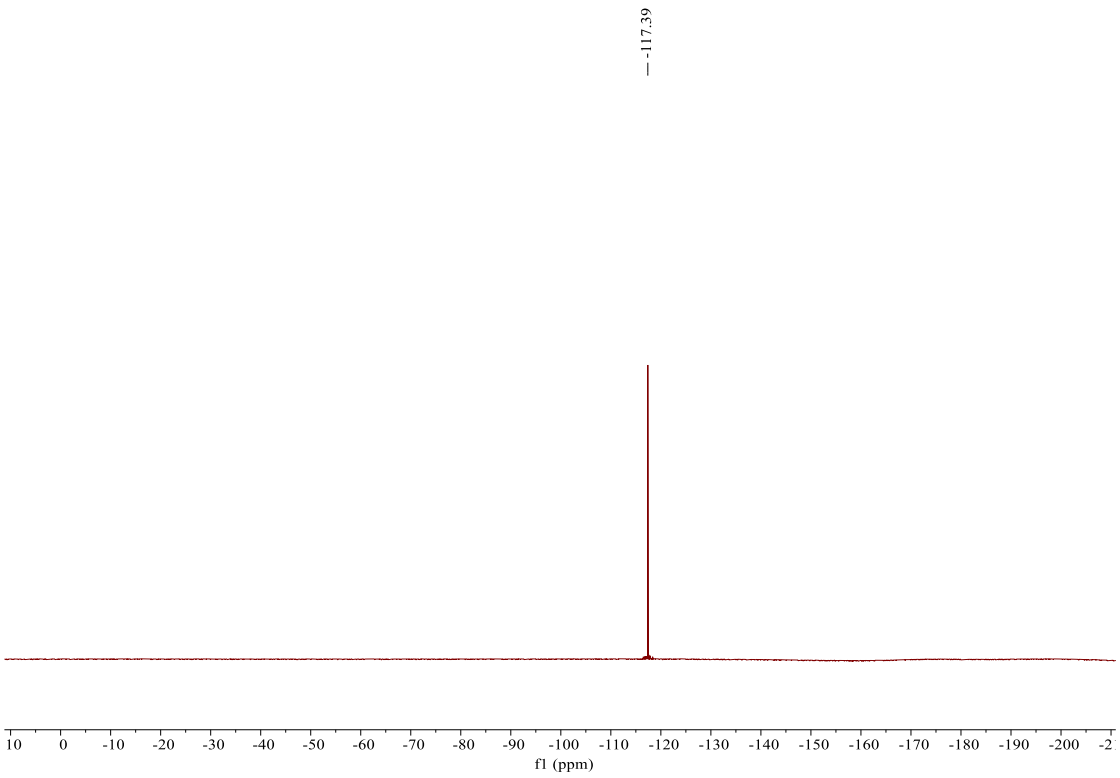
3-(2-fluoro-[1,1'-biphenyl]-4-yl)-1-(1-methyl-1*H*-indol-2-yl)butan-2-one(9g)



