Supplementary Information

Combinatorial Synthesis of Substituted Pyrazolo-Fused Quinazolines by the Rh(III)-Catalyzed [5+1] Annulation of Phenyl-1H-pyrazol-5-amine with Alkynoates and Alkynamide

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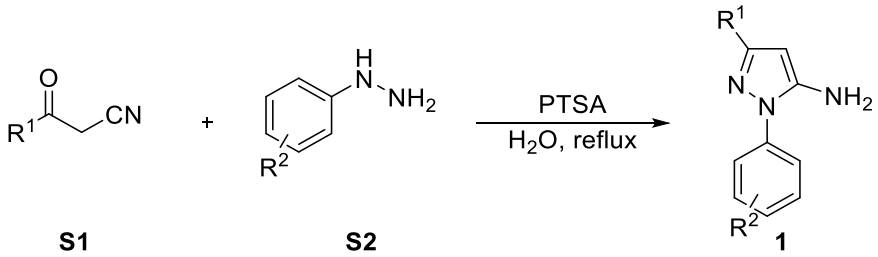
1. General Information

All reactions were carried out in oven-dried round bottoms. All other chemicals were also purchased from Sigma-Aldrich and TCI and were used as received. All the solvents were distilled before use.

2. Analytical Methods

Analytical thin-layer chromatography (TLC) was performed using 0.25mm silica gel coated plates. Flash chromatography was performed using the indicated solvent and silica gel 60 (230-400 mesh). ^{1}H NMR and ^{13}C NMR spectra were recorded on 400 MHz spectrometers. Chemical shifts are reported in parts per million (ppm) on the δ scale from an internal standard (TMS). High resolution mass spectra (HRMS) were recorded in ESI mode using TOF mass spectrometer.

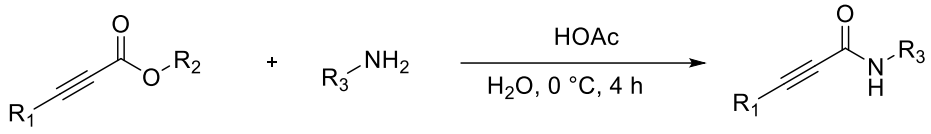
3. General procedure for synthesis of 1



S1 **S2** **1**

A round bottom flask was charged with *β*-ketonitrile (1 equiv.), aryl hydrazine (1.1 equiv.) and PTSA (0.1 equiv.) in water, which was heated at 105 °C for 3-6 h. The reaction was monitored by TLC. After disappearance of the starting material, the reaction mixture was then cooled to room temperature and was extracted with ethyl acetate trice. The combined organic layer was washed with brine solution, dried over anhydrous $MgSO_4$, then the residue was separated by silica gel chromatography using 20% ethyl acetate in hexane as eluent (Rf = 0.18) to obtain the desired 5-amino-4-arylpyrazoles in 72-90% yield.

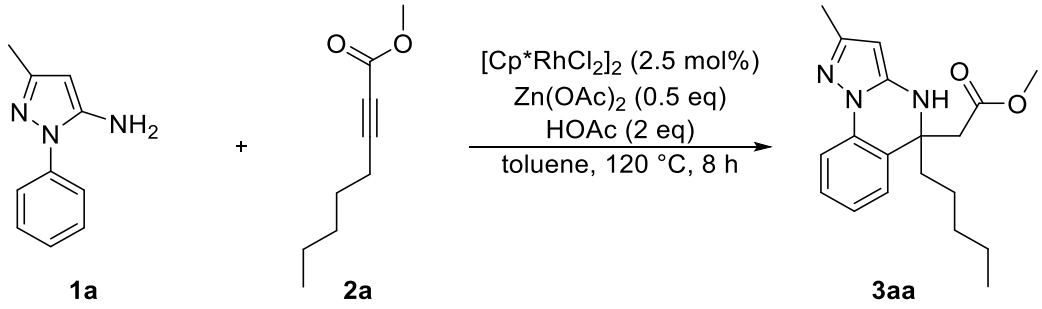
4. General procedure for synthesis of 2



S3 **S4** **2**

To a solution of alkyl amine **S4** (1.2 equiv.) in 5 mL, alkynyl ester **S3** (1 equiv.) was added dropwise at 0 ◦C for 30 min. The mixture was stirred for 2 h at 0 ◦C, and then a few drops of acetic acid were added. The mixture was stirred for another 2h and saturated with NaCl, followed by extraction with ethyl acetate (3 × 10 mL), dried over $MgSO_4$, then the residue was separated by silica gel chromatography with hexane/ethyl acetate (1:1, Rf = 0.3) to obtain the desired alkynyl amide **2** in 66-78% yield.

5. General procedure for synthesis of 3aa

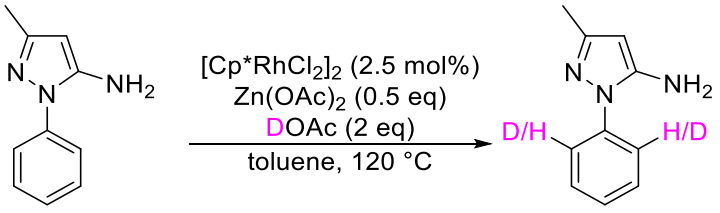


1a **2a** **3aa**

To an oven-dried 25 mL round bottom equipped with magnetic stir bar, **1a** (200 mg, 1.16 mmol), methyl oct-2-ynoate **2a** (232 mg, 1.5 mmol), $[Cp^*RhCl_2]_2$ (17 mg, 2.5 mol%), $Zn(OAc)_2$ (106 mg, 0.58 mmol) and HOAc (139 mg, 2.32 mmol) in toluene (6.0 mL) was stirred in 120 °C oil bath for 8 h under air atmosphere. After removal of the solvent under reduced pressure, purification was performed by flash column chromatography on silica gel with hexane/ethyl acetate (3:1, Rf = 0.25) as eluent to afford corresponding products.

6. Mechanism Experiments

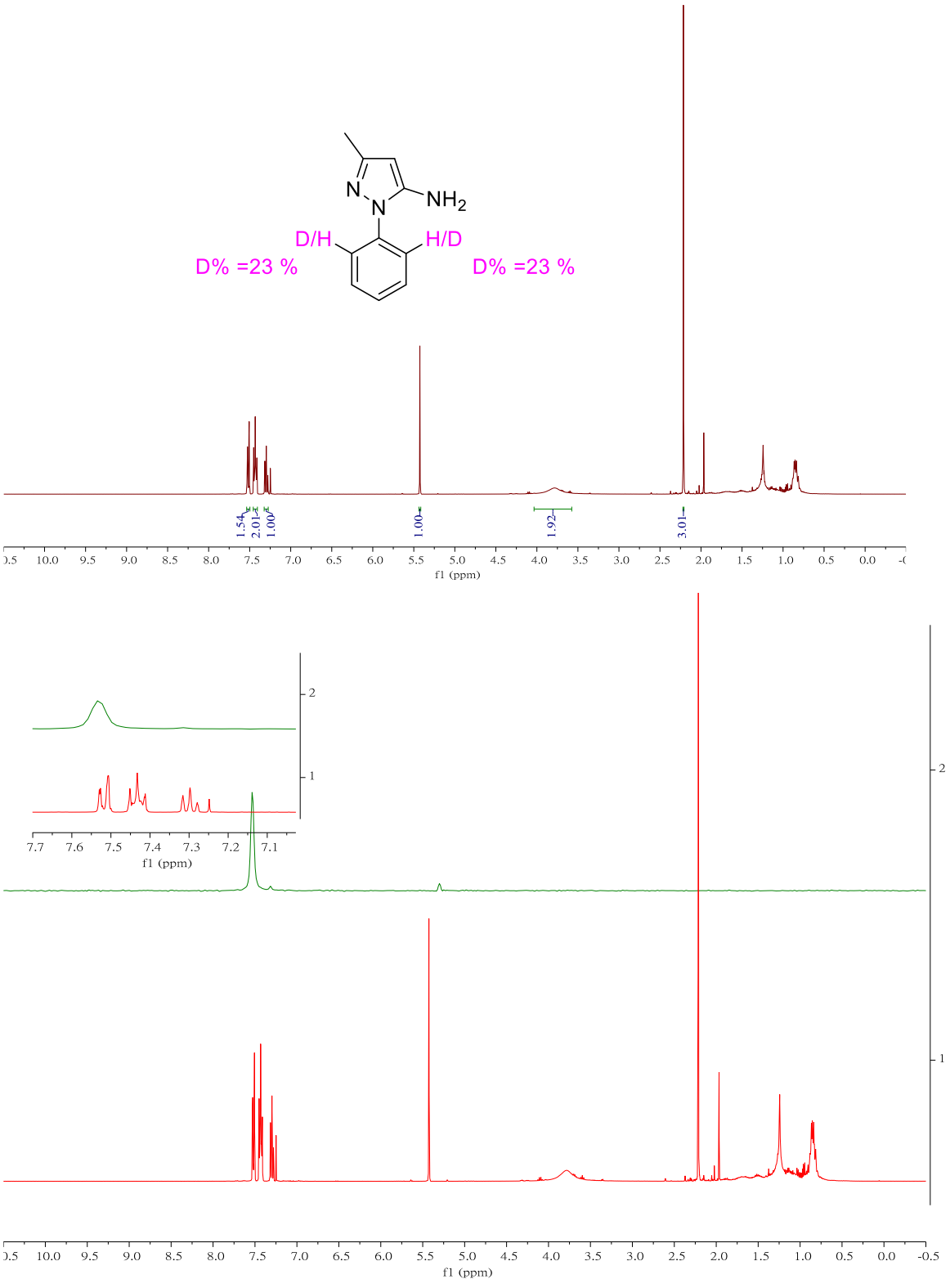
Deuterium exchange

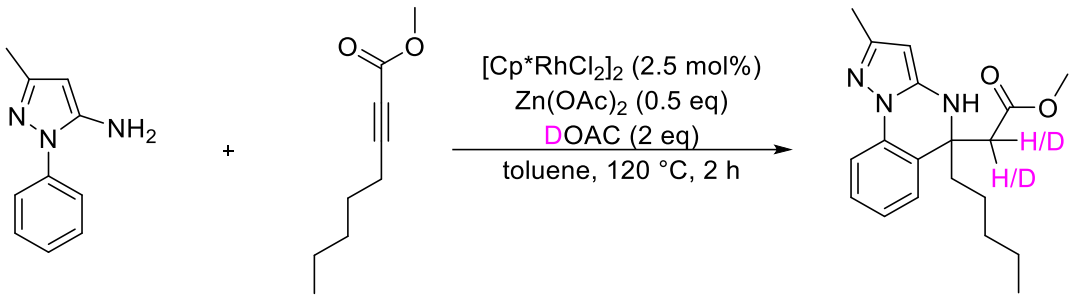


1a **1a-d_2**

(A) An oven-dried 25 mL round bottom is equipped with 3-methyl-1-phenyl-1H-pyrazol-5-amine **1a** (50 mg, 0.29 mmol.), $[Cp^*RhCl_2]_2$ (4.4 mg, 2.5 mol%), $Zn(OAc)_2$ (27 mg, 0.15 mmol) and DOAc (34 mg, 0.57 mmol) in toluene (2 mL). The reaction mixture was stirred in 120 °C oil bath for 30 mins. The solvent was evaporated and the crude product obtained was purified

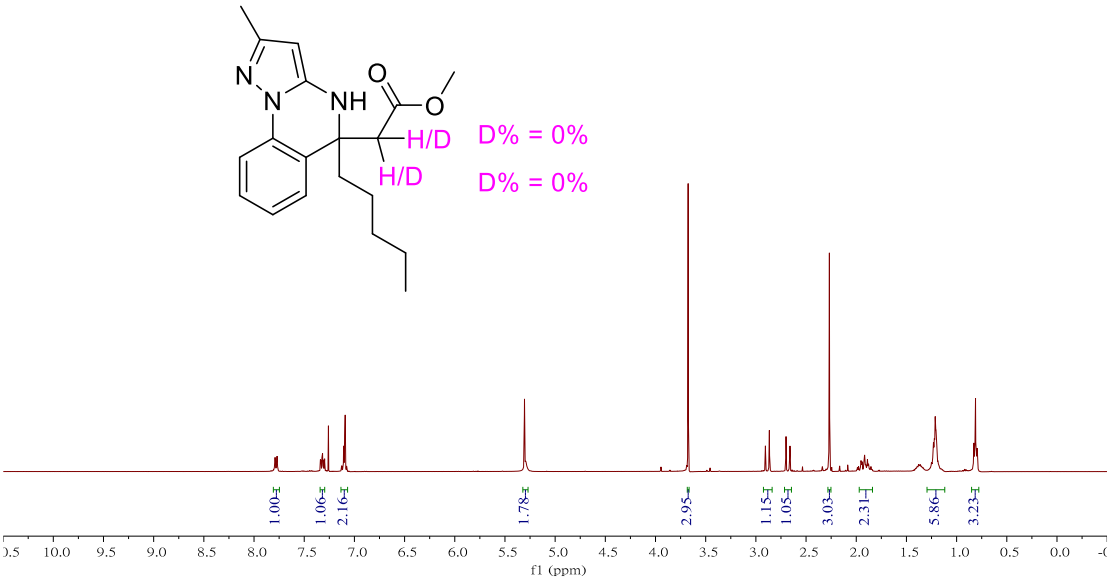
by silica gel column chromatography with hexane/ethyl acetate (1:3, Rf = 0.22). The H/D exchange was found to be 23 % at the protons attached to C-2′ and C-6′ in the recovered **1a-*d*$_2$**.



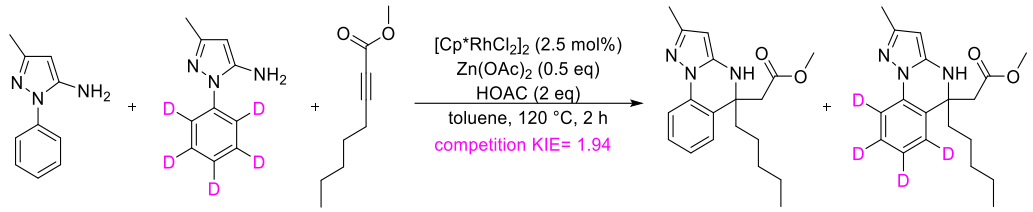


1a **2a** **3aa-d_2**

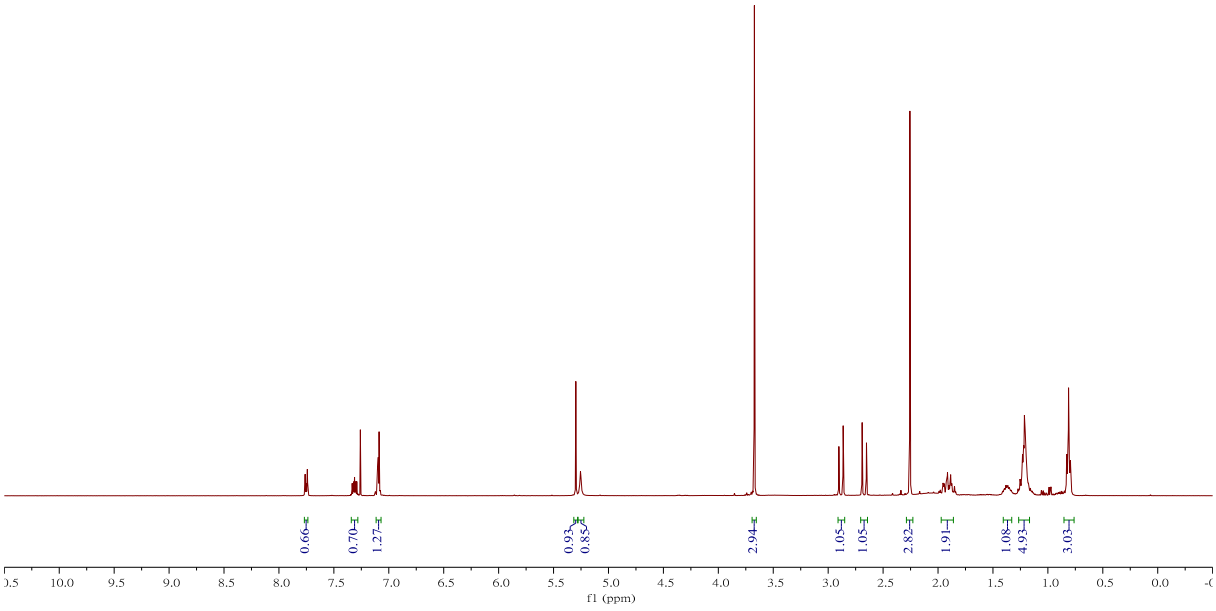
(B) An oven-dried 25 mL round bottom is equipped with 3-methyl-1-phenyl-1H-pyrazol-5-amine **1a** (50 mg, 0.29 mmol), methyl oct-2-ynoate **2a** (52 mg, 0.34 mmol), $[Cp^*RhCl_2]_2$ (4.4 mg, 2.5 mol%), $Zn(OAc)_2$ (27 mg, 0.15 mmol) and DOAc (34 mg, 0.57 mmol) in toluene (2 mL). The reaction mixture was stirred in 120 °C oil bath for 30 mins. The solvent was evaporated and the crude product obtained was purified by silica gel column chromatography with hexane/ethyl acetate (1:3, Rf = 0.25). The H/D exchange was found to be 0 % at the alpha-carbon proton in the recovered **3aa-d_2**.

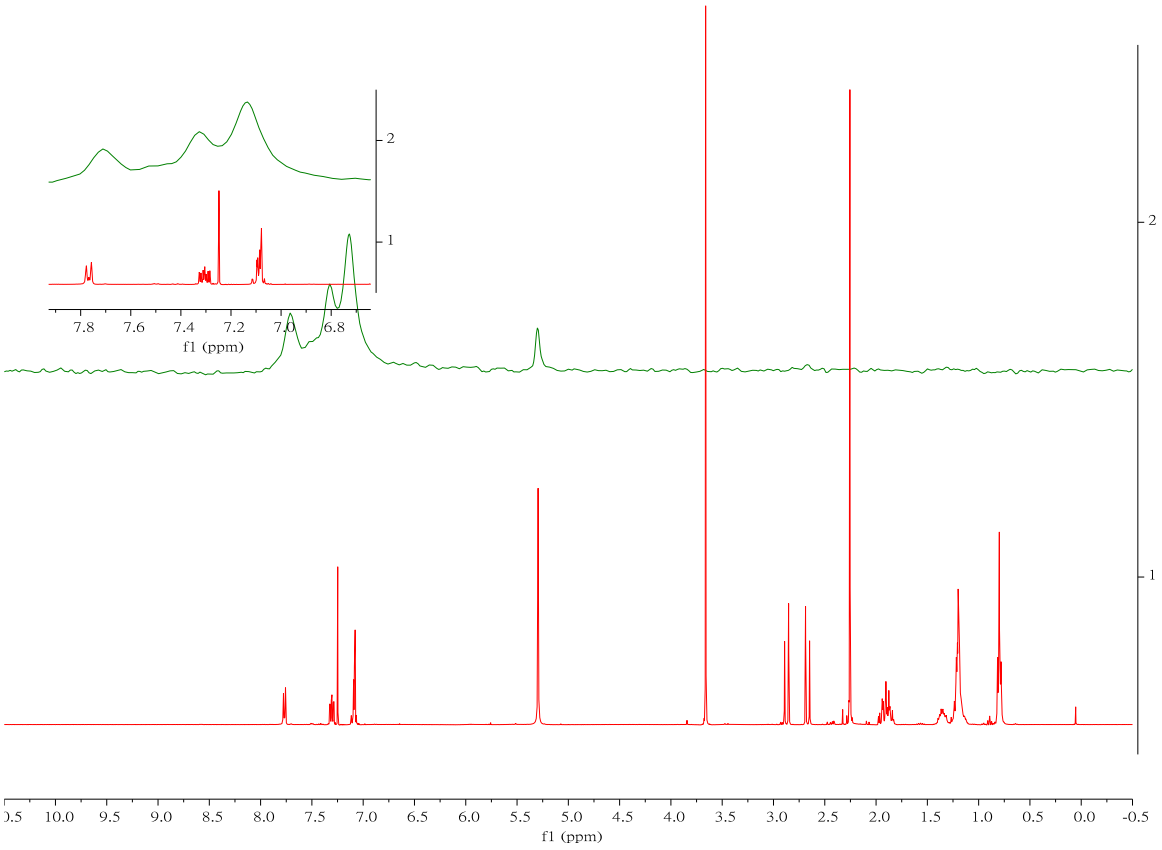


(2) Competition KIE study

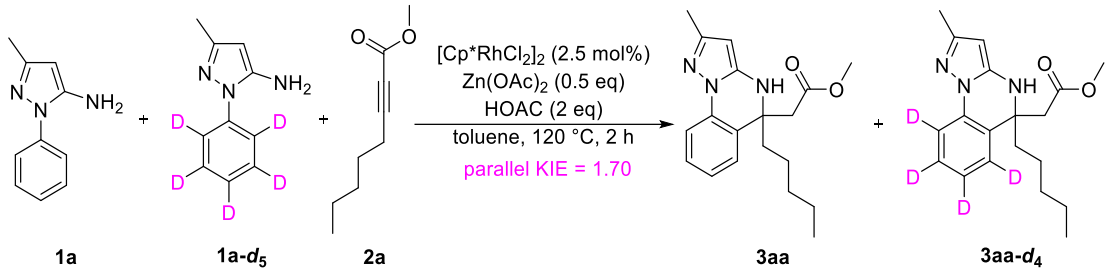


An oven-dried 25 mL round bottom containing **1a** (25 mg, 0.14 mmol) and **1a-*d*5** (25 mg, 0.14 mmol), methyl oct-2-ynoate **2a** (56.1 mg, 0.36 mmol), $[Cp^*RhCl_2]_2$ (4.4 mg, 2.5 mol%), $Zn(OAc)_2$ (26 mg, 0.14 mmol) and HOAc (34 mg, 0.57 mmol) in toluene (2 mL). The reaction mixture was stirred in 120 °C oil bath for 2 h under air atmosphere. After removal of the solvent under reduced pressure, purification was performed by flash column chromatography on silica gel with petroleum ether/ethyl acetate (3:1, Rf = 0.25) as eluent to afford the corresponding products. The KIE value was determined using ^{1}H NMR.