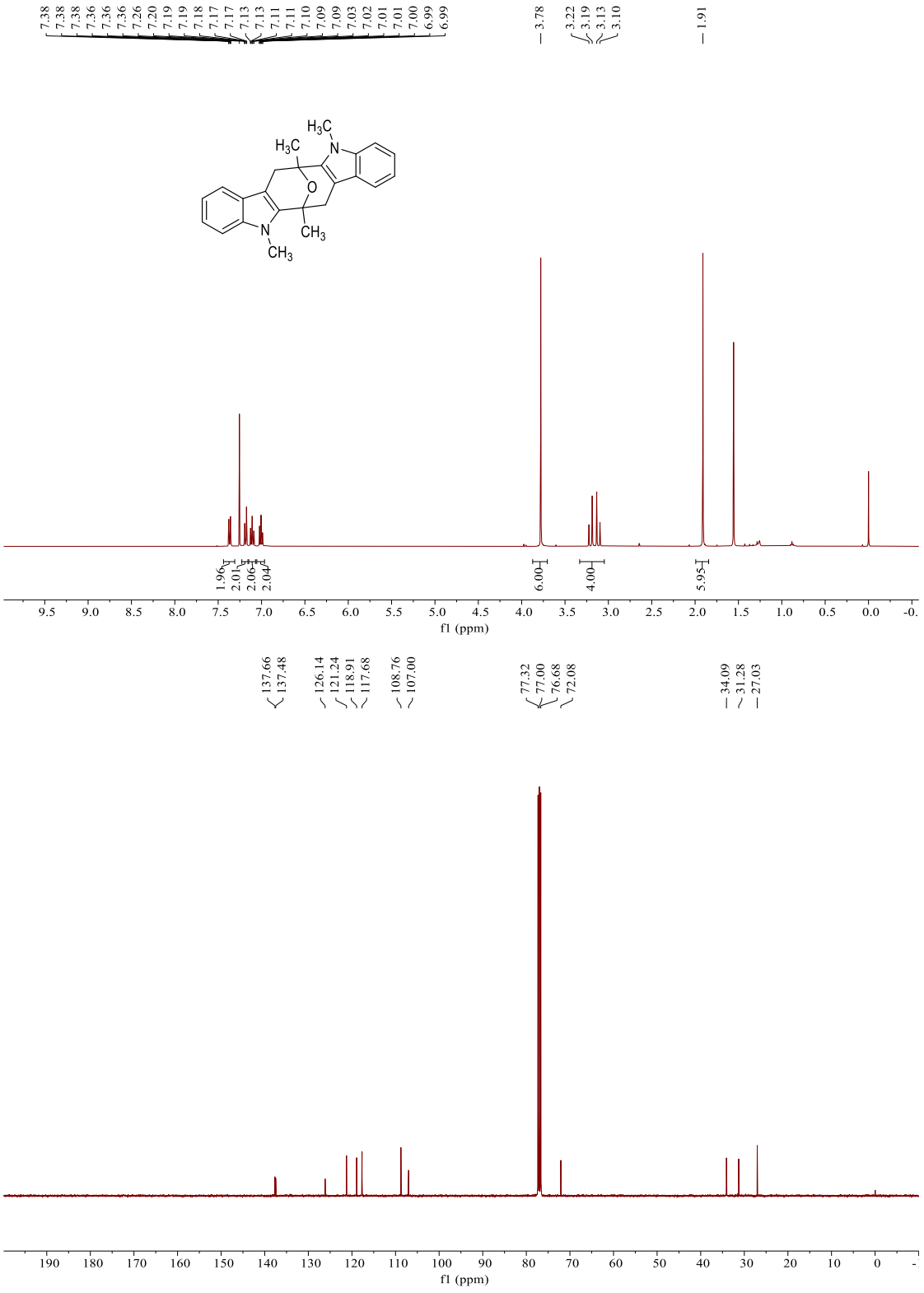

-116.92
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

3-(2-fluoro-[1,1'-biphenyl]-4-yl)-1-(1-methyl-1*H*-indol-3-yl)butan-2-one(9h)

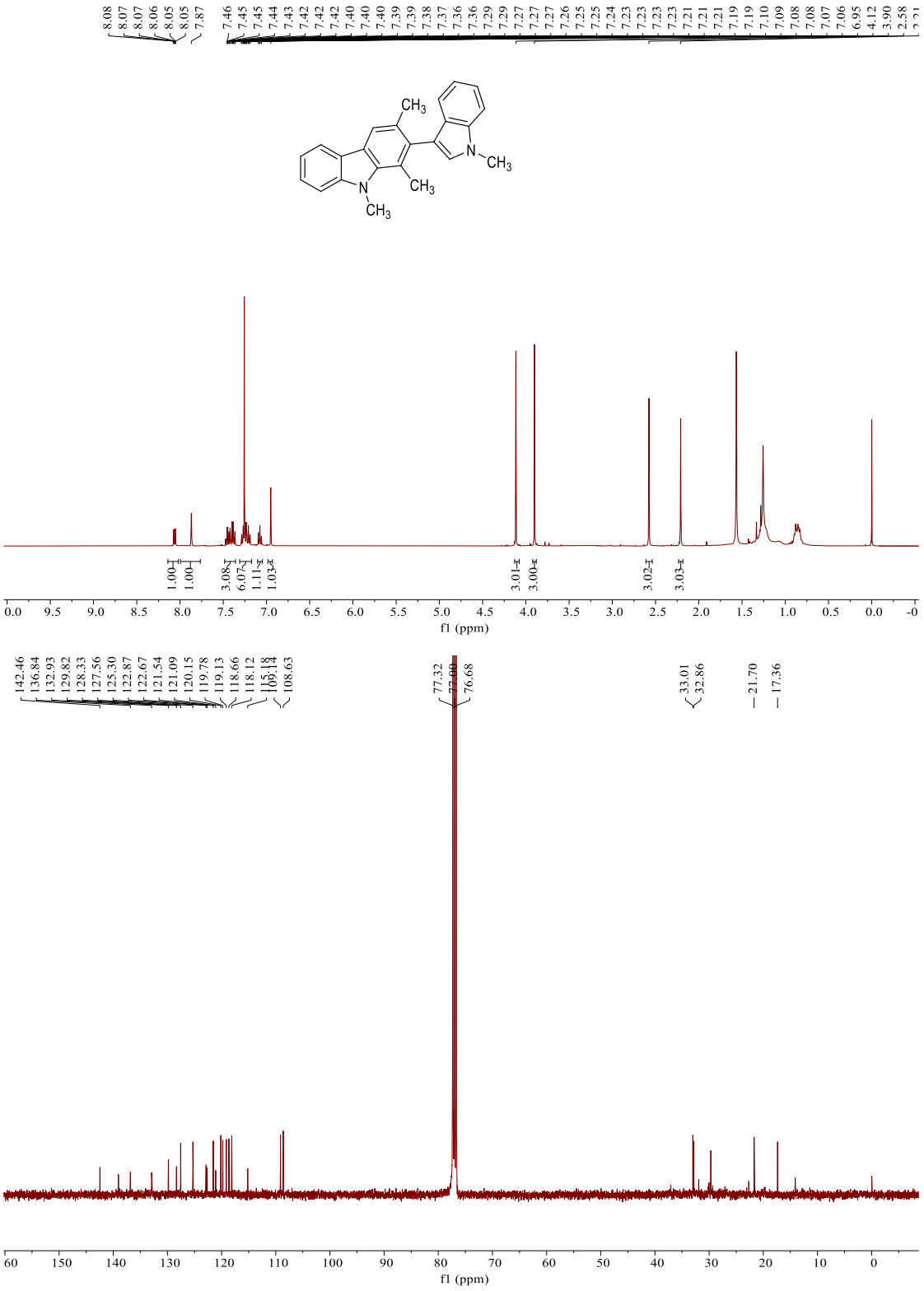



-117.39
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -2
f1 (ppm)