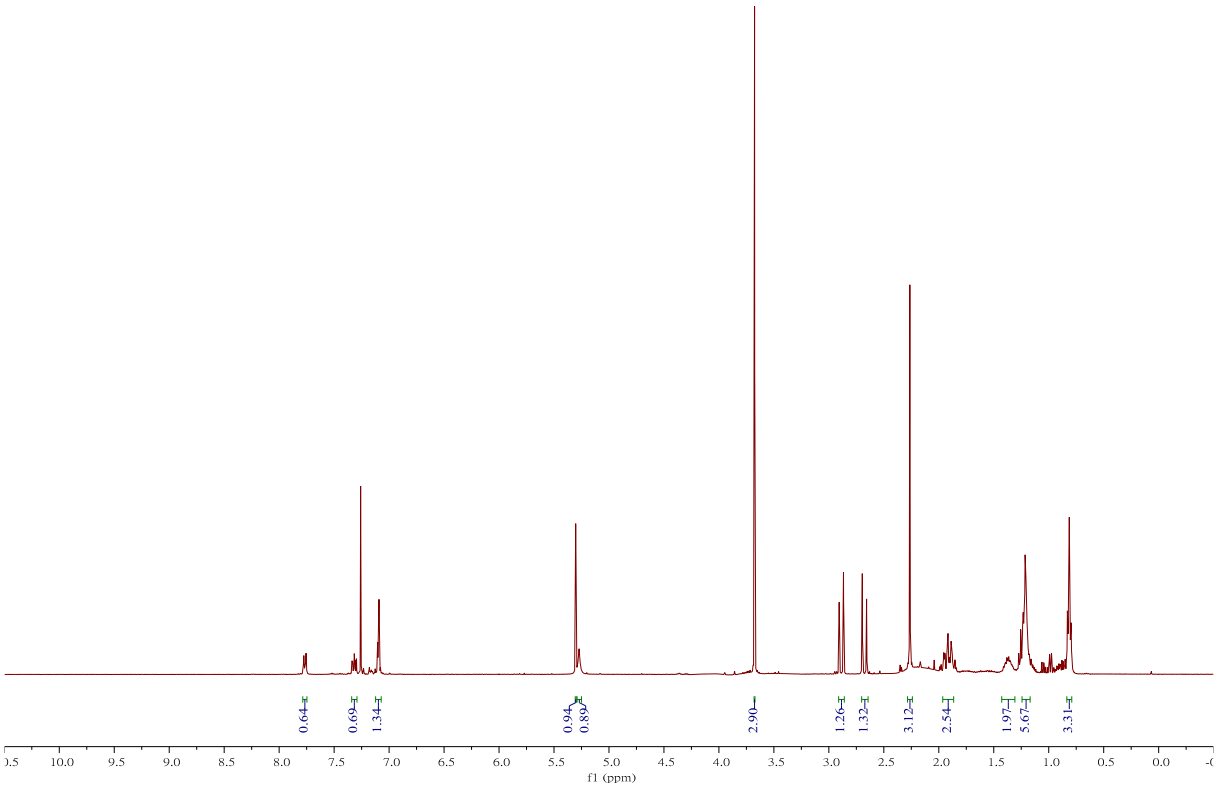




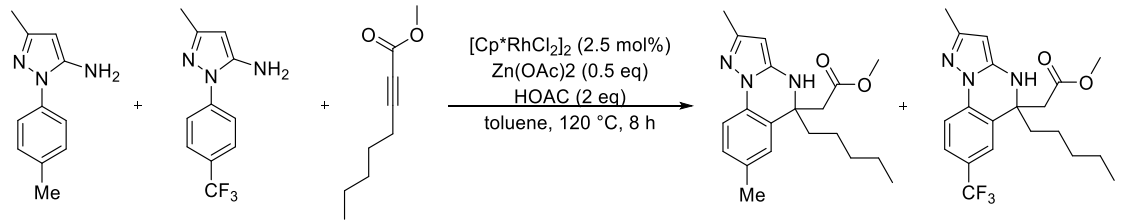
(3) Parallel KIE study



Two separated oven-dried 25 mL round bottom containing **1a** (25 mg, 0.14 mmol) or **1a-*d*$_5$** (25 mg, 0.14 mmol), methyl oct-2-ynoate **2a** (25 mg, 0.16 mmol), $[Cp^*RhCl_2]_2$ (2.2 mg, 2.5 mol%), $Zn(OAc)_2$ (13 mg, 0.07 mmol) and HOAc (18.6 mg, 0.31 mmol) in toluene (2 mL). The reaction mixture was stirred in 120 °C oil bath for 2 h under air atmosphere. Then the two separated reaction mixture was transferred to 25-mL round bottom flask and washed with CH_2Cl_2 (2 mL × 3). After removal of the solvent under reduced pressure, purification was performed by flash column chromatography on silica gel with petroleum ether/ethyl acetate (3:1, Rf = 0.25) as eluent to afford the corresponding products. The KIE value was determined using ^{1}H NMR.

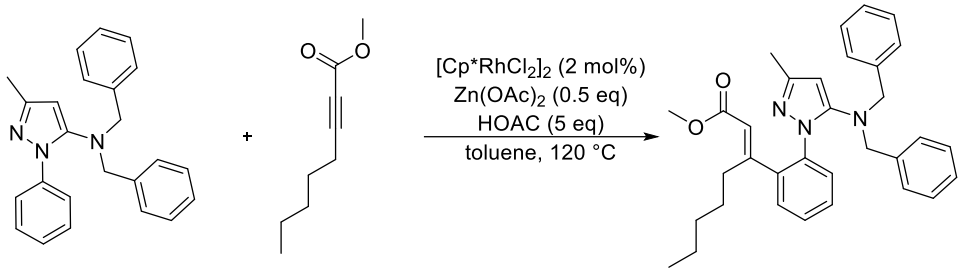


(4) Intermolecular competition experiments



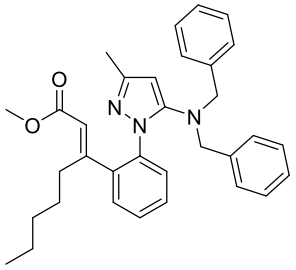
An oven-dried 25 mL round bottom containing **1h** (25 mg, 0.14 mmol) and **1j** (25 mg, 0.14 mmol), methyl oct-2-ynoate **2a** (56.1 mg, 0.18 mmol), $[Cp^*RhCl_2]_2$ (4.4 mg, 2.5 mol%), $Zn(OAc)_2$ (26 mg, 0.14 mmol) and HOAc (17 mg, 0.28 mmol) in toluene (2 mL). The reaction mixture was stirred in 120 °C oil bath for 8 h under air atmosphere. After removal of the solvent under reduced pressure, purification was performed by flash column chromatography on silica gel with petroleum ether/ethyl acetate (3:1, Rf = 0.25) as eluent to afford the **3ha** and **3ja** in 42% and 31% yields respectively.

(5) The synthesis of **6aa**

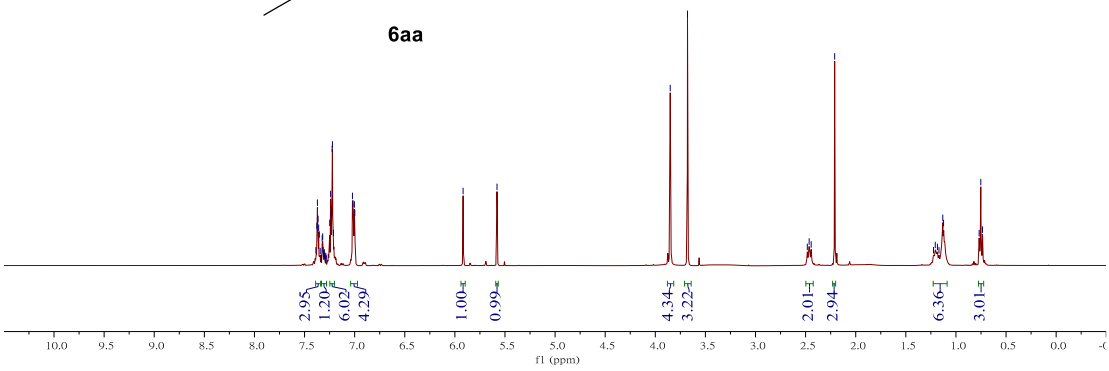


5a **2a** **6aa**

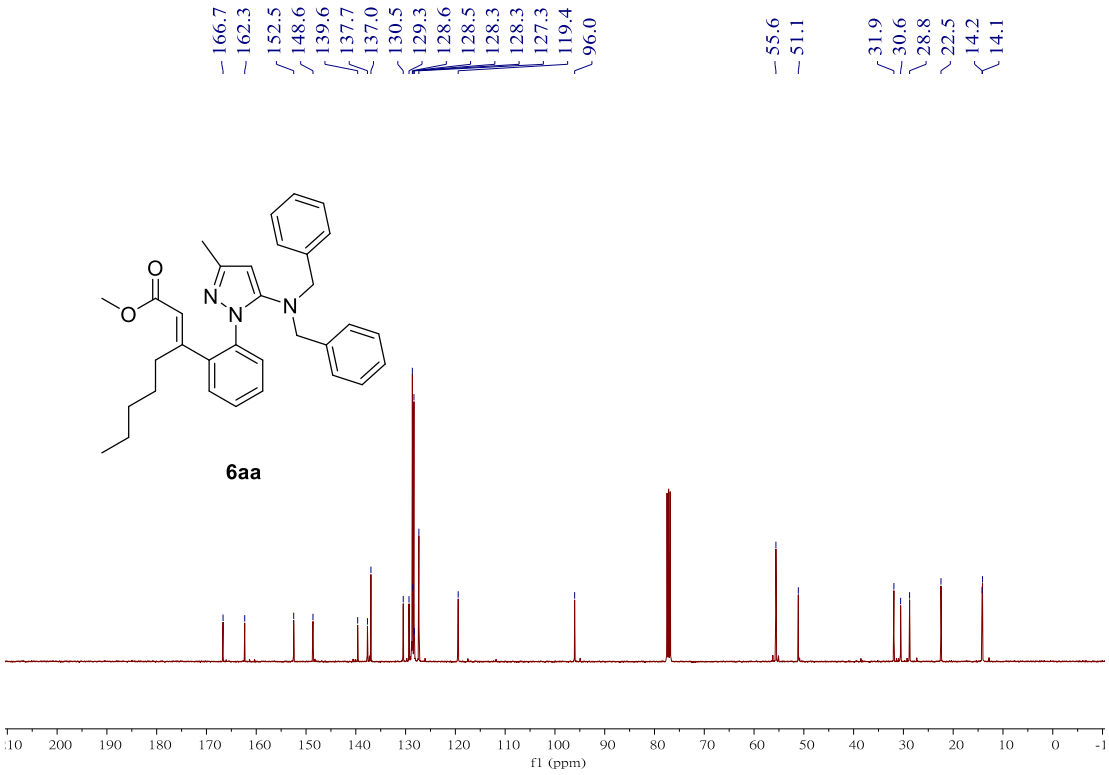
To an oven-dried 25 mL round bottom equipped with magnetic stir bar, **5a** (100 mg, 0.28 mmol), methyl oct-2-ynoate **2a** (65 mg, 0.42 mmol), $[Cp^*RhCl_2]_2$ (17 mg, 2.5 mol%), $Zn(OAc)_2$ (26 mg, 0.14 mmol) and HOAc (85 mg, 1.42 mmol) in toluene (6.0 mL) was stirred in 120 °C oil bath for 8 h under air atmosphere. After removal of the solvent under reduced pressure, purification was performed by flash column chromatography on silica gel with hexane/ethyl acetate (20:1, Rf = 0.45) as eluent to afford corresponding product **6aa** in 66% yield.



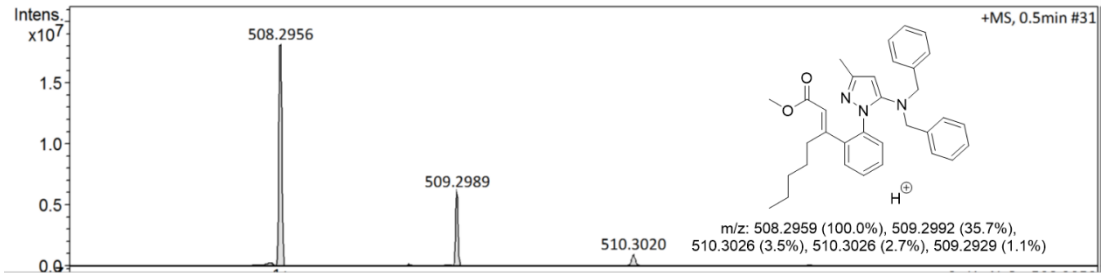
6aa



^{1}H spectrum (400 MHz) of compound **6aa** in $CDCl_3$



$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **6aa** in$CDCl_3$

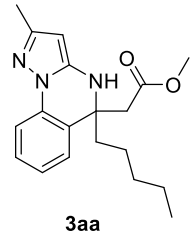


Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
508.2956	1	C33H38N3O2	508.2959	0.4	21.7	1	100.00	16.5	even	ok	M+H

HRMS Mass (ESI) spectrum of compound **6aa**

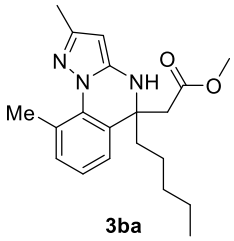
7. Characterization Data of 3aa-3ak



3aa

ethyl 2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin5-yl)acetate (3aa)

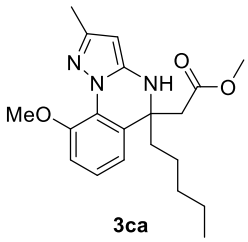
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow solid; mp 183–185 °C. Yield= 161.0 mg; (82%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.4 Hz, 1H), 7.32 – 7.26 (m, 1H), 7.08 (m, 2H), 5.28 (s, 1H), 5.23 (s, 1H), 3.66 (s, 3H), 2.87 (d, *J* = 15.7 Hz, 1H), 2.65 (d, *J* = 15.7 Hz, 1H), 2.24 (s, 3H), 1.89 (m, 2H), 1.42 – 1.28 (m, 1H), 1.27 – 1.12 (m, 5H), 0.81 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 151.3, 144.1, 134.3, 128.7, 125.2, 124.6, 124.1, 114.5, 87.7, 57.7, 51.9, 44.8, 38.9, 32.1, 23.9, 22.6, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{19}H_{26}N_3O_2$ $(M + H)^+$: 328.2020, Found: 328.2019.



3ba

methyl 2-(2,9-dimethyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ba)

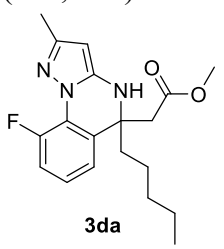
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 176.6 mg; (86%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.15-7.10 (m, 1H), 7.00 (t, *J* = 7.6 Hz, 1H), 6.96-6.92 (m, 1H), 5.37 (s, 1H), 5.15 (s, 1H), 3.66 (s, 3H), 2.82-2.71 (m, 4H), 2.60 (d, *J* = 15.6 Hz, 1H), 2.24 (s, 3H), 2.00-1.90 (m, 1H), 1.86-1.76 (m, 1H), 1.32-1.26 (m, 1H), 1.24-1.13 (m, 5H), 0.81 (t, *J* = 6.8 Hz, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 172.0, 149.4, 145.4, 133.1, 132.6, 128.0, 127.4, 123.9, 122.3, 88.4, 58.2, 51.8, 43.5, 37.7, 32.2, 23.9, 22.6, 22.6, 14.5, 14.1. HRMS (ESI, m/z) calculated for $C_{20}H_{28}N_3O_2$ $(M + H)^+$: 342.2176, Found: 342.2174.



3ca

methyl 2-(9-methoxy-2-methyl-5-pentyl-4,5-dihydro-pyrazolo[1,5-a]quinazolin-5-yl)acetate (3ca)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 169.3 mg; (79%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 – 7.03 (m, 1H), 6.96 (d, *J* = 9.2 Hz, 1H), 6.73 (d, *J* = 9.2 Hz, 1H), 5.37 (s, 1H), 5.19 (s, 1H), 3.94 (s, 3H), 3.65 (s, 3H), 2.77 (d, *J* = 15.6 Hz, 1H), 2.62 (d, *J* = 15.6 Hz, 1H), 2.28 (s, 3H), 1.86 (m, 2H), 1.34 (m, 1H), 1.19 (m, 5H), 0.80 (t, *J* = 6.8Hz, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 150.5, 149.3, 145.4, 129.3, 124.7, 124.3, 116.9, 112.9, 88.5, 58.2, 56.9, 51.9, 43.5, 38.1, 32.1, 23.8, 22.6, 14.7, 14.1. HRMS (ESI, m/z) calculated for $C_{20}H_{28}N_3O_3$ $(M + H)^+$: 358.2125, Found: 358.2127.

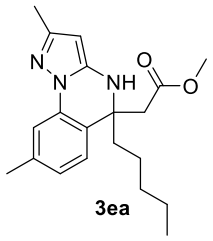


3da

methyl 2-(9-fluoro-2-methyl-5-pentyl-4,5-dihydropyrazolo-[1,5-a]quinazolin-5-yl)acetate (3da)

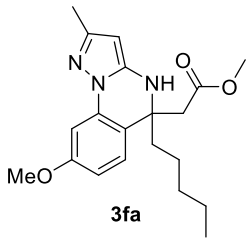
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 149.1 mg; (72%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (dd, *J* = 8.9, 5.1 Hz, 1H), 7.02 (td, *J* = 8.7, 2.7 Hz, 1H), 6.81 (dd, *J* = 9.4, 2.6

Hz, 1H), 5.30 (s, 1H), 5.23 (s, 1H), 3.68 (s, 3H), 2.87 (d, *J* = 15.7 Hz, 1H), 2.64 (d, *J* = 15.7 Hz, 1H), 2.24 (s, 3H), 1.93-1.84 (m, 2H), 1.39 (q, *J* = 8.3, 7.6 Hz, 1H), 1.29 – 1.14 (m, 5H), 0.82 (t, *J* = 6.6 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.6, 151.3, 143.7, 127 (d, *J* = 6.6 Hz), 116.1 (d, *J* = 7.4 Hz), 115.5 (d, *J* = 22.9 Hz), 111.8 (d, *J* = 24.8 Hz), 88.0, 57.8, 52.0, 44.4, 38.8, 32.0, 23.9, 22.6, 14.3, 14.1. ^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ 121.4. HRMS (ESI, m/z) calculated for $C_{19}H_{25}FN_3O_2$ $(M + H)^+$: 346.1925, Found: 346.1925.



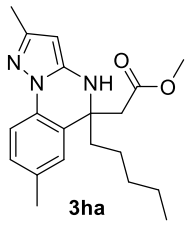
methyl 2-(2,8-dimethyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ea)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 167.9 mg; (82%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (s, 1H), 6.97-6.93 (d, *J* = 7.92 Hz, 1H), 6.90-6.86 (d, *J* = 7.96 Hz, 1H), 5.27 (s, 1H), 5.24 (s, 1H), 3.64 (s, 3H), 2.83 (d, *J* = 15.6 Hz, 1H), 2.64 (d, *J* = 15.7 Hz, 1H), 2.33 (s, 3H), 2.23 (s, 3H), 1.98-1.76 (m, 2H), 1.36 (m, 1H), 1.18 (m, 5H), 0.79 (t, *J* = 6.5 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 151.2, 144.3, 138.8, 133.9, 124.9, 124.5, 122.3, 114.9, 87.7, 57.5, 51.8, 44.9, 38.9, 32.0, 23.9, 22.5, 21.2, 14.2, 14.1. HRMS (ESI, m/z) calculated for $C_{20}H_{28}N_3O_2$ $(M + H)^+$: 342.2176, Found: 342.2176.



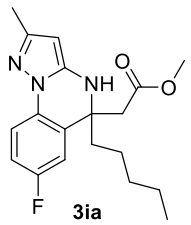
methyl 2-(8-methoxy-2-methyl-5-pentyl-4,5-dihydro-pyrazolo[1,5-a]quinazolin-5-yl)acetate (3fa)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow solid; mp 193–196 °C. Yield= 180.0 mg; (84%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (s, 1H), 6.96 (d, *J* = 8.6 Hz, 1H), 6.64 (d, *J* = 10.3 Hz, 1H), 5.29 (s, 2H), 3.86 (s, 3H), 3.66 (s, 3H), 2.84 (d, *J* = 15.8 Hz, 1H), 2.64 (d, *J* = 15.7 Hz, 1H), 2.26 (s, 3H), 1.90-1.83 (m, 2H), 1.39 – 1.29 (m, 1H), 1.20 (m, 5H), 0.80 (t, *J* = 6.5 Hz, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 159.9, 151.2, 144.4, 144.4, 125.7, 117.0, 111.3, 98.9, 87.7, 57.4, 55.7, 51.7, 44.9, 39.0, 31.9, 23.8, 22.5, 14.1, 14.0. HRMS (ESI, m/z) calculated for $C_{20}H_{28}N_3O_3$ $(M + H)^+$: 358.2125, Found: 358.2125.



methyl 2-(2,7-dimethyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ha)

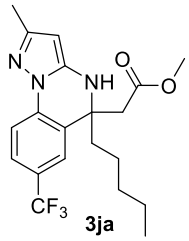
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 163.8 mg; (80%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.2 Hz, 1H), 7.11 (d, *J* = 8.5 Hz, 1H), 6.87 (s, 1H), 5.28 (s, 1H), 5.24 (s, 1H), 3.67 (s, 3H), 2.86 (d, *J* = 15.7 Hz, 1H), 2.66 (d, *J* = 15.6 Hz, 1H), 2.32 (s, 3H), 2.25 (s, 3H), 1.99 – 1.80 (m, 2H), 1.36 (d, *J* = 9.1 Hz, 1H), 1.21 (m, 6H), 0.81 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 150.9, 143.9, 133.6, 132.0, 129.2, 125.1, 125.1, 114.3, 87.6, 57.7, 51.9, 44.9, 38.9, 32.1, 23.9, 22.5, 21.3, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{20}H_{28}N_3O_2$ $(M + H)^+$: 342.2176, Found: 342.2175.