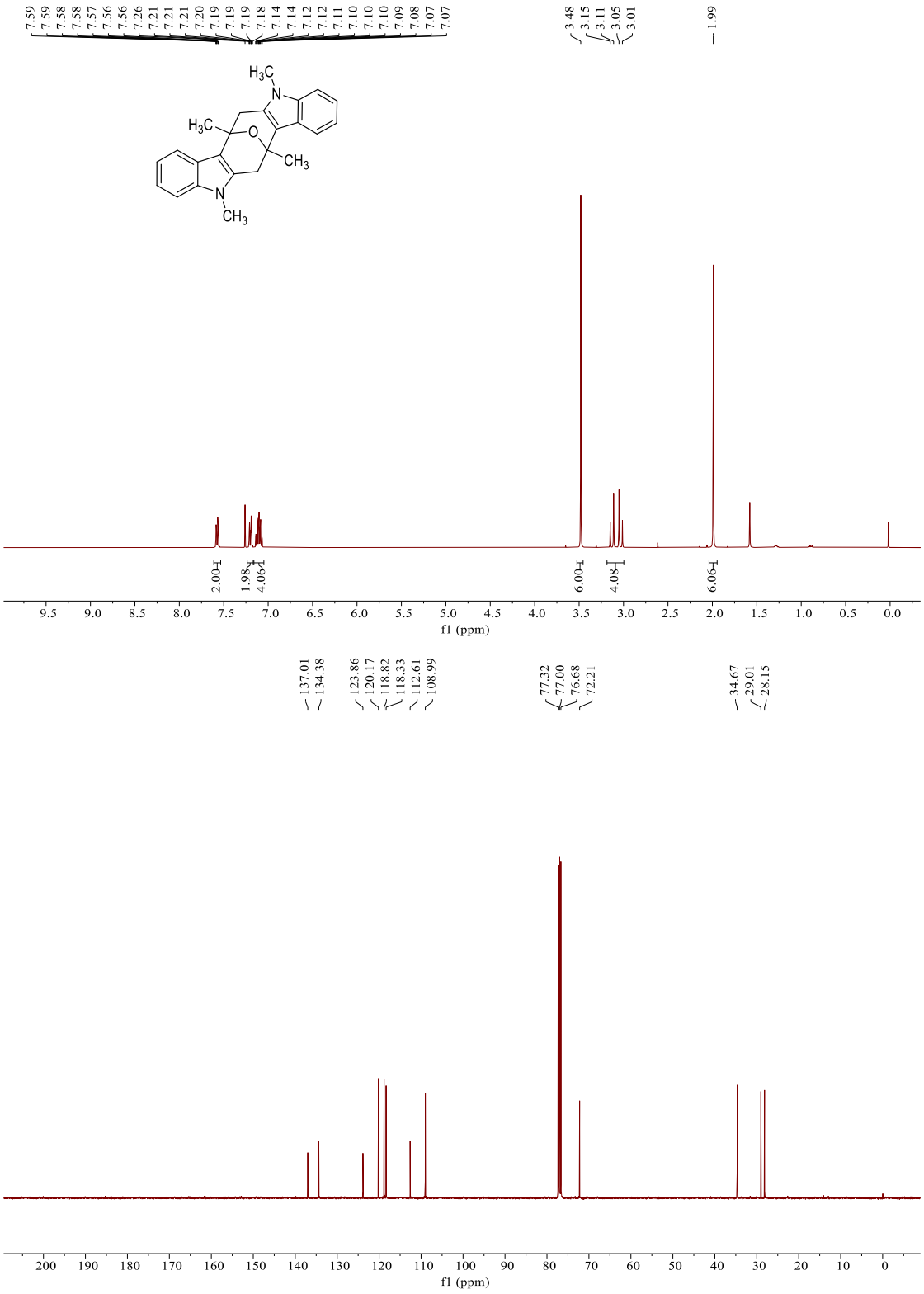
5,6,12,13-tetramethyl-5,6,7,12,13,14-hexahydro-6,13-epoxycycloocta[1,2-*b*:5,6-*b*']diindole(10)