3ia

methyl 2-(7-fluoro-2-methyl-5-pentyl-4,5-dihydropyrazolo-[1,5-a]quinazolin-5-yl)acetate (3ia)

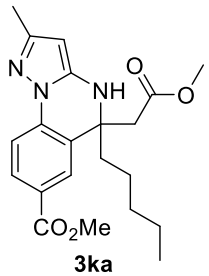
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 153.3 mg; (74%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (dd, *J* = 11.3, 8.7 Hz, 1H), 7.04 (td, *J* = 8.0, 4.8 Hz, 1H), 6.89 (d, *J* = 7.7 Hz, 1H), 5.34 (s, 1H), 5.25 (s, 1H), 3.65 (s, 3H), 2.82 (d, *J* = 15.7 Hz, 1H), 2.65 (d, *J* = 15.7 Hz, 1H), 2.26 (s, 3H), 1.97-1.77 (m, 2H), 1.41-1.26 (m, 1H), 1.25-1.08 (m, 5H), 0.80 (t, *J* = 6.7 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.5, 151.8 (d, *J* = 4.3 Hz), 151.4 (d, *J* = 254.8 Hz), 144.9, 129.3, 124.3 (d, *J* = 7.8 Hz), 123.1 (d, *J* = 8.4 Hz), 120.2 (d, *J* = 3.5 Hz), 117.1 (d, *J* = 20.8 Hz), 88.1, 58.1, 51.9, 43.9, 38.4, 32.0, 23.8, 22.5, 14.5, 14.0. ^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$): δ 118.3. HRMS (ESI, m/z) calculated for $C_{19}H_{25}FN_3O_2$ $(M + H)^+$: 346.1925, Found: 346.1933.



3ja

methyl 2-(2-methyl-5-pentyl-7-(trifluoromethyl)-4,5 dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ja)

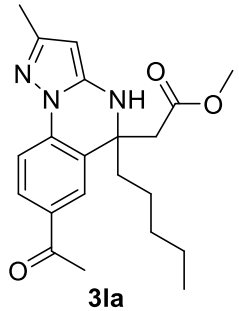
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 170.7 mg; (72%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 8.5 Hz, 1H), 7.55 (d, *J* = 8.9 Hz, 1H), 7.29 (s, 1H), 5.34 (s, 1H), 5.28 (s, 1H), 3.65 (s, 3H), 2.87 (d, *J* = 15.6 Hz, 1H), 2.68 (d, *J* = 15.7 Hz, 1H), 2.22 (s, 3H), 1.93-1.88 (m, 2H), 1.33 (m, 1H), 1.21 (m, 5H), 0.79 (t, *J* = 6.8 Hz, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 171.4, 152.7, 144.5, 136.7, 126.1, 126.0 (q, *J* = 3.4 Hz), 125.8, 125.6, 122.9, 122.0 (q, *J* = 3.6 Hz), 121.0 (q, *J* = 273.0 Hz), 114.7, 88.1, 57.8, 52.0, 44.6, 38.9, 31.9, 23.8, 22.4, 14.3, 14.0. ^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$): δ 62.0. HRMS (ESI, m/z) calculated for $C_{20}H_{25}F_3N_3O_2$ $(M + H)^+$: 396.1893, Found: 396.1899.



3ka

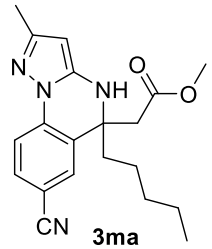
methyl 5-(2-methoxy-2-oxoethyl)-2-methyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazoline-7-carboxylate (3ka)

Flash chromatography for purification: hexane/ethyl acetate = 2:1. Rf = 0.3. Yellow solid; mp 170–172 °C; Yield= 183.4 mg; (78%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 – 7.97 (m, 1H), 7.81 – 7.74 (m, 2H), 5.40 (s, 1H), 5.28 (s, 1H), 3.89 (s, 3H), 3.66 (s, 3H), 2.88 (d, *J* = 15.8 Hz, 1H), 2.74 (d, *J* = 15.8 Hz, 1H), 2.24 (s, 3H), 2.00 – 1.86 (m, 2H), 1.34 – 1.13 (m, 6H), 0.81 – 0.73 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.5, 166.5, 152.7, 144.5, 137.3, 130.4, 126.5, 125.5, 124.9, 114.1, 87.8, 57.6, 52.1, 51.8, 44.7, 39.2, 31.8, 23.7, 22.4, 14.2, 13.9. HRMS (ESI, m/z) calculated for $C_{21}H_{28}N_3O_4$ $(M + H)^+$: 386.2074, Found: 386.2079.



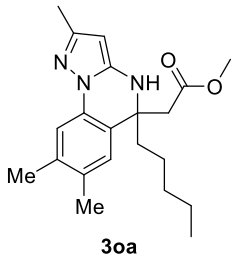
methyl 2-(7-acetyl-2-methyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3la)

Flash chromatography for purification: hexane/ethyl acetate = 1:1. Rf = 0.3. Yellow solid; mp 184–188 °C; Yield= 184.1 mg; (81%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 – 7.86 (m, 1H), 7.78 (dd, *J* = 15.7, 5.8 Hz, 2H), 5.44 (s, 1H), 5.29 (s, 1H), 3.68 (s, 3H), 2.88 (d, *J* = 15.8 Hz, 1H), 2.75 (d, *J* = 15.9 Hz, 1H), 2.57 (s, 3H), 2.24 (s, 3H), 2.01 – 1.85 (m, 2H), 1.30 – 1.07 (m, 6H), 0.78 (d, *J* = 6.6 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.8, 171.6, 153.0, 144.7, 137.6, 132.8, 130.9, 129.9, 125.4, 125.1, 114.1, 113.8, 87.9, 57.7, 52.0, 44.8, 39.4, 31.9, 26.5, 23.8, 22.5, 14.3, 14.0. HRMS (ESI, m/z) calculated for $C_{21}H_{28}N_3O_3$ $(M + H)^+$: 370.2125, Found: 370.2128.



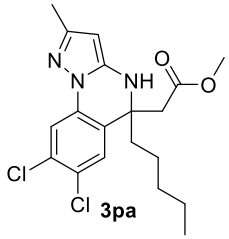
methyl 2-(7-cyano-2-methyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ma)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.22. Yellow solid; mp 172–174 °C; Yield= 147.9 mg; (70%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.4 Hz, 1H), 7.61 (dd, *J* = 8.4, 1.7 Hz, 1H), 7.36 (d, *J* = 1.7 Hz, 1H), 5.44 (s, 1H), 5.32 (s, 1H), 3.69 (s, 3H), 2.88 (d, *J* = 15.8 Hz, 1H), 2.68 (d, *J* = 15.8 Hz, 1H), 2.26 (s, 3H), 1.91 (m, 2H), 1.33-1.13 (m, 6H), 0.85 – 0.79 (t, *J* = 6.84 Hz 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.2, 153.5, 144.8, 137.1, 133.1, 129.1, 125.9, 118.9, 115.3, 107.4, 88.5, 57.7, 52.2, 44.6, 39.2, 31.9, 23.9, 22.5, 14.2, 14.1. HRMS (ESI, m/z) calculated for $C_{20}H_{25}N_4O_2$ $(M + H)^+$: 353.1972, Found: 353.1960.



methyl 2-(2,7,8-trimethyl-5-pentyl-4,5-dihydropyrazolo-[1,5-a]quinazolin-5-yl)acetate (3oa)

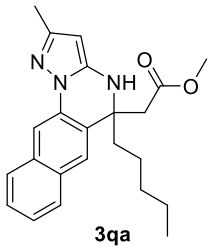
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 179.0 mg; (84%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (s, 1H), 6.80 (s, 1H), 5.26 (s, 1H), 5.18 (s, 1H), 3.67 (s, 3H), 2.83 (d, *J* = 15.6 Hz, 1H), 2.63 (d, *J* = 15.7 Hz, 1H), 2.25 (s, 3H), 2.24 (s, 3H), 2.23 (s, 3H), 1.98-1.76 (m, 2H), 1.36 (m, 1H), 1.20 (m, 5H), 0.81 (t, *J* = 6.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.0, 150.8, 144.0, 137.3, 132.3, 132.1, 125.6, 122.6, 115.4, 87.5, 57.5, 51.9, 45.1, 38.9, 32.1, 23.9, 22.6, 19.7, 19.6, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{21}H_{30}N_3O_2$ $(M + H)^+$: 356.2333, Found: 356.2347.



methyl 2-(7,8-dichloro-2-methyl-5-pentyl-4,5-dihydro-pyrazolo[1,5-a]quinazolin-5-yl)acetate (3pa)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 154.1 mg; (65%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (s, 1H), 7.13 (s, 1H), 5.28 (s, 2H), 3.67 (s, 3H), 2.84 (d, *J* = 15.8 Hz,

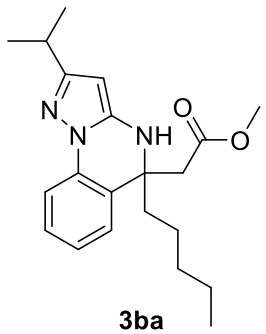
1H), 2.64 (d, *J* = 15.8 Hz, 1H), 2.22 (s, 3H), 1.87 (m, 2H), 1.39 – 1.30 (m, 1H), 1.22 (m, 5H), 0.86 – 0.77 (t, *J* = 6.6 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.3, 152.3, 144.1, 133.6, 132.9, 127.3, 126.6, 125.2, 116.3, 88.1, 57.6, 52.0, 44.6, 39.1, 31.9, 23.8, 22.5, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{19}H_{24}Cl_2N_3O_2$ $(M + H)^+$: 396.1240, Found: 396.1239.



3qa

methyl 2-(2-methyl-5-pentyl-4,5-dihydrobenzo[g]pyrazolo-[1,5-a]quinazolin-5-yl)acetate (3qa)

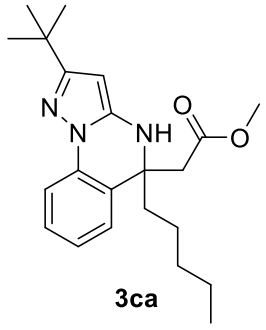
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.28. Yellow solid; mp 188–190 °C. Yield= 183.3 mg; (81%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.82 (d, *J* = 8.0 Hz, 1H), 7.75 (d, *J* = 8.1 Hz, 1H), 7.54 (s, 1H), 7.43 (m, 1H), 7.40 – 7.35 (m, 1H), 5.39 (s, 1H), 5.35 (s, 1H), 3.67 (s, 3H), 2.96 (d, *J* = 15.7 Hz, 1H), 2.81 (d, *J* = 15.9 Hz, 1H), 2.30 (s, 3H), 2.22 – 1.87 (m, 2H), 1.36 (m, 1H), 1.23 (m, 5H), 0.79 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 151.9, 144.5, 133.5, 131.9, 130.5, 127.9, 127.5, 127.0, 126.6, 125.1, 124.3, 110.7, 88.0, 57.9, 51.9, 44.8, 39.1, 32.1, 23.9, 22.5, 14.4, 14.1. HRMS (ESI, m/z) calculated for $C_{23}H_{28}N_3O_2$ $(M + H)^+$: 378.2176, Found: 378.2179.



3ba

methyl 2-(2-isopropyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ba)

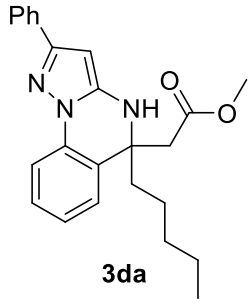
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 181.2 mg; (85%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (dt, *J* = 7.9, 0.9 Hz, 1H), 7.31 – 7.23 (m, 1H), 7.07 (d, *J* = 0.9 Hz, 1H), 7.06 (dd, *J* = 1.9, 0.9 Hz, 1H), 5.31 (s, 1H), 5.25 (s, 1H), 3.64 (s, 3H), 2.97 – 2.89 (m, 1H), 2.86 (d, *J* = 15.6 Hz, 1H), 2.64 (d, *J* = 15.6 Hz, 1H), 2.02 – 1.77 (m, 2H), 1.43 – 1.31 (m, 1H), 1.26 (s, 3H), 1.25 (s, 3H), 1.23 – 1.14 (m, 5H), 0.84 – 0.73 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.7, 161.5, 143.7, 134.3, 128.4, 125.0, 124.5, 124.4, 123.9, 114.5, 84.4, 57.5, 51.7, 44.7, 38.6, 31.9, 28.4, 23.8, 22.7, 22.4, 13.9. HRMS (ESI, m/z) calculated for $C_{21}H_{30}N_3O_2$ $(M + H)^+$: 356.2333, Found: 356.2333.



3ca

methyl 2-(2-(tert-butyl)-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ca)

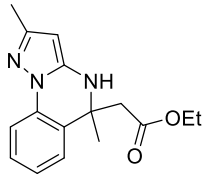
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 186.1 mg; (84%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 8.1 Hz, 1H), 7.35 – 7.27 (m, 1H), 7.08 (d, *J* = 4.3 Hz, 2H), 5.36 (s, 1H), 5.21 (s, 1H), 3.67 (s, 3H), 2.89 (d, *J* = 15.6 Hz, 1H), 2.65 (d, *J* = 15.6 Hz, 1H), 2.02 – 1.82 (m, 2H), 1.32 (s, 9H), 1.25 – 1.16 (m, 6H), 0.86 – 0.76 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.7, 164.1, 143.5, 134.4, 128.4, 125.0, 124.4, 124.4, 123.8, 114.7, 84.4, 57.5, 51.7, 44.6, 38.5, 32.5, 31.9, 30.2, 23.9, 22.5, 14.0. HRMS (ESI, m/z) calculated for $C_{22}H_{32}N_3O_2$ $(M + H)^+$: 370.2489, Found: 370.2491.



3da

methyl 2-(5-pentyl-2-phenyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3da)

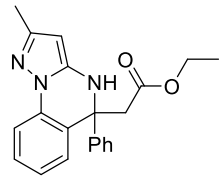
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.3. Yellow solid; mp 184–188 °C; Yield= 189.1 mg; (81%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.96 (m, 1H), 7.93 – 7.82 (m, 2H), 7.44 – 7.37 (m, 3H), 7.37 – 7.30 (m, 1H), 7.21 – 7.09 (m, 2H), 5.84 (s, 1H), 5.49 (s, 1H), 3.69 (s, 3H), 2.94 (d, *J* = 15.8 Hz, 1H), 2.74 (d, *J* = 15.8 Hz, 1H), 2.02 – 1.87 (m, 2H), 1.46 – 1.30 (m, 1H), 1.28 – 1.13 (m, 5H), 0.86 – 0.75 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.7, 152.7, 144.4, 134.0, 133.1, 128.7, 128.5, 128.1, 125.8, 125.5, 124.6, 124.5, 114.9, 110.5, 85.0, 57.7, 51.8, 44.7, 38.9, 31.9, 23.8, 22.4, 14.0. HRMS (ESI, m/z) calculated for $C_{24}H_{28}N_3O_2$ $(M + H)^+$: 390.2176, Found: 390.2176.



3ab

ethyl 2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ab)

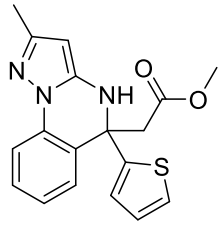
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.25. Yellow liquid; Yield= 135.2 mg; (79%); ^{1}H NMR (400 MHz, acetone-d_6) δ 7.68 (d, *J* = 8.4 Hz, 1H), 7.33 (t, *J* = 7.1 Hz, 2H), 7.12 (t, *J* = 7.6 Hz, 1H), 5.96 (s, 1H), 5.29 (s, 1H), 3.99 (q, *J* = 7.1 Hz, 2H), 2.78 – 2.66 (m, 2H), 2.14 (s, 3H), 1.74 (s, 3H), 1.11 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, acetone-d_6) δ 169.8, 150.1, 144.3, 133.8, 128.2, 127.6, 124.5, 123.8, 113.8, 87.0, 60.0, 54.4, 45.4, 26.0, 13.4. HRMS (ESI, m/z) calculated for $C_{16}H_{20}N_3O_2$ $(M + H)^+$: 386.1550, Found: 386.1546.



3ac

ethyl 2-(2-methyl-5-phenyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ac)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.28. Yellow liquid; Yield= 160.4 mg; (77%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (dd, *J* = 1.3, 0.4 Hz, 1H), 7.56 – 7.52 (m, 2H), 7.37 – 7.31 (m, 2H), 7.31 – 7.26 (m, 2H), 6.99 (td, *J* = 7.6, 1.3 Hz, 1H), 6.80 (m, 1H), 6.08 (s, 1H), 5.43 (s, 1H), 4.12 – 4.00 (m, 2H), 3.21 (d, *J* = 2.7 Hz, 2H), 2.29 (s, 3H), 1.15 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.3, 151.6, 144.3, 143.1, 133.5, 128.9, 128.6, 127.9, 127.3, 127.1, 126.0, 124.2, 114.5, 88.5, 60.9, 60.7, 42.6, 14.4, 14.1. HRMS (ESI, m/z) calculated for $C_{21}H_{22}N_3O_2$ $(M + H)^+$: 348.1707, Found: 348.1706.

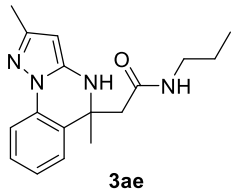


3ad

methyl 2-(2-methyl-5-(thiophen-2-yl)-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetate (3ad)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.3. Yellow solid; mp 184–188 °C; Yield= 159.4 mg; (79%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 8.0 Hz, 1H), 7.35 – 7.30 (m, 2H), 7.07 (d, *J* = 3.6 Hz, 1H), 7.04 (t, *J* = 7.6 Hz, 1H), 6.98 (t, *J* = 4.3 Hz, 1H), 6.89 (d, *J* =

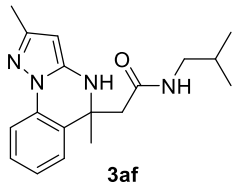
7.8 Hz, 1H), 6.29 (s, 1H), 5.48 (s, 1H), 3.65 (s, 3H), 3.22 – 3.11 (m, 2H), 2.31 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.4, 151.5, 148.0, 143.6, 132.7, 129.5, 126.8, 126.8, 126.7, 125.5, 125.2, 124.9, 114.8, 89.3, 59.4, 52.2, 43.1, 14.2. HRMS (ESI, m/z) calculated for $C_{18}H_{18}N_3O_2S$ $(M + H)^+$: 340.1114, Found: 340.1114.



3ae

2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)-N-propylacetamide (3ae)

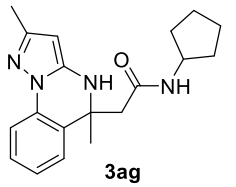
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 143.1 mg; (80%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.31 (ddd, *J* = 8.1, 7.3, 1.5 Hz, 1H), 7.16 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.09 (td, *J* = 7.5, 1.3 Hz, 1H), 5.70 (s, 1H), 5.53 (s, 1H), 5.35 (s, 1H), 3.26 – 3.06 (m, 2H), 2.77 (d, *J* = 14.7 Hz, 1H), 2.33 (d, *J* = 14.7 Hz, 1H), 2.26 (s, 3H), 1.68 (d, *J* = 0.6 Hz, 3H), 1.42 (p, *J* = 7.3 Hz, 2H), 0.84 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 151.4, 144.3, 133.6, 128.8, 127.9, 124.5, 123.8, 114.5, 88.7, 55.0, 46.1, 41.23, 26.5, 22.8, 14.4, 11.4. HRMS (ESI, m/z) calculated for $C_{17}H_{23}N_4O$ $(M + H)^+$: 299.1866, Found: 299.1866.



3af

2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)-N-isobutylacetamide (3af)

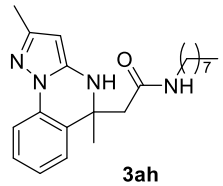
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 163.0 mg; (87%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.31 (m, 1H), 7.16 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.09 (td, *J* = 7.5, 1.3 Hz, 1H), 5.78 (m, 1H), 5.52 (s, 1H), 5.35 (s, 1H), 3.11 – 3.04 (m, 1H), 2.95 (m, 1H), 2.80 (d, *J* = 14.8 Hz, 1H), 2.35 (d, *J* = 14.8 Hz, 1H), 2.26 (s, 3H), 1.70 – 1.64 (m, 4H), 0.84 – 0.76 (t, 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 151.4, 144.3, 133.6, 128.8, 127.9, 124.5, 123.8, 114.6, 88.8, 55.0, 46.9, 46.1, 28.5, 26.7, 20.1, 14.4. HRMS (ESI, m/z) calculated for $C_{18}H_{25}N_4O$ $(M + H)^+$: 313.2023, Found: 313.2026.



3ag

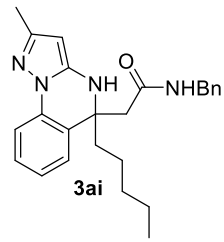
N-cyclopentyl-2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)acetamide (3ag)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 157.6 mg; (81%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.32 (m, 1H), 7.16 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.09 (m, 1H), 5.54 (d, *J* = 7.5 Hz, 1H), 5.47 (s, 1H), 5.35 (s, 1H), 4.14 (m, 1H), 2.74 (d, *J* = 14.6 Hz, 1H), 2.32 (d, *J* = 14.6 Hz, 1H), 2.26 (s, 3H), 1.96 – 1.84 (m, 2H), 1.71 – 1.64 (m, 4H), 1.60 – 1.52 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.8, 151.4, 144.3, 133.6, 128.8, 127.8, 124.5, 123.9, 114.6, 88.7, 55.1, 51.3, 46.4, 33.2, 26.5, 23.7, 14.4. HRMS (ESI, m/z) calculated for $C_{19}H_{25}N_4O$ $(M + H)^+$: 325.2023, Found: 325.2017.