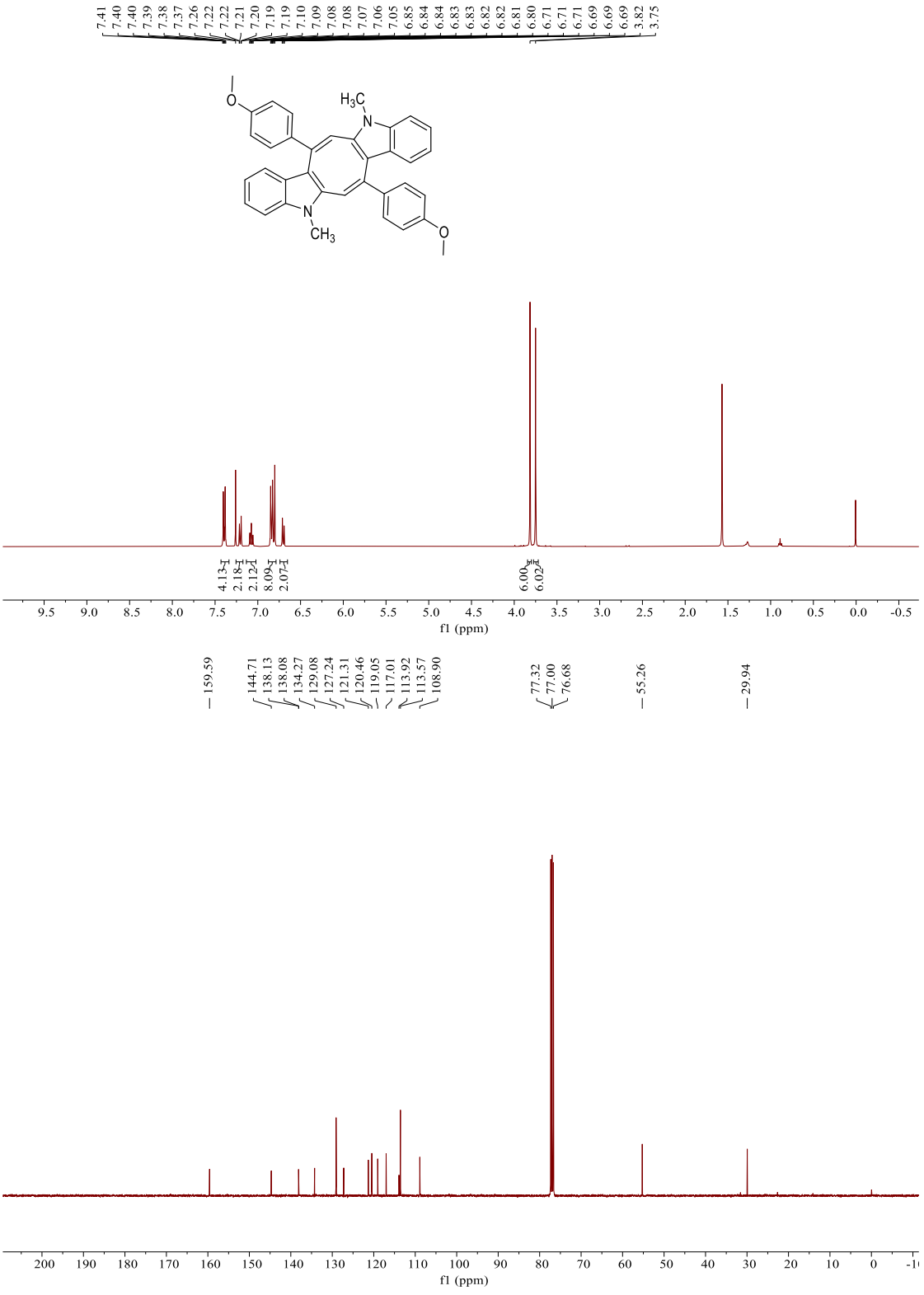
1,3,9-trimethyl-2-(1-methyl-1*H*-indol-3-yl)-9*H*-carbazole(11)



5,7,12,14-tetramethyl-5,6,7,12,13,14-hexahydro-7,14-epoxycycloocta[1,2-*b*:5,6-*b*']diindole(12)



(6*Z*,13*Z*)-7,14-bis(4-methoxyphenyl)-5,12-dimethyl-5,12-dihydrocycloocta[1,2-*b*:5,6-*b*']diindole(13)



2,2,6,6-tetramethylpiperidin-1-yl 4-methoxybenzoate(14)