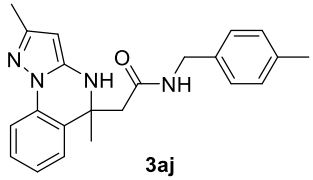
2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)-N-octylacetamide (3ah)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 156.9 mg; (71%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.4 Hz, 1H), 7.28 (d, *J* = 7.4 Hz, 1H), 7.13 (m, 1H), 7.07 (m, 1H), 5.79 (s, 1H), 5.61 (s, 1H), 5.34 (s, 1H), 3.25 – 3.06 (m, 2H), 2.74 (d, *J* = 14.8 Hz, 1H), 2.32 (d, *J* = 14.7 Hz, 1H), 2.25 (s, 3H), 1.64 (s, 3H), 1.43 – 1.13 (m, 12H), 0.90 – 0.81 (t, *J* = 6.8 Hz, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 151.4, 144.4, 133.4, 128.7, 127.8, 124.5, 123.9, 114.5, 88.7, 55.0, 46.0, 39.6, 31.9, 29.6, 29.3, 29.3, 27.0, 26.6, 22.7, 14.3, 14.2. HRMS (ESI, m/z) calculated for $C_{22}H_{33}N_4O$ $(M + H)^+$: 369.2649, Found: 369.2646.



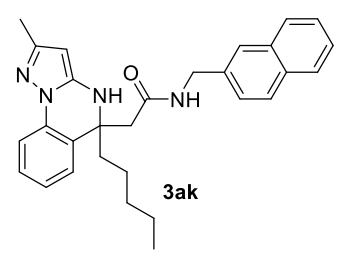
N-benzyl-2-(2-methyl-5-pentyl-4,5-dihydropyrazolo[1,5 a]quinazolin-5-yl)acetamide (3ai)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 222 mg; (92%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.69 (m, 1H), 7.33 – 7.22 (m, 4H), 7.12 – 7.04 (m, 4H), 6.23 (t, *J* = 5.8 Hz, 1H), 5.31 (s, 1H), 5.29 (s, 1H), 4.41 (dd, *J* = 14.8, 6.0 Hz, 1H), 4.28 (dd, *J* = 14.8, 5.5 Hz, 1H), 2.85 (d, *J* = 14.9 Hz, 1H), 2.46 (d, *J* = 14.9 Hz, 1H), 2.24 (s, 3H), 1.91 (td, *J* = 6.9, 5.8, 3.5 Hz, 2H), 1.19 (tt, *J* = 6.7, 4.2 Hz, 6H), 0.85 – 0.76 (t, 6,8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.2, 151.3, 144.1, 137.9, 134.2, 128.8, 128.7, 127.6, 125.5, 124.7, 124.3, 114.5, 88.2, 58.4, 46.3, 43.5, 39.8, 32.0, 23.8, 22.6, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{25}H_{31}N_4O$ $(M + H)^+$: 403.2429, Found: 403.2494.



2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)-N-(4-methylbenzyl)-acetamide (3aj)

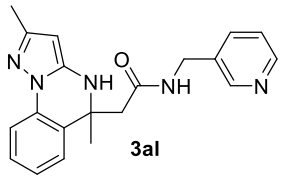
Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 181.5 mg; (84%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.30 (m, 1H), 7.15 – 7.08 (m, 2H), 7.08 – 7.01 (m, 4H), 6.10 (t, *J* = 5.7 Hz, 1H), 5.51 (s, 1H), 5.31 (s, 1H), 4.32 (m, 2H), 2.78 (d, *J* = 14.8 Hz, 1H), 2.35 (d, *J* = 14.9 Hz, 1H), 2.31 (s, 3H), 2.24 (s, 3H), 1.67 (s, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 170.1, 151.4, 144.2, 137.4, 134.9, 133.6, 129.5, 128.7, 127.8, 127.7, 124.5, 123.8, 114.6, 88.7, 55.1, 46.1, 43.3, 26.6, 21.2, 14.3. HRMS (ESI, m/z) calculated for $C_{22}H_{25}N_4O$ $(M + H)^+$: 361.2023, Found: 361.2027.



2-(2-methyl-5-pentyl-4,5-dihydropyrazolo[1,5-a]quinazolin-5-yl)-N-(naphthalen-2-ylmethyl)acetamide (3ak)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 252.3 mg; (93%); ^{1}H NMR (400 MHz, $CDCl_3$)) δ 7.93 – 7.84 (m, 2H), 7.78 (dt, *J* = 8.3, 1.0 Hz, 1H), 7.69 – 7.63 (m, 1H), 7.55 – 7.44 (m, 2H), 7.36 (dd, *J* = 8.3,

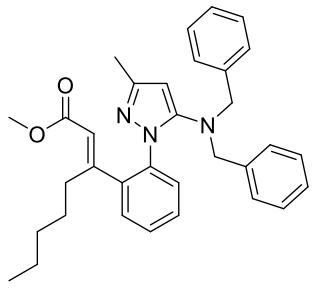
7.0 Hz, 1H), 7.29 – 7.18 (m, 2H), 7.04 – 6.93 (m, 2H), 6.16 (t, *J* = 5.5 Hz, 1H), 5.23 (s, 1H), 5.12 (s, 1H), 4.80 (qd, *J* = 14.5, 5.4 Hz, 2H), 2.79 (d, *J* = 14.8 Hz, 1H), 2.40 (d, *J* = 14.8 Hz, 1H), 1.94 – 1.87 (m, 2H), 1.17 (m, 6H), 0.84 – 0.76 (t, 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.9, 151.3, 144.0, 134.1, 133.9, 133.3, 131.3, 129.0, 128.8, 128.6, 126.8, 126.7, 126.1, 125.5, 125.4, 124.6, 124.2, 123.3, 114.4, 88.1, 58.4, 46.5, 41.6, 39.5, 32.0, 23.8, 22.6, 14.3, 14.1. HRMS (ESI, m/z) calculated for $C_{29}H_{33}N_4O$ $(M + H)^+$: 453.2649, Found: 453.2651.



3al

2-(2,5-dimethyl-4,5-dihydropyrazolo[1,5-a]quina-zolin-5-yl)-N-(pyridin-3-ylmeth-yl)acetamide (3al)

Flash chromatography for purification: hexane/ethyl acetate = 3:1. Rf = 0.2. Yellow liquid; Yield= 193.7 mg; (93%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.45 (s, 1H), 8.40 (s, 1H), 7.68 (s, 1H), 7.43 (d, *J* = 9.1 Hz, 1H), 7.33 – 7.26 (m, 1H), 7.20 (s, 1H), 7.13 (s, 1H), 7.06 (s, 1H), 6.57 (m, 1H), 5.35 (s, 1H), 5.33 (s, 1H), 4.40 (m, 1H), 4.29 (m, 1H), 2.82 (d, *J* = 15.0 Hz, 1H), 2.45 (d, *J* = 15.0 Hz, 1H), 2.23 (s, 3H), 1.66 (s, 3H).^{13}C NMR (101 MHz, $CDCl_3$) δ 170.4, 151.4, 148.7, 148.5, 144.1, 136.0, 133.5, 128.9, 127.5, 124.7, 124.0, 123.9, 114.6, 88.9, 55.2, 46.2, 40.9, 29.4, 27.1, 14.3. HRMS (ESI, m/z) calculated for $C_{20}H_{22}N_5O$ $(M + H)^+$: 348.1819, Found: 348.1815.

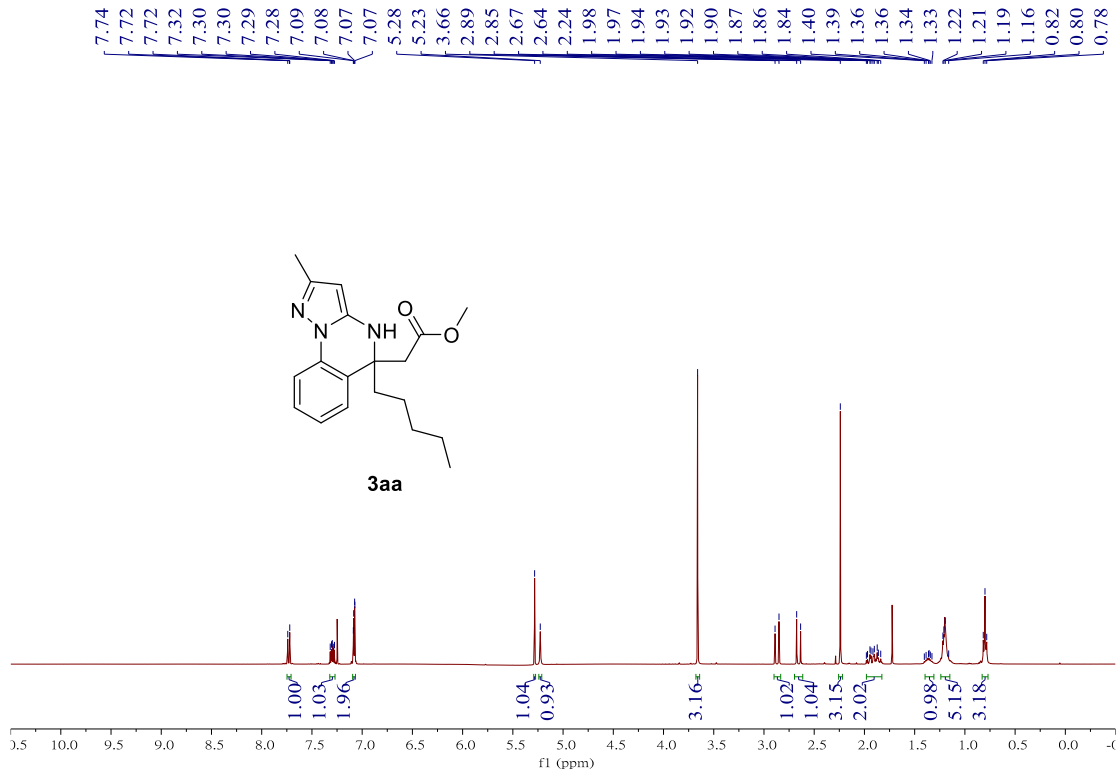


6aa

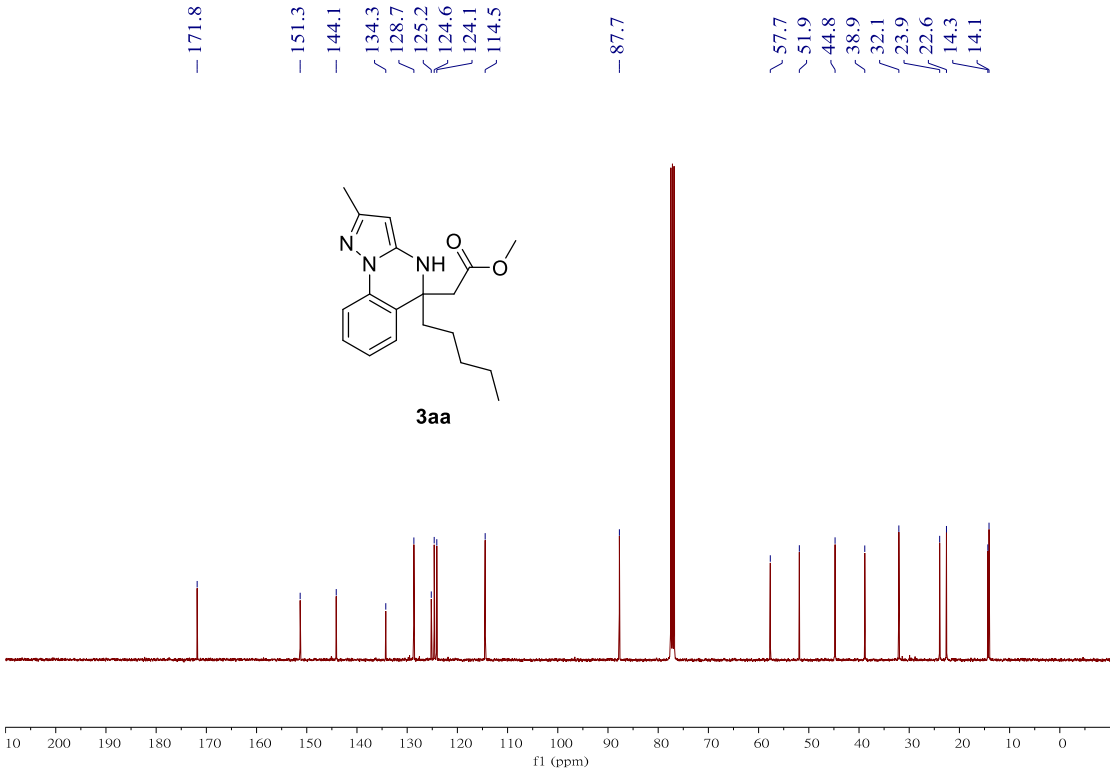
methyl (E)-3-(2-(5-(dibenzylamino)-3-methyl-1H-pyrazol-1-yl)phenyl)oct-2-enoate (6aa)

Flash chromatography for purification: hexane/ethyl acetate = 20:1. Rf = 0.45. Yellow liquid; Yield= 95.0 mg; (66%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (dt, J = 5.1, 2.4 Hz, 3H), 7.33 – 7.28 (m, 1H), 7.26 – 7.19 (m, 6H), 7.01 (dd, J = 7.3, 2.0 Hz, 4H), 5.92 (s, 1H), 5.58 (s, 1H), 3.85 (s, 4H), 3.68 (s, 3H), 2.52 – 2.40 (m, 2H), 2.21 (s, 3H), 1.28 – 1.04 (m, 6H), 0.78 – 0.73 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 162.3, 152.5, 148.6, 139.6, 137.7, 137.0, 130.5, 129.3, 128.6, 128.5, 128.3, 128.3, 127.3, 119.4, 96.0, 55.6, 51.1, 31.9, 30.6, 28.8, 22.5, 14.2, 14.1. HRMS (ESI, m/z) calculated for $C_{33}H_{38}N_3O_2$ $(M + H)^+$: 508.2959, Found: 508.2956.

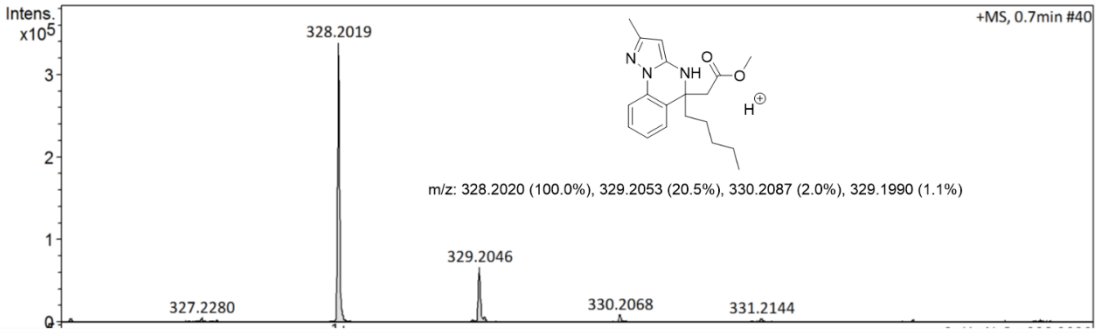
8. Spectral Data of 3aa-3al



^{1}H spectrum (400 MHz) of compound **3aa** in $CDCl_3$



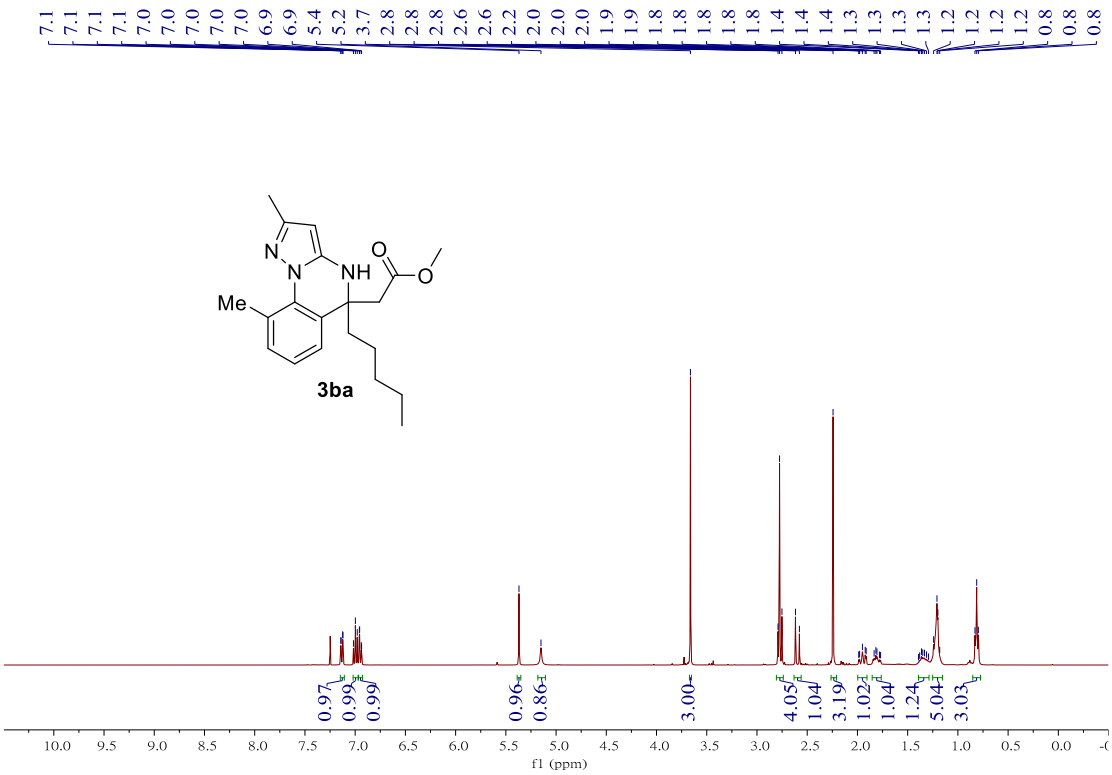
^{13}C{1 H} spectrum (101 MHz) of compound **3aa** in$CDCl_3$



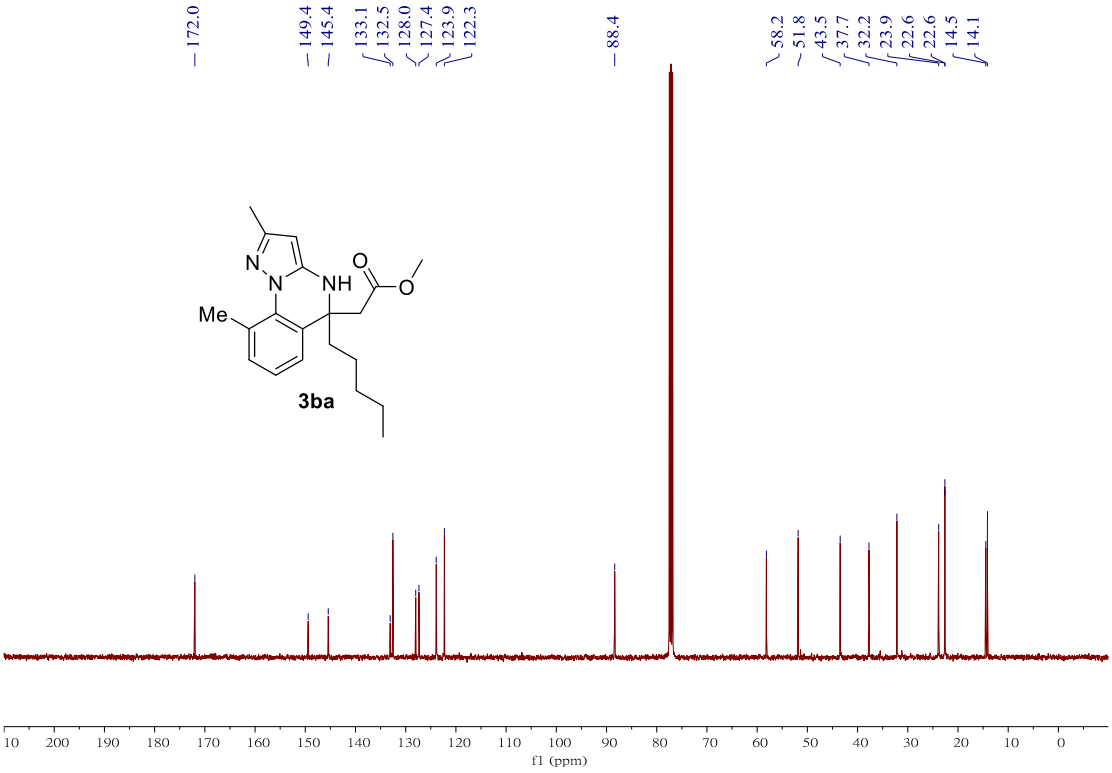
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
328.2019	1	C19H26N3O2	328.2020	0.2	13.1	1	100.00	8.5	even	ok	M+H

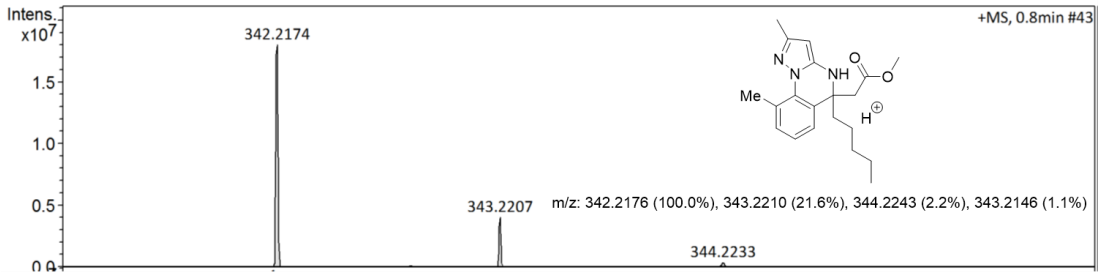
HRMS Mass (ESI) spectrum of compound **3aa**



^{1}H spectrum (400 MHz) of compound **3ba** in $CDCl_3$



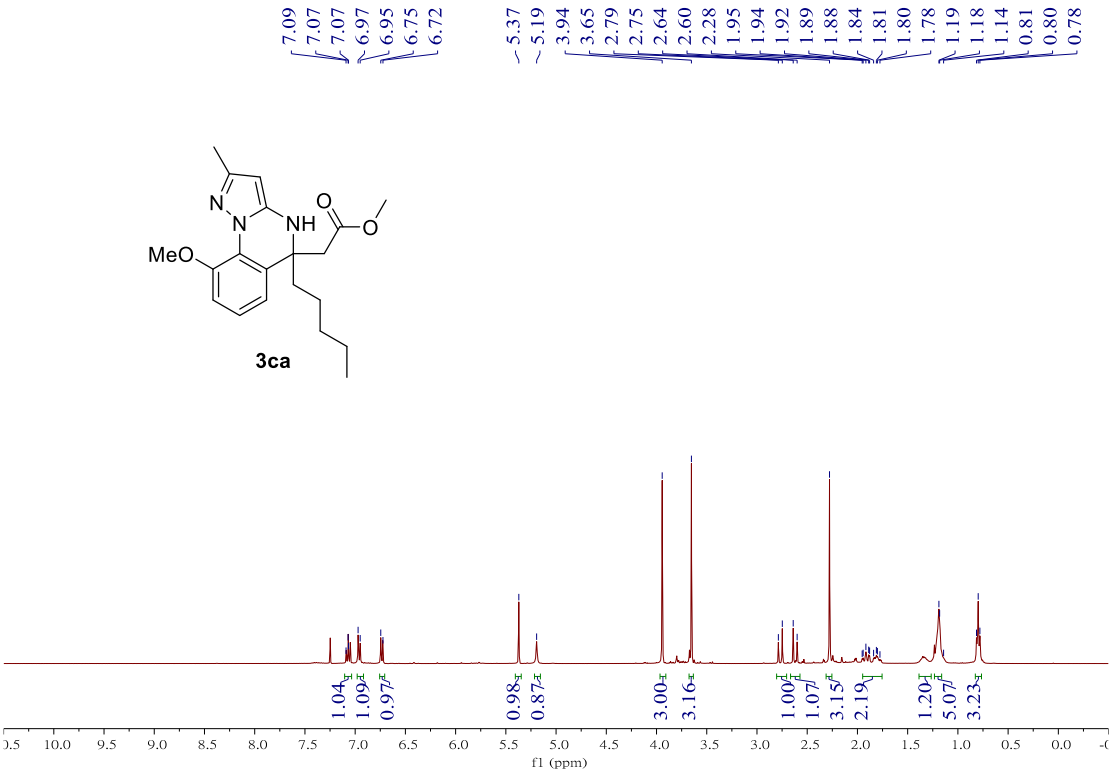
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ba** in$CDCl_3$



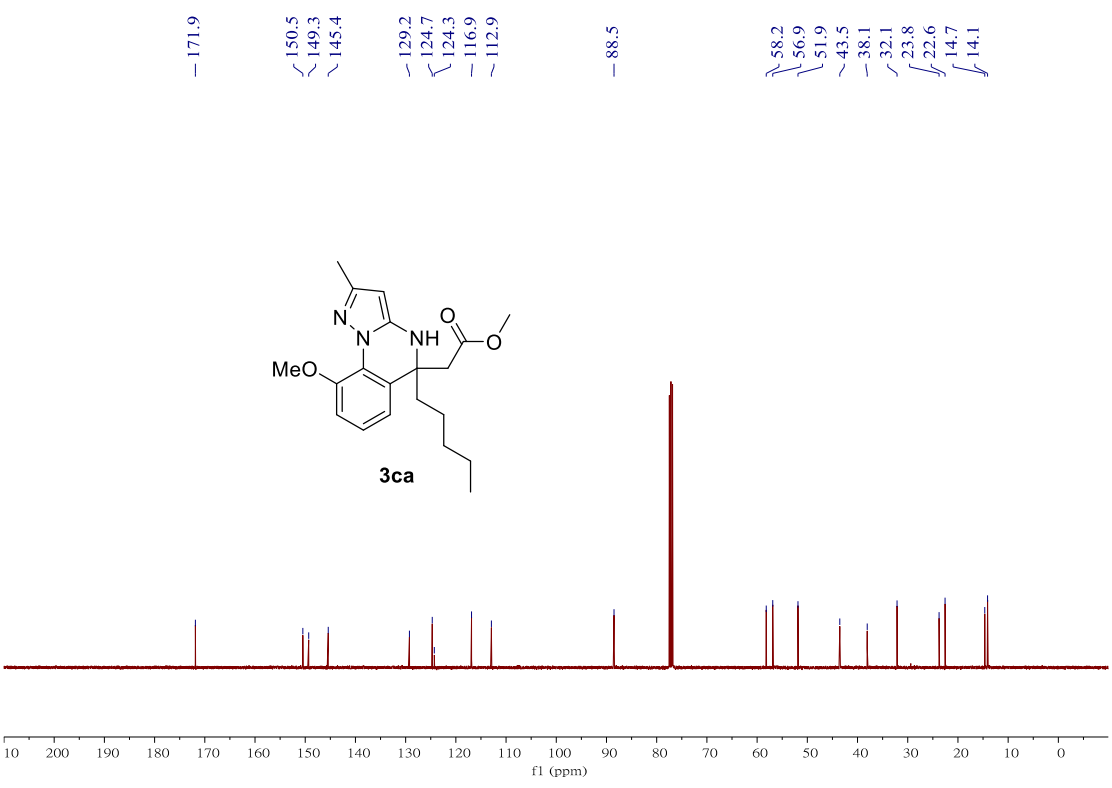
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
342.2174	1	C20H28N3O2	342.2176	-0.6	6.3	1	100.00	8.5	even	ok	M+H

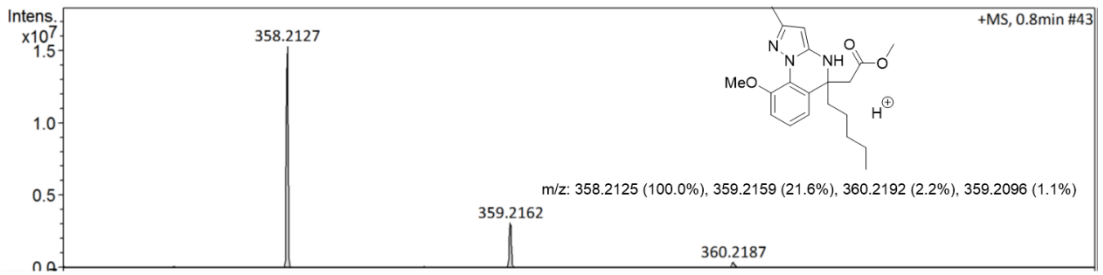
HRMS Mass (ESI) spectrum of compound **3ba**



^{1}H spectrum (400 MHz) of compound **3ca** in $CDCl_3$



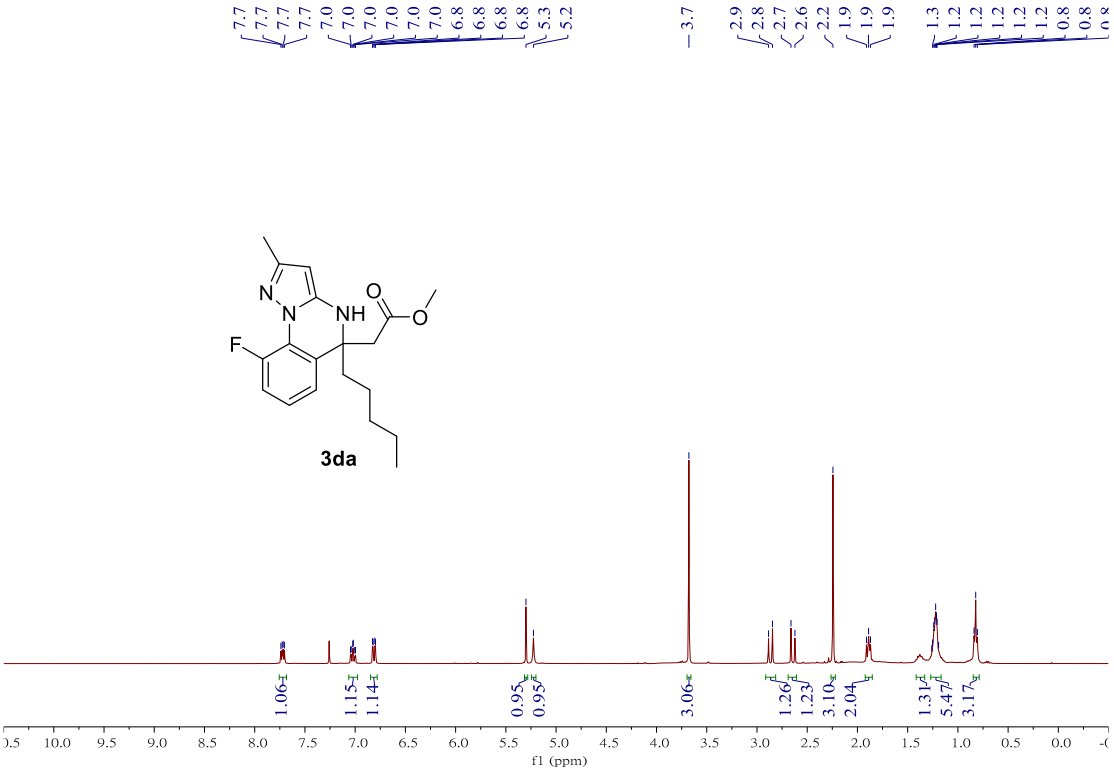
^{13}C{1 H} spectrum (101 MHz) of compound **3ca** in$CDCl_3$



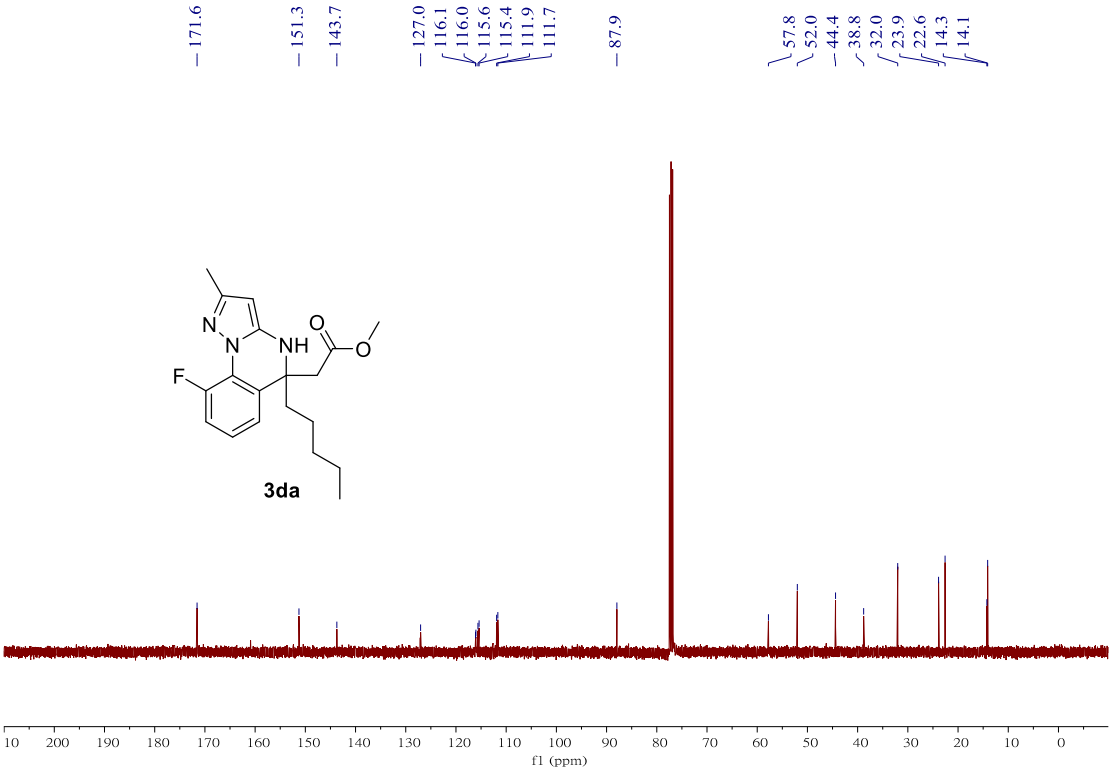
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
358.2127	1	C20H28N3O3	358.2125	-0.5	19.2	1	100.00	8.5	even	ok	M+H

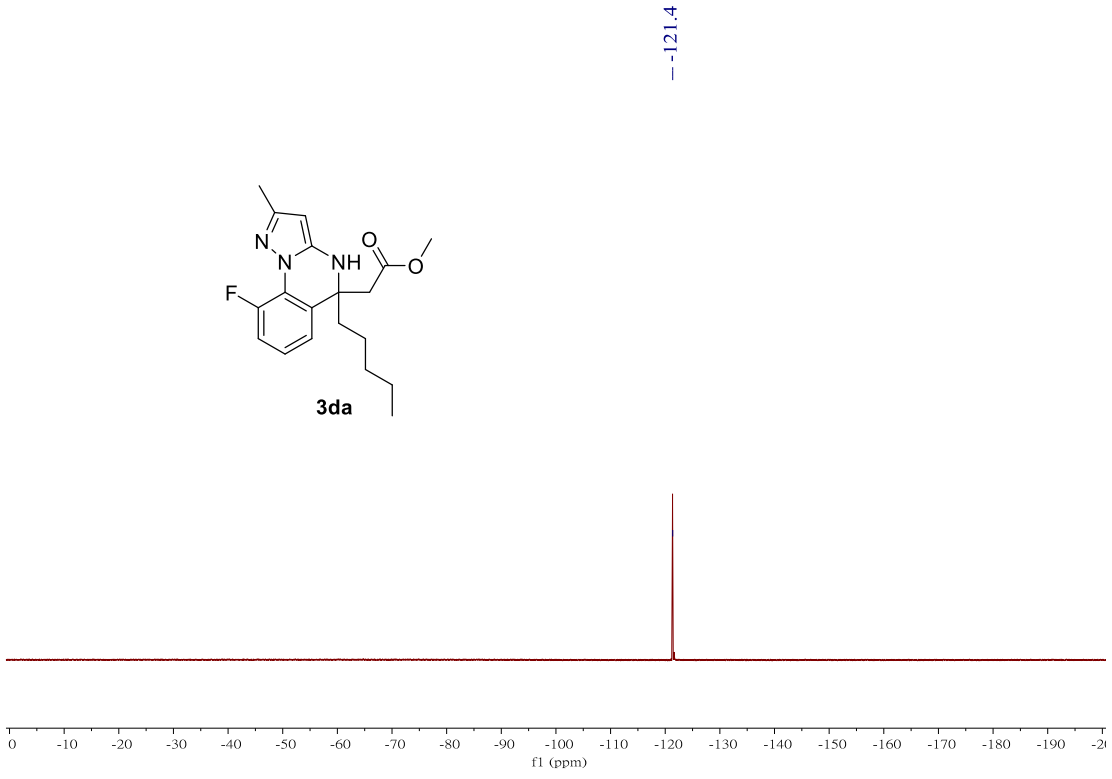
HRMS Mass (ESI) spectrum of compound **3ca**



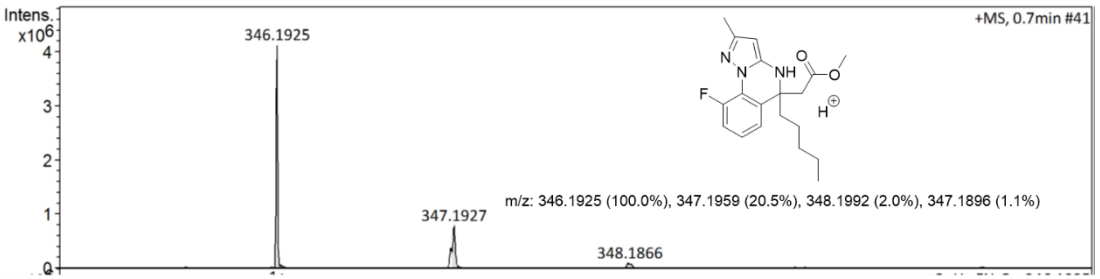
^{1}H spectrum (400 MHz) of compound **3da** in $CDCl_3$



$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3da** in$CDCl_3$



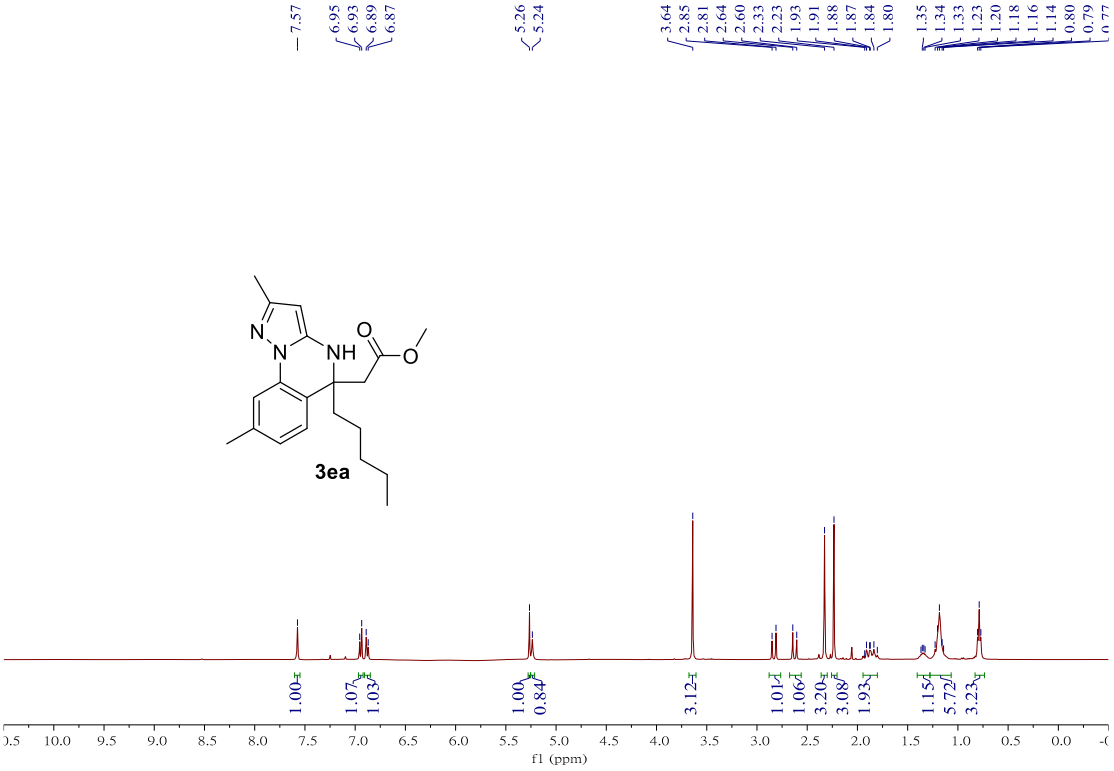
$^{19}F\{1\ H\}$ spectrum (376 MHz) of compound **3da** in$CDCl_3$



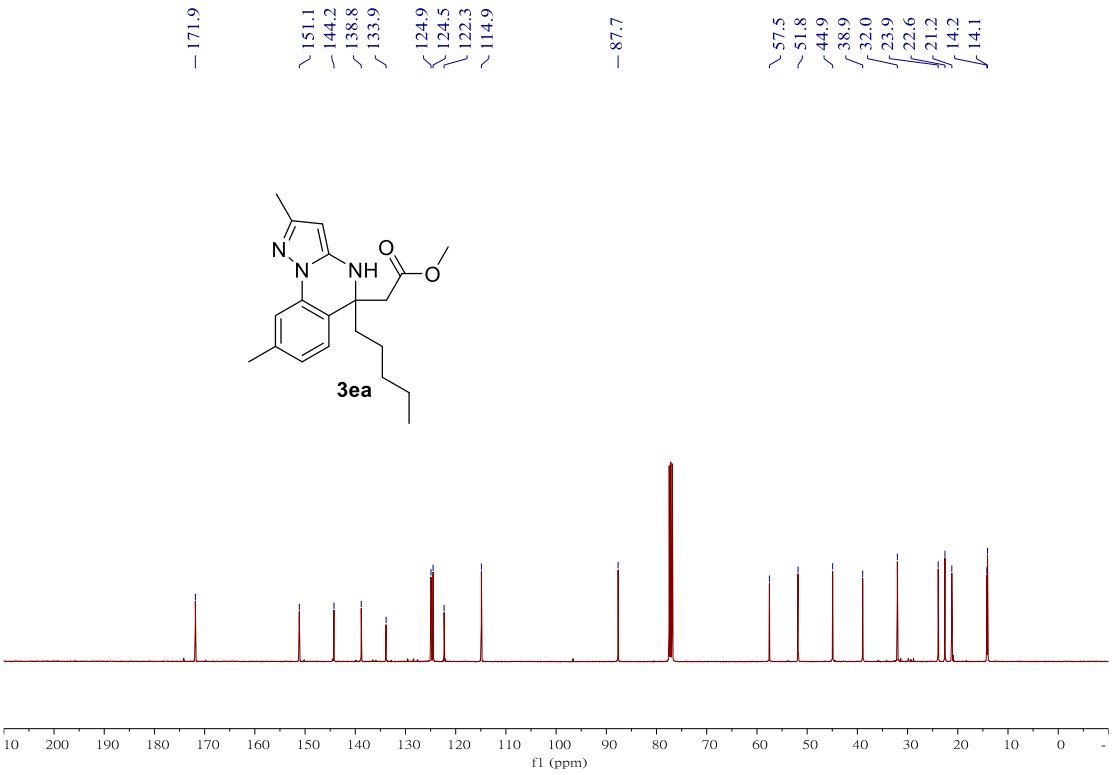
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
346.1925	1	C19H25FN3O2	346.1925	-0.0	18.1	1	100.00	8.5	even	ok	M+H

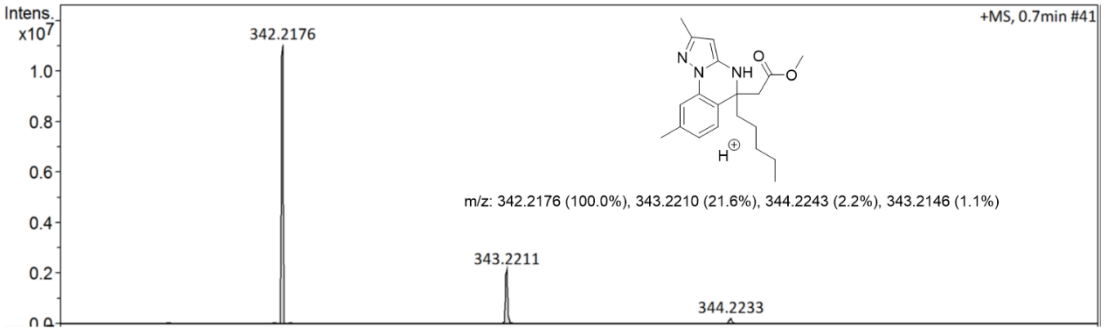
HRMS Mass (ESI) spectrum of compound **3da**



^{1}H spectrum (400 MHz) of compound **3ea** in $CDCl_3$



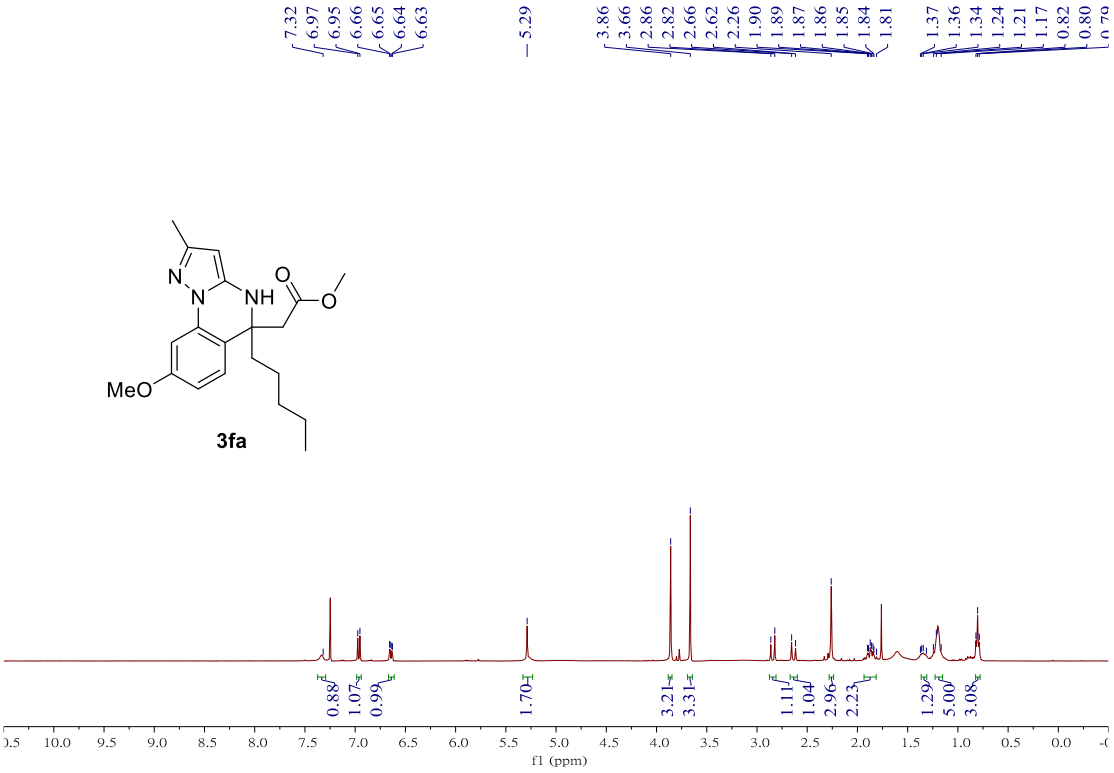
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ea** in$CDCl_3$



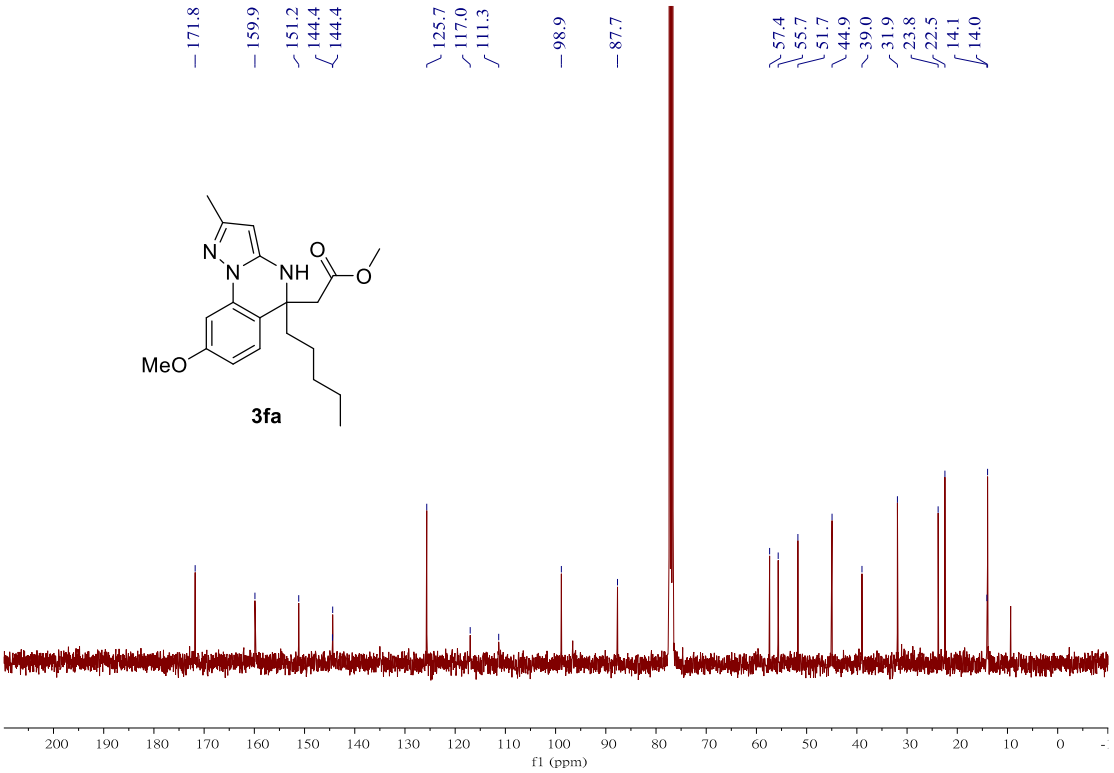
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
342.2176	1	C20H28N3O2	342.2176	0.0	21.9	1	100.00	8.5	even	ok	M+H

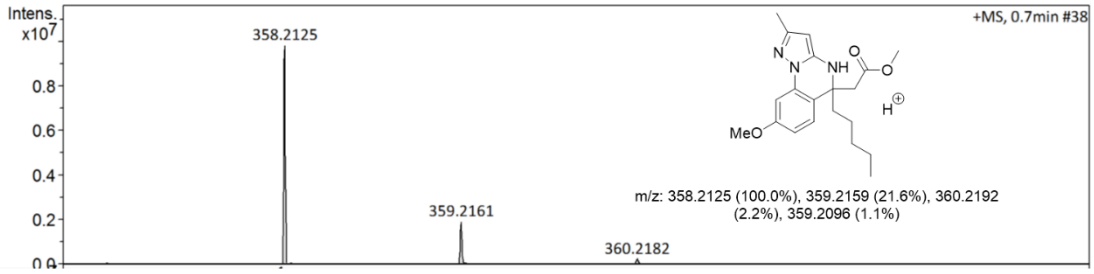
HRMS Mass (ESI) spectrum of compound **3ea**



^{1}H spectrum (400 MHz) of compound **3fa** in $CDCl_3$



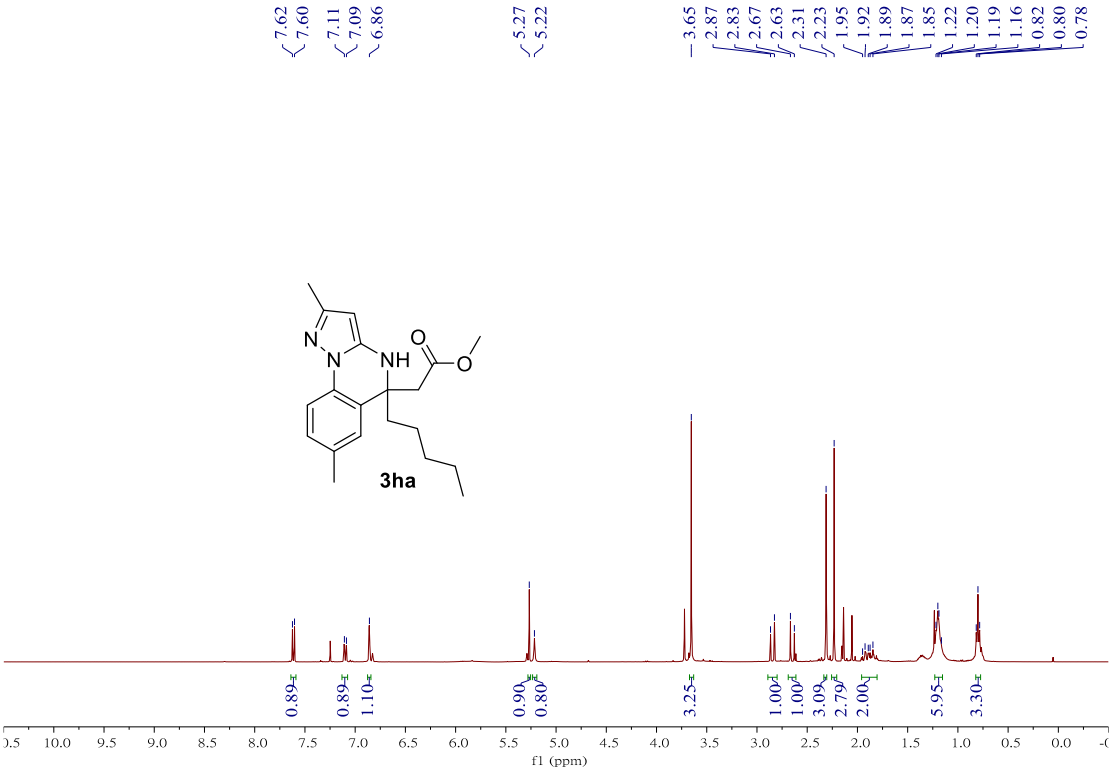
^{13}C{1 H} spectrum (101 MHz) of compound **3fa** in$CDCl_3$



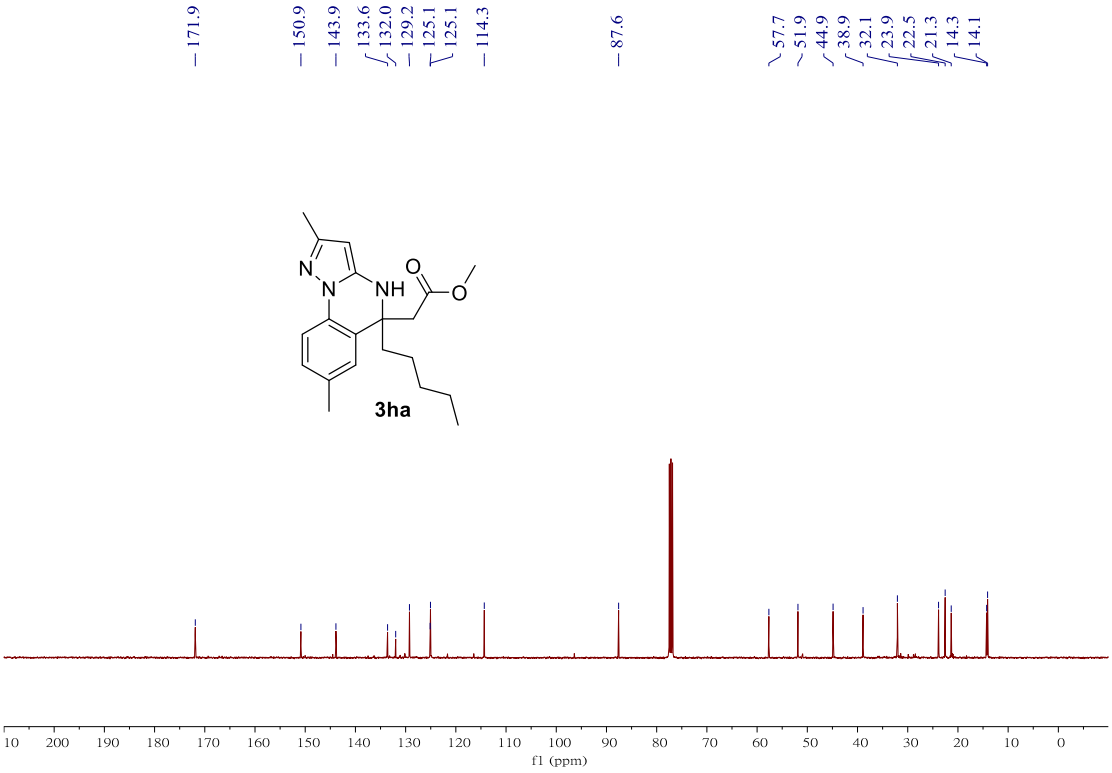
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
358.2125	1	C20H28N3O3	358.2125	-0.1	22.2	1	100.00	8.5	even	ok	M+H

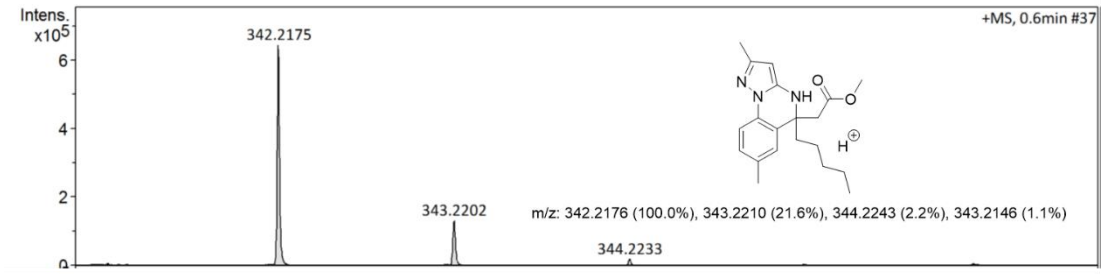
HRMS Mass (ESI) spectrum of compound **3fa**



^{1}H spectrum (400 MHz) of compound **3ha** in $CDCl_3$



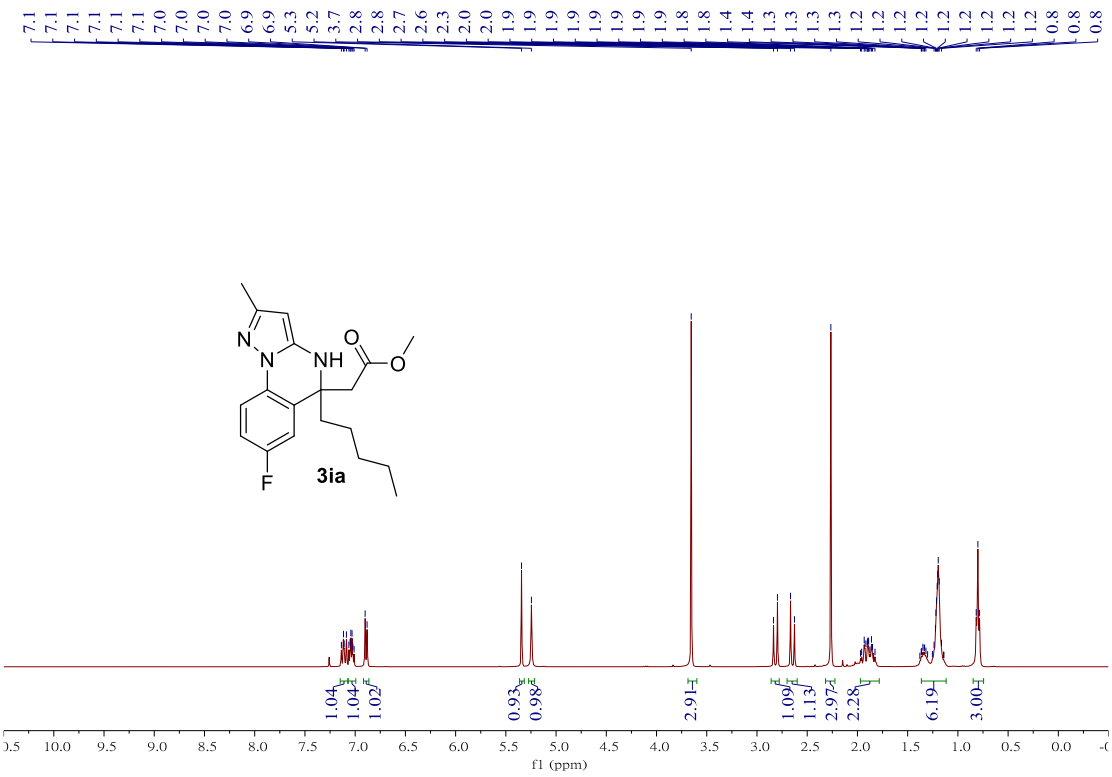
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ha** in$CDCl_3$



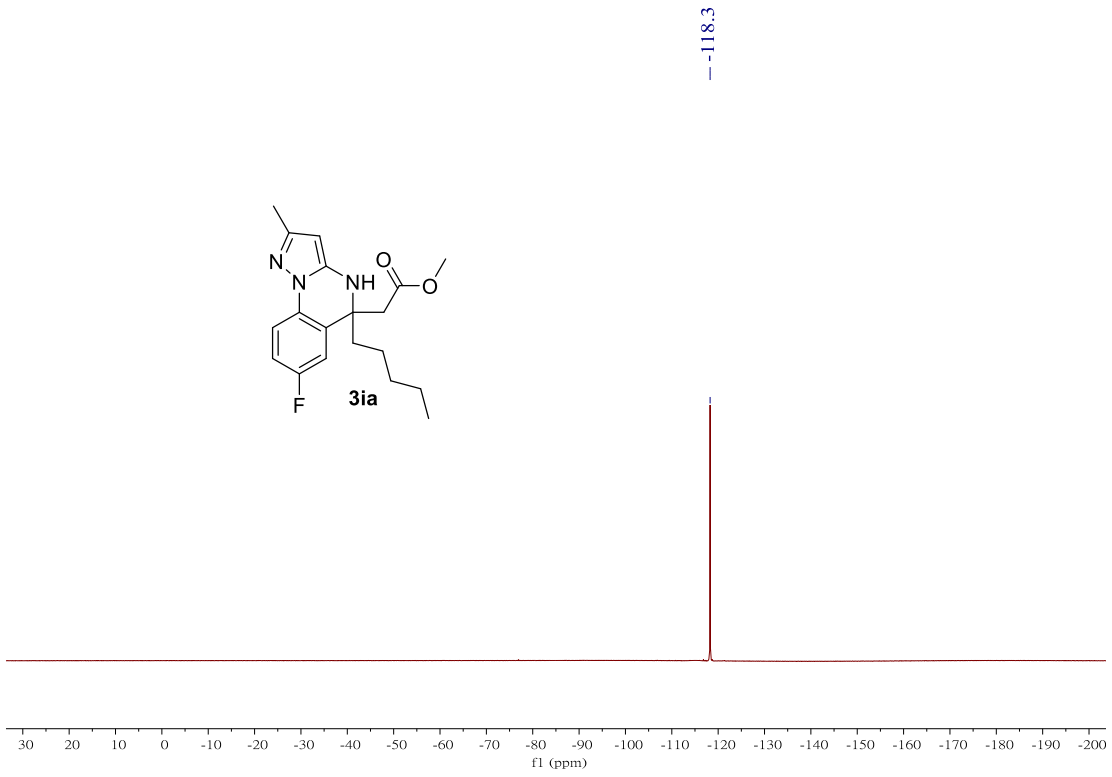
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
342.2175	1	C20H28N3O2	342.2176	0.4	16.5	1	100.00	8.5	even	ok	M+H

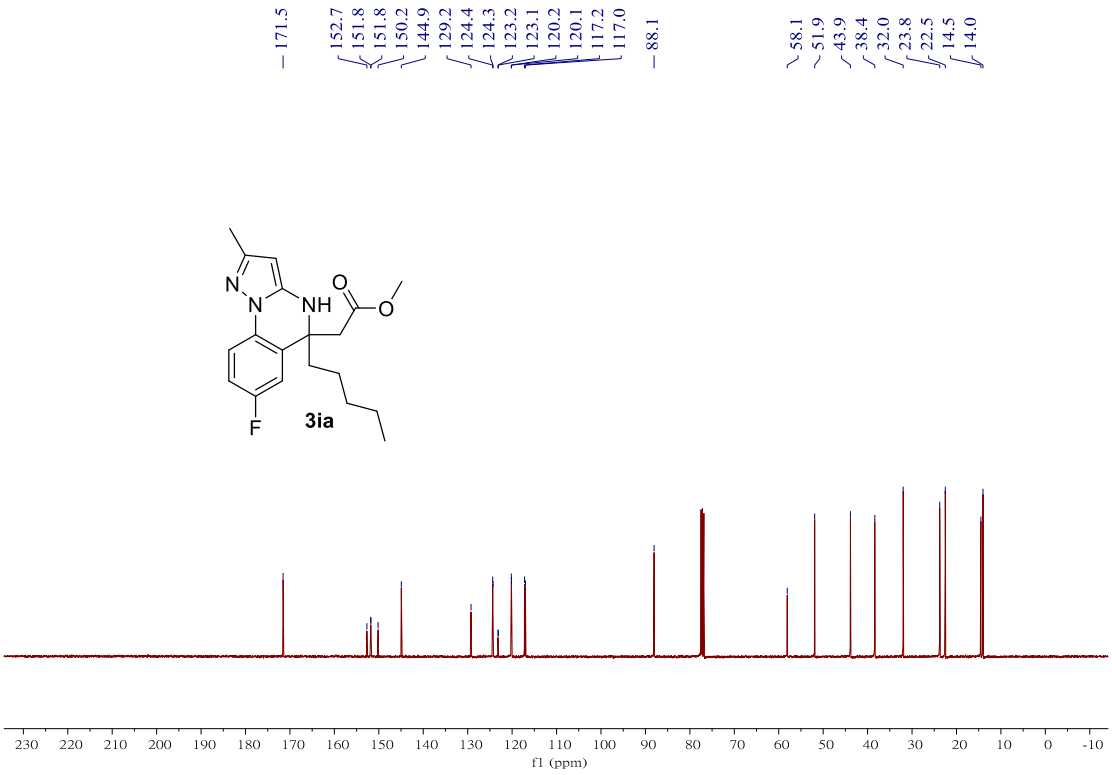
HRMS Mass (ESI) spectrum of compound **3ha**



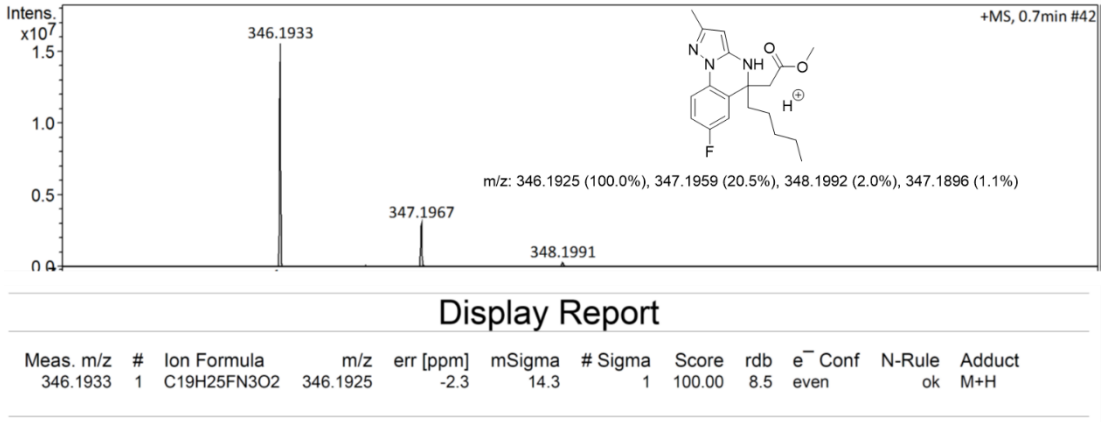
^{1}H spectrum (400 MHz) of compound **3ia** in $CDCl_3$



^{19}F{1 H} spectrum (376 MHz) of compound **3ia** in$CDCl_3$



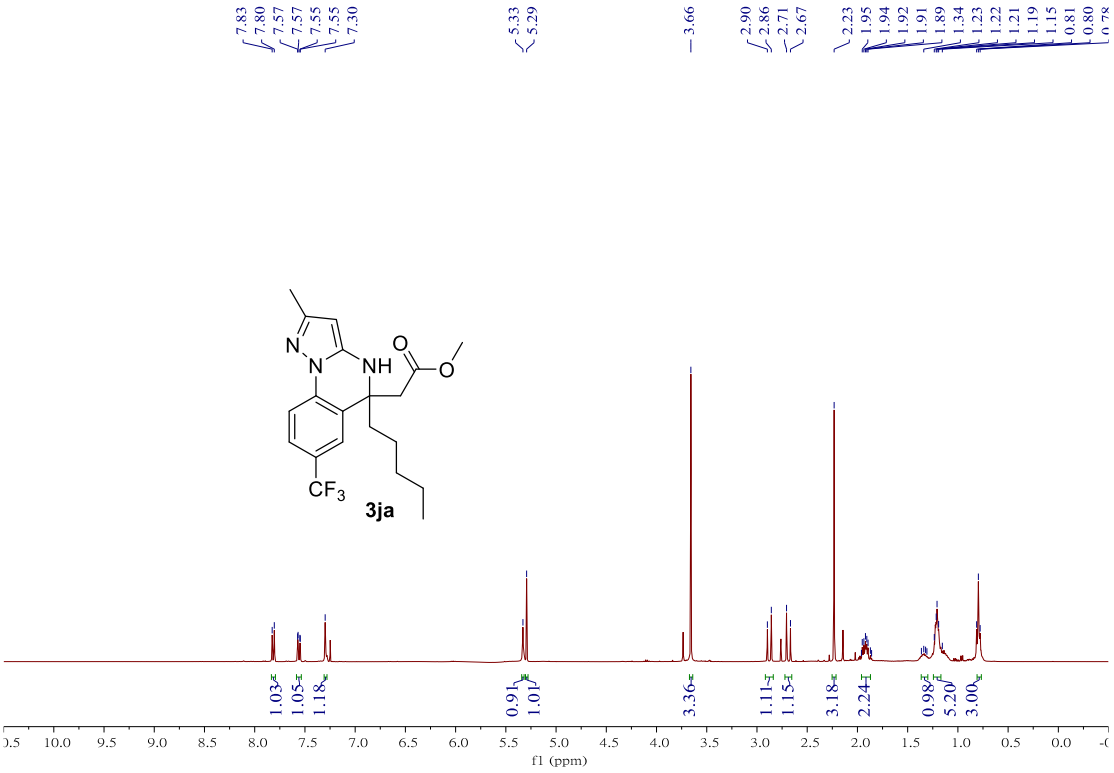
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ia** in$CDCl_3$



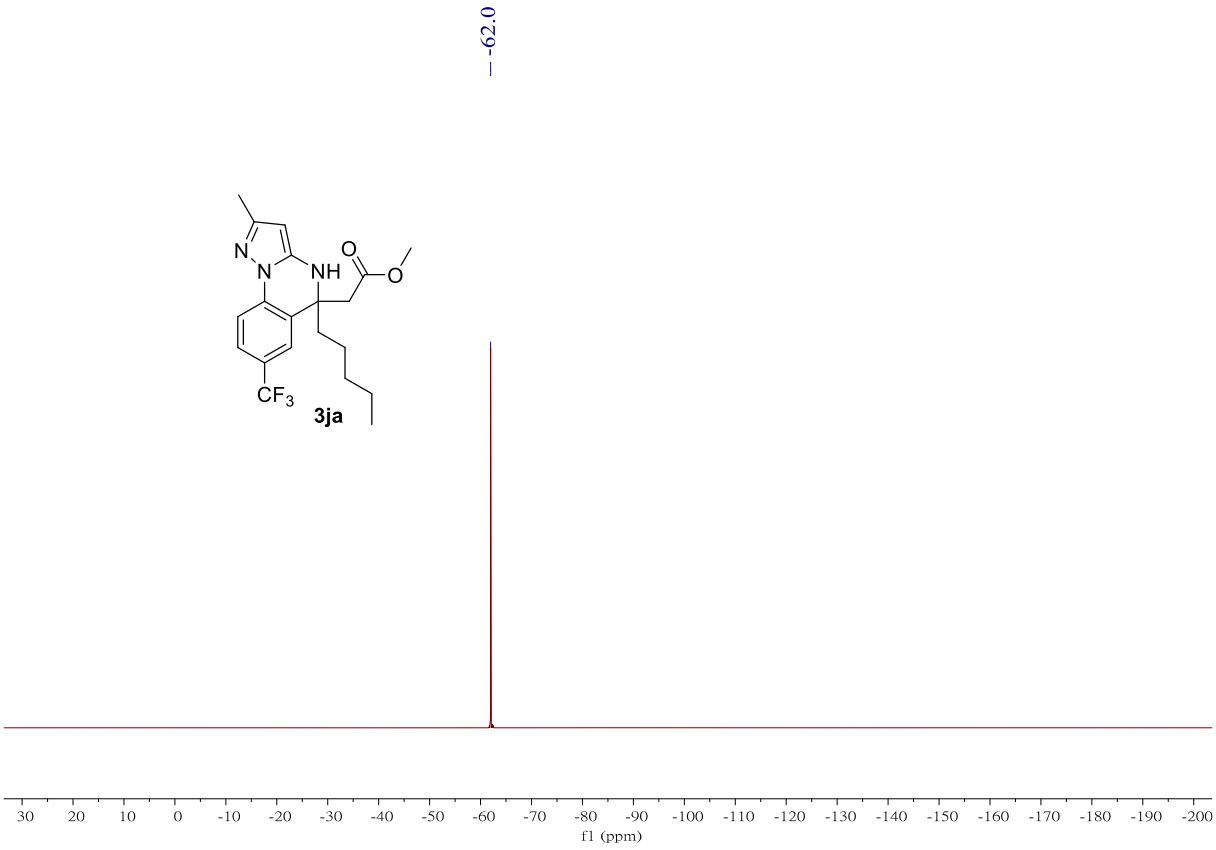
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
346.1933	1	C19H25FN3O2	346.1925	-2.3	14.3	1	100.00	8.5	even	ok	M+H

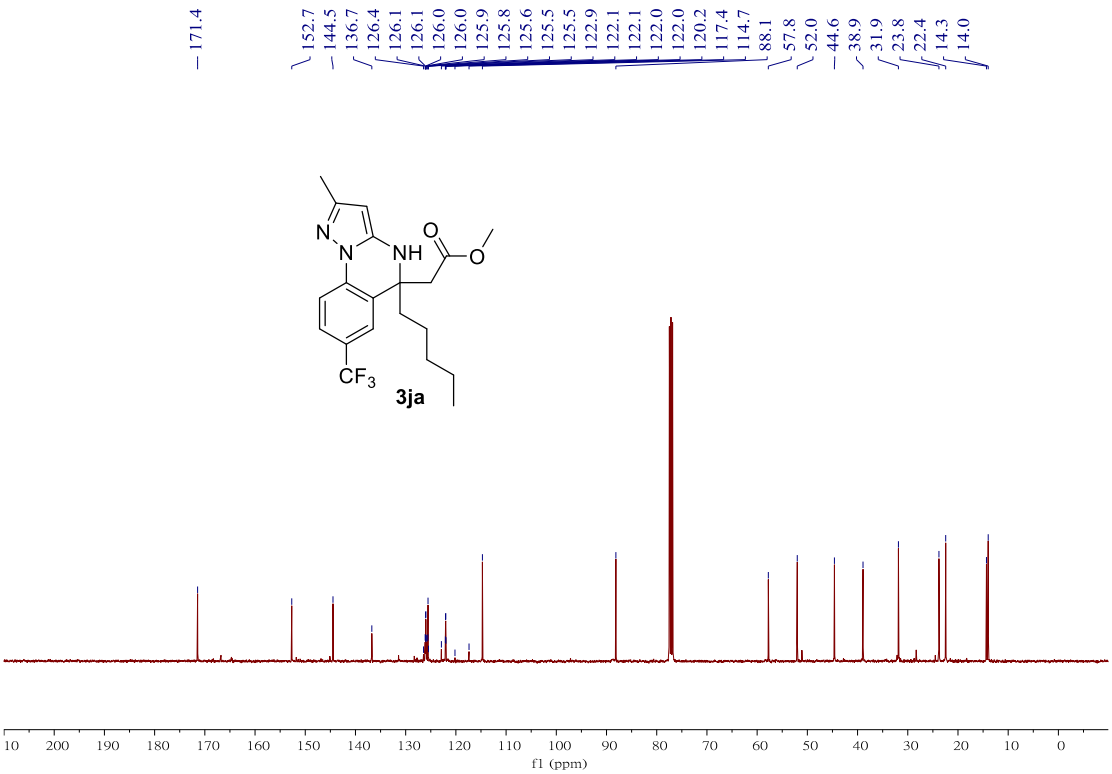
HRMS Mass (ESI) spectrum of compound **3ia**



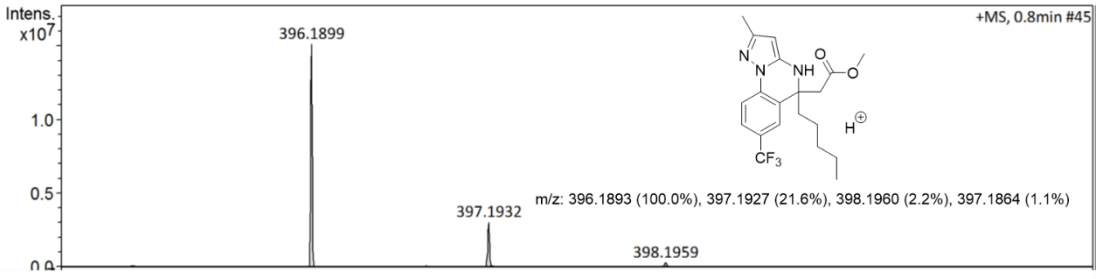
^{1}H spectrum (400 MHz) of compound **3ja** in $CDCl_3$



^{19}F{1 H} spectrum (376 MHz) of compound **3ja** in$CDCl_3$



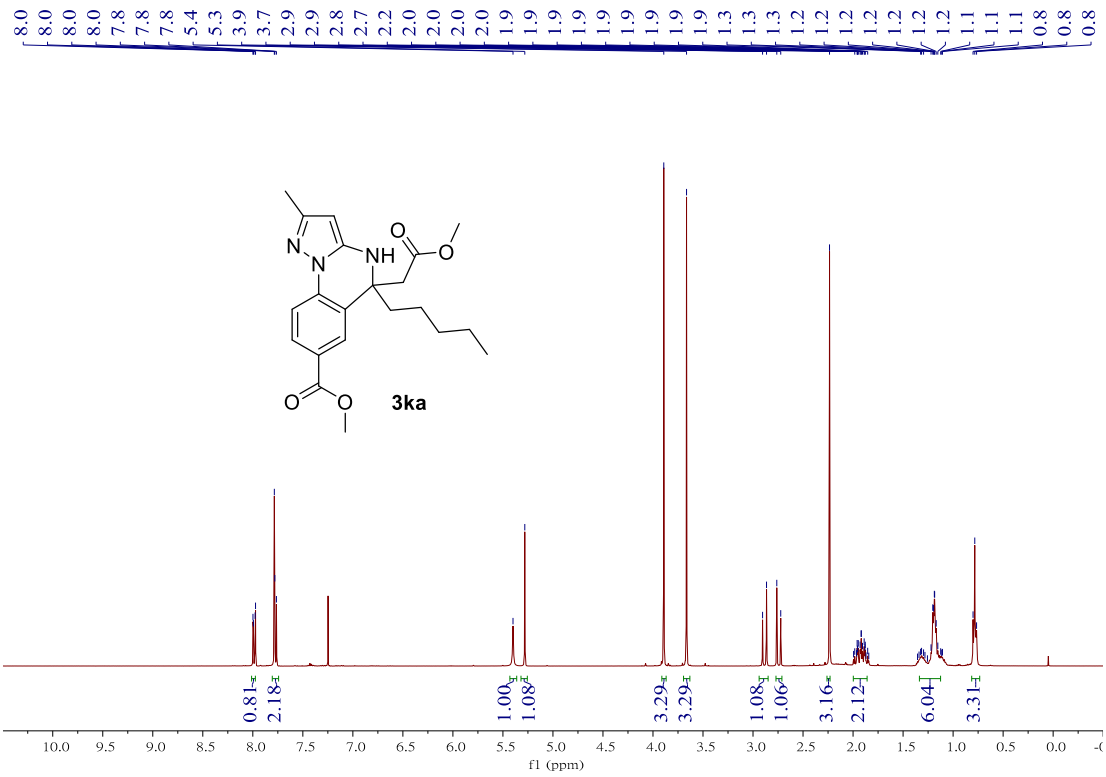
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ja** in$CDCl_3$



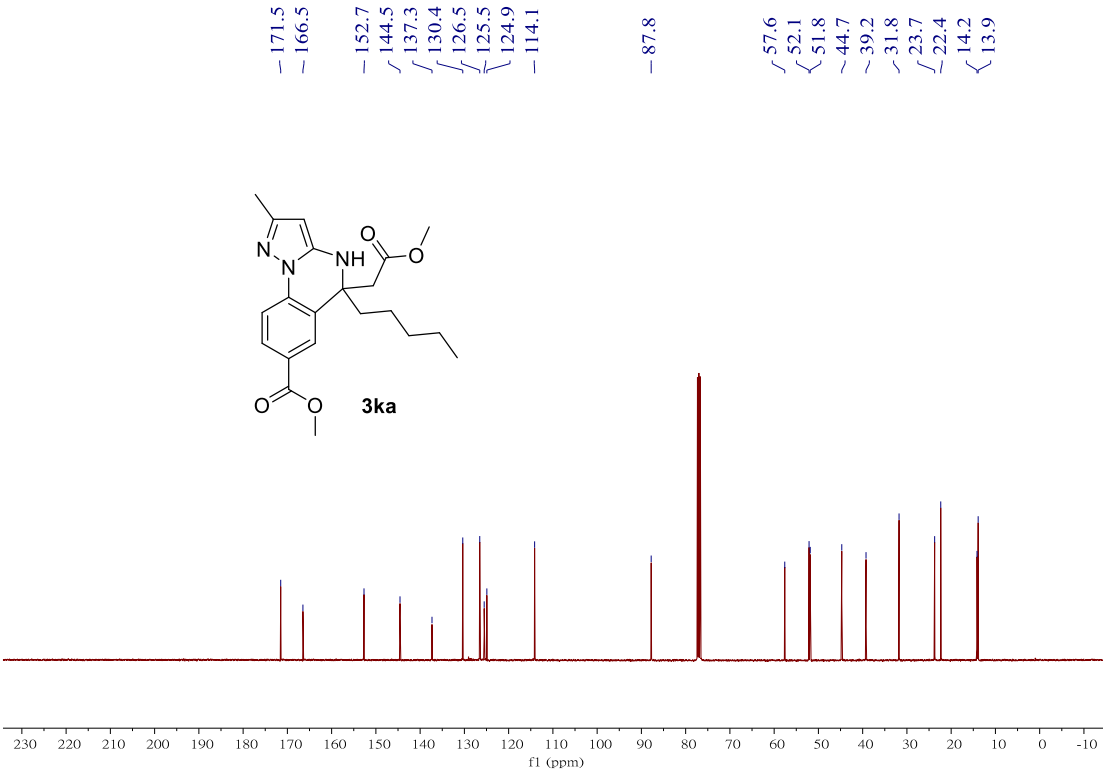
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
396.1899	1	C20H25F3N3O2	396.1893	-1.3	18.7	1	100.00	8.5	even	ok	M+H

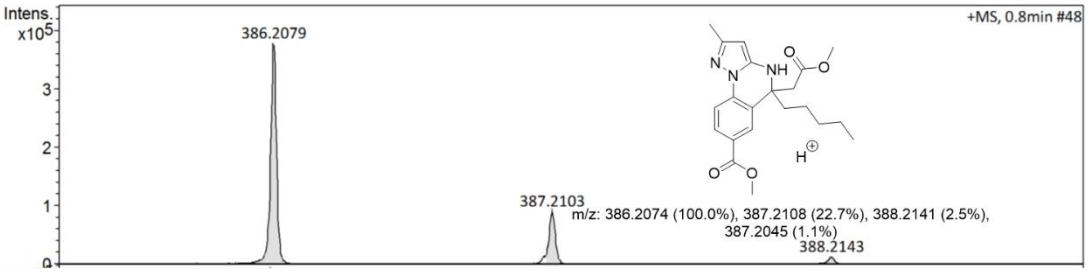
HRMS Mass (ESI) spectrum of compound **3ja**



^{1}H spectrum (400 MHz) of compound **3ka** in $CDCl_3$



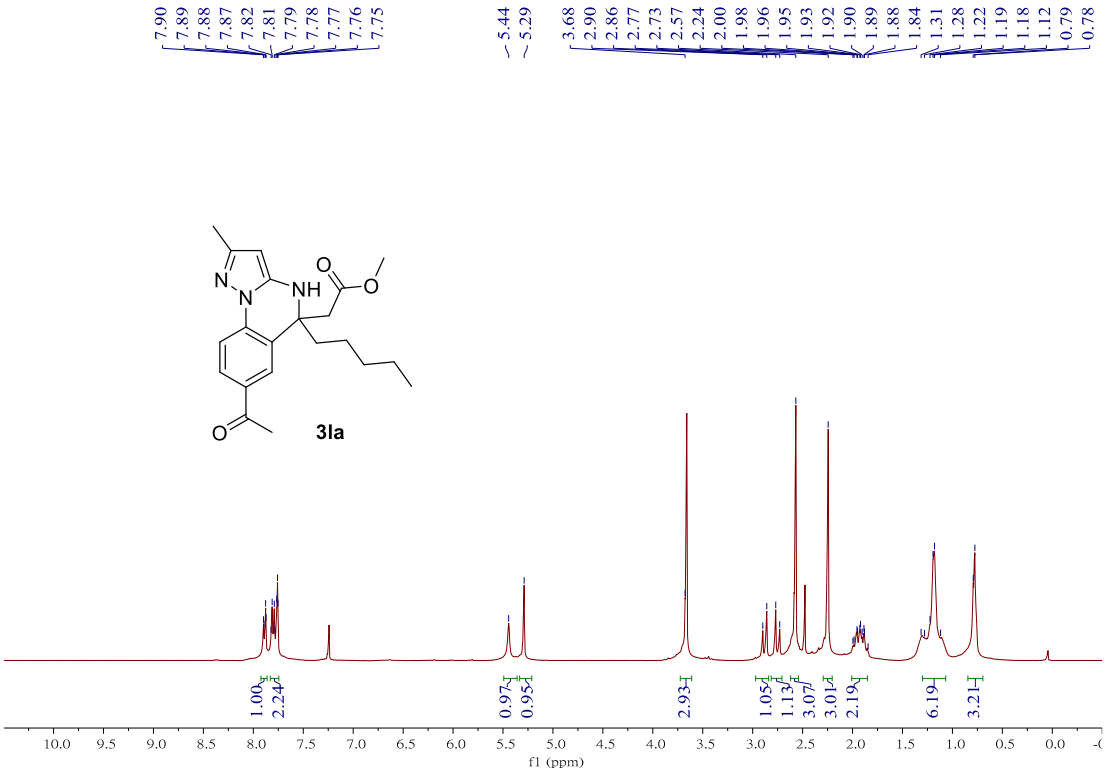
^{13}C{1 H} spectrum (101 MHz) of compound **3ka** in$CDCl_3$



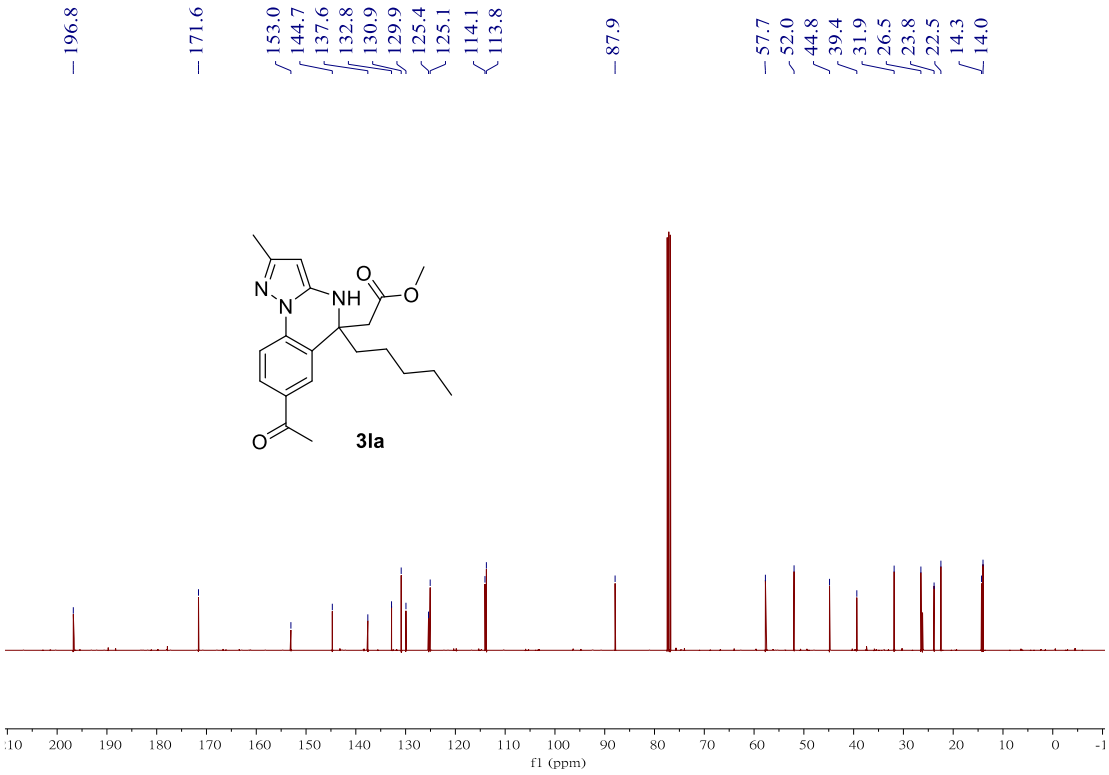
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
386.2079	1	C21H28N3O4	386.2074	-1.3	3.0	1	100.00	9.5	even	ok	M+H

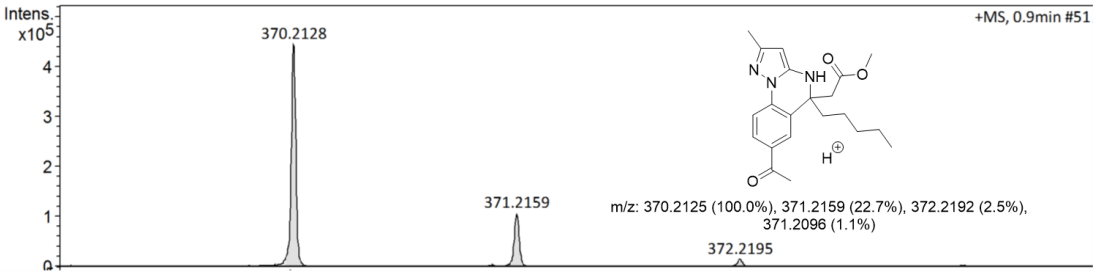
HRMS Mass (ESI) spectrum of compound **3ka**



^{1}H spectrum (400 MHz) of compound **3la** in $CDCl_3$



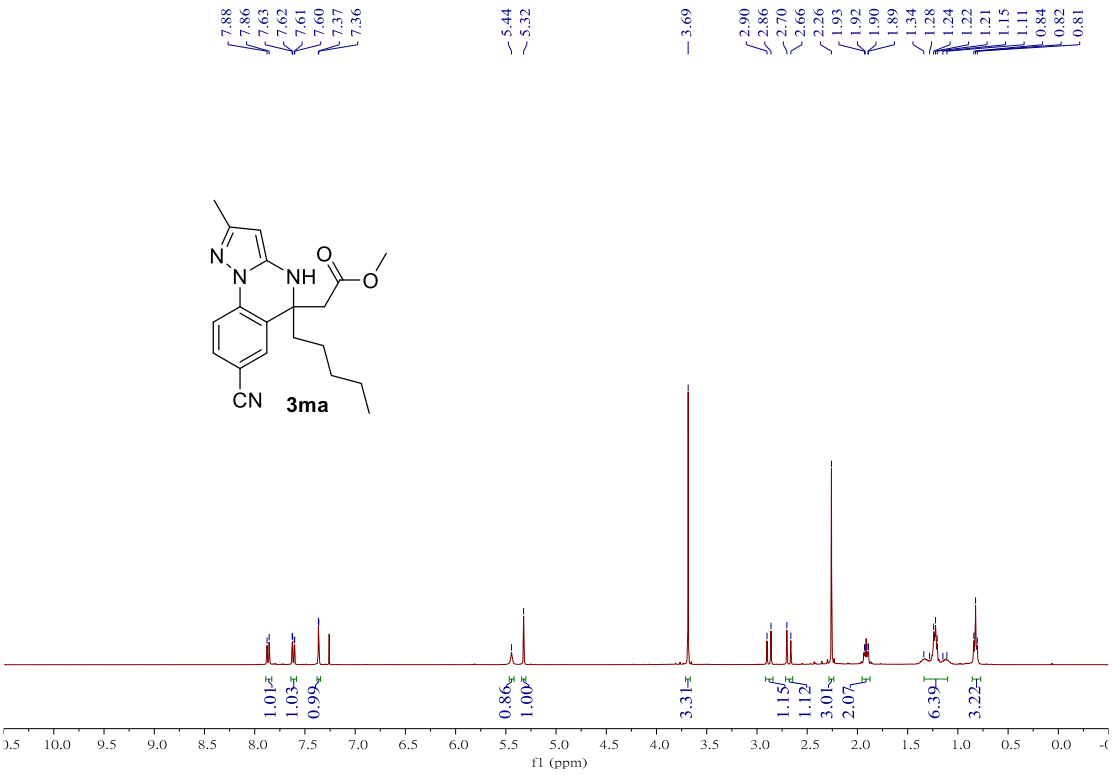
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3la** in$CDCl_3$



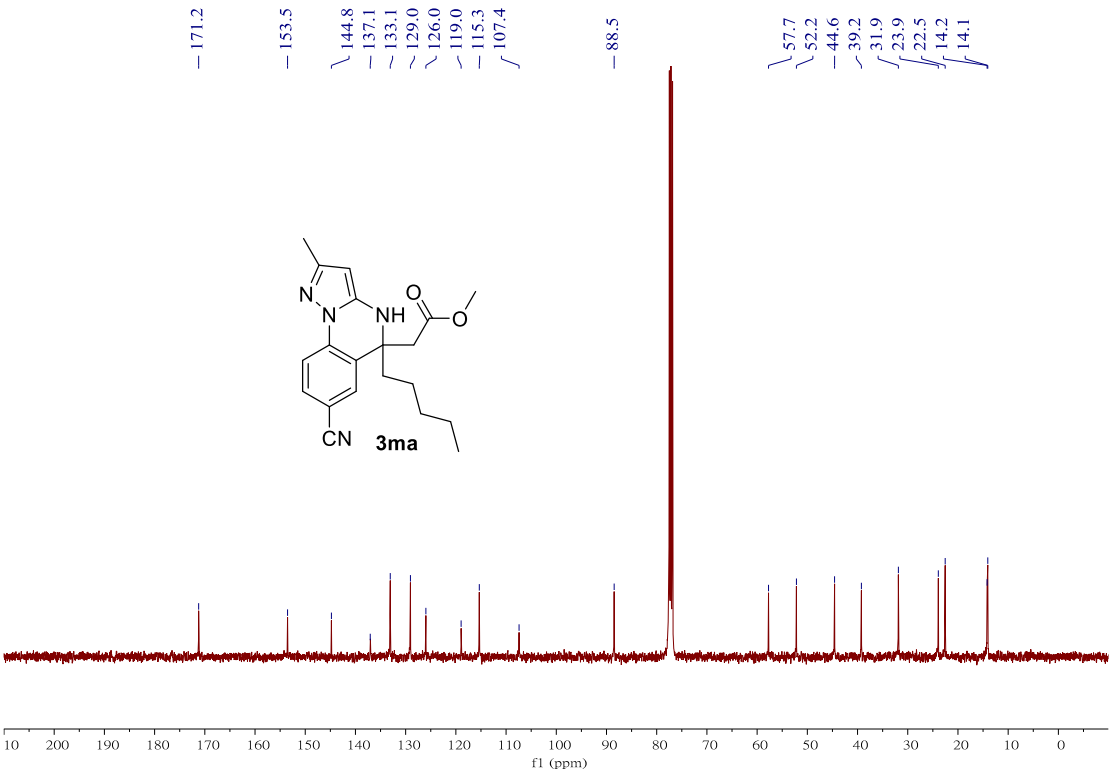
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
370.2128	1	C21H28N3O3	370.2125	-0.9	1.2	1	100.00	9.5	even	ok	M+H

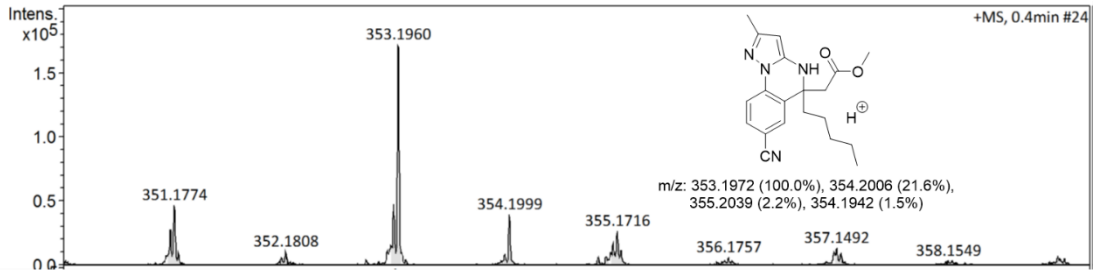
HRMS Mass (ESI) spectrum of compound **3la**



^{1}H spectrum (400 MHz) of compound **3ma** in $CDCl_3$



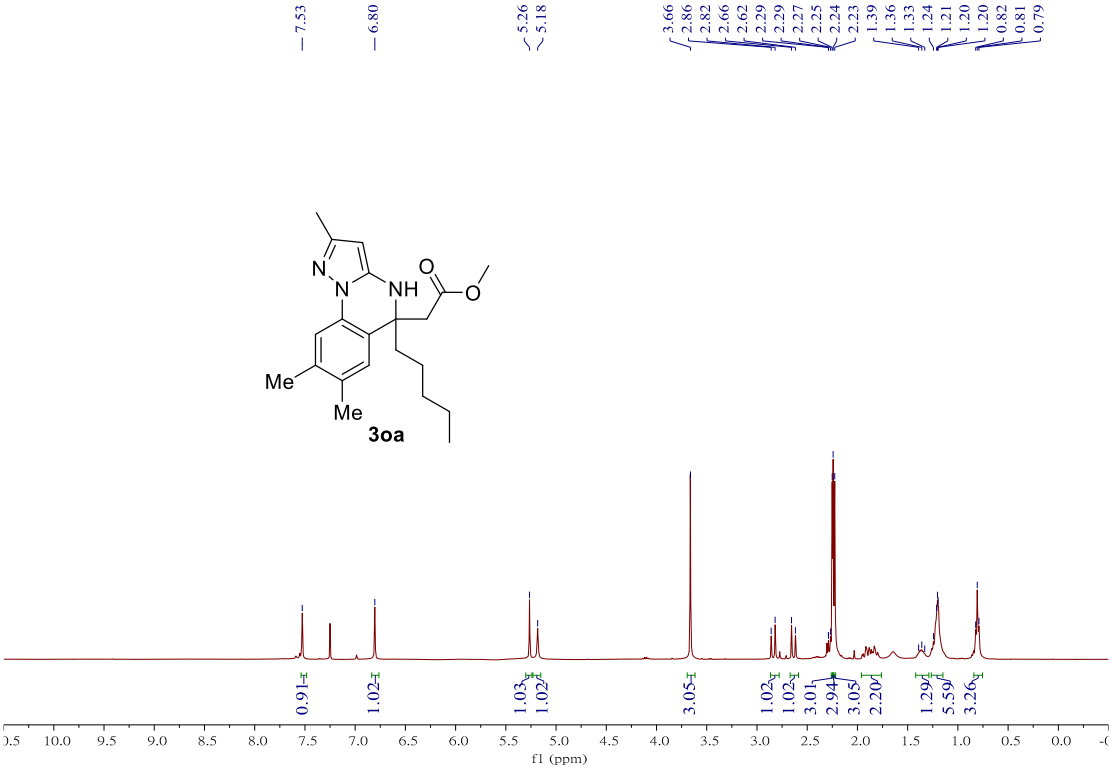
^{13}C{1 H} spectrum (101 MHz) of compound **3ma** in$CDCl_3$



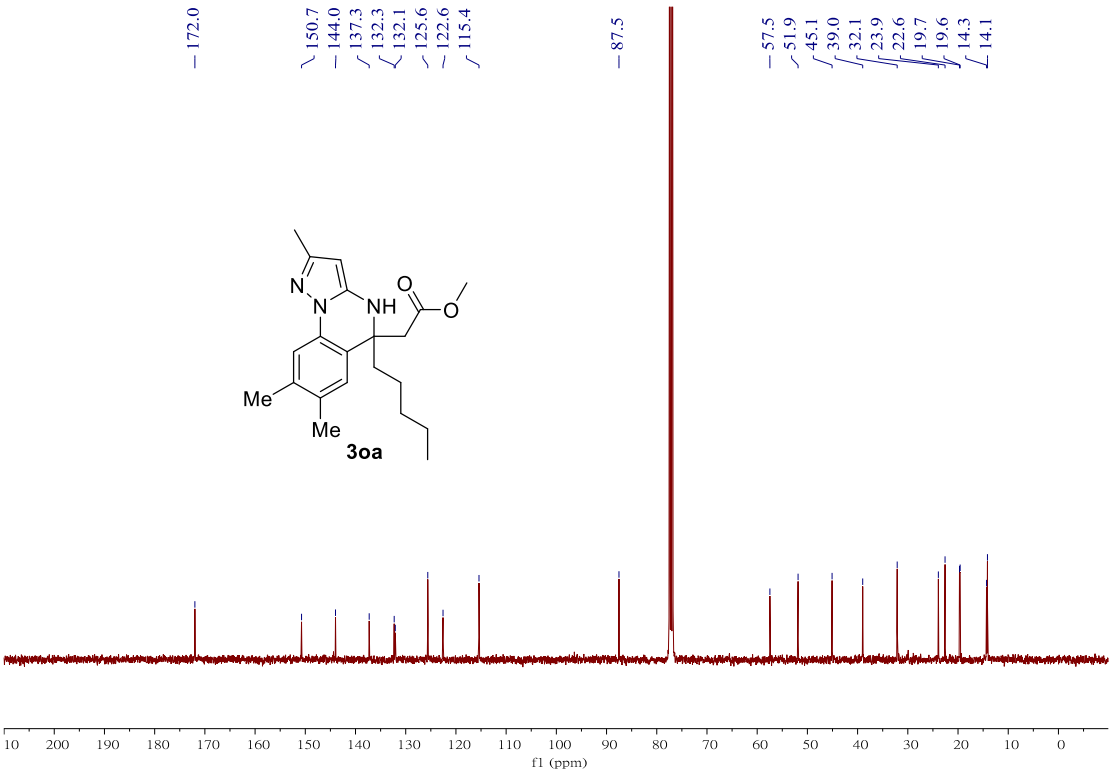
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e¯ Conf	N-Rule	Adduct
353.1960	1	C20H25N4O2	353.1972	-3.4	19.9	1	100.00	10.5	even	ok	M+H

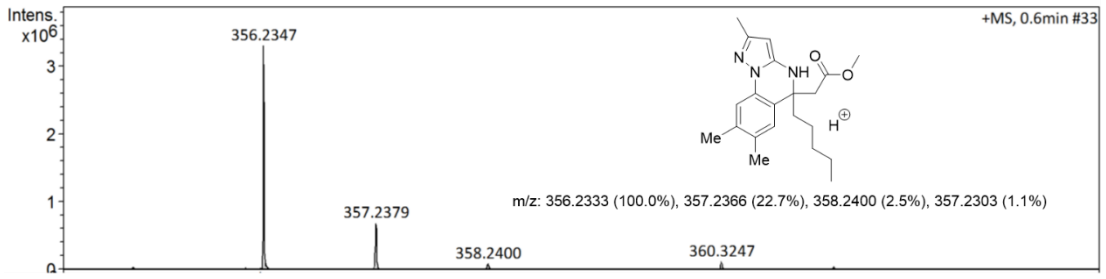
HRMS Mass (ESI) spectrum of compound **3ma**



^{1}H spectrum (400 MHz) of compound **3oa** in $CDCl_3$



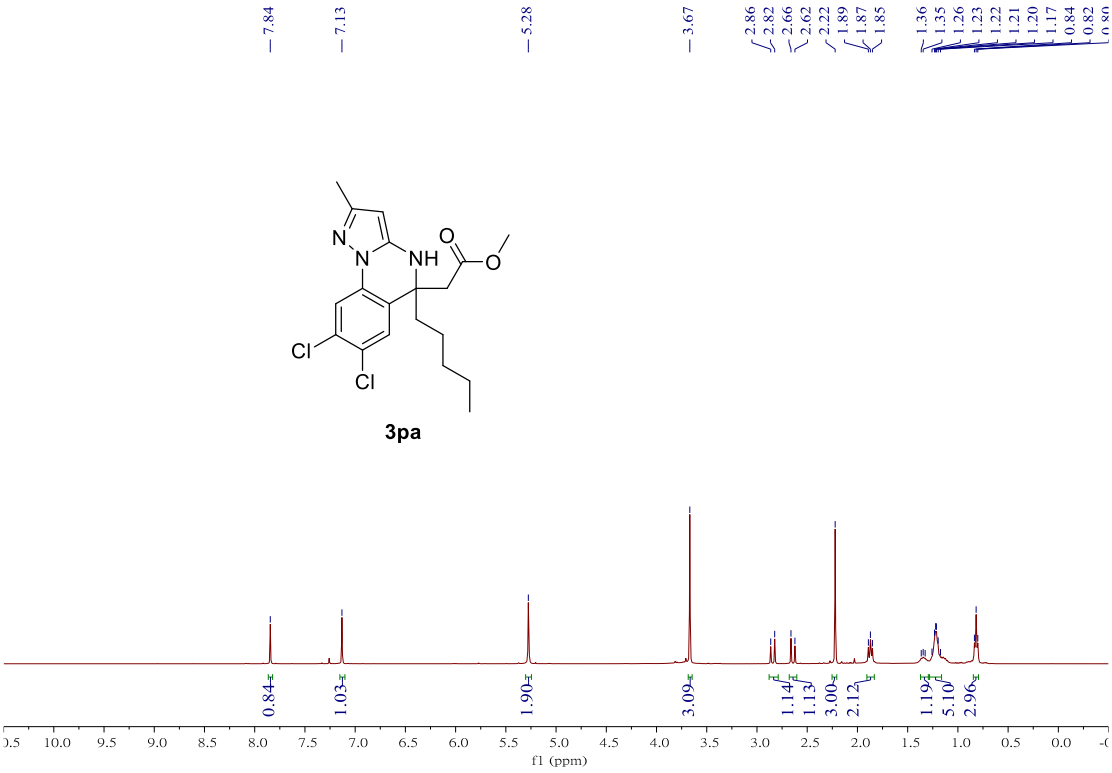
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3oa** in$CDCl_3$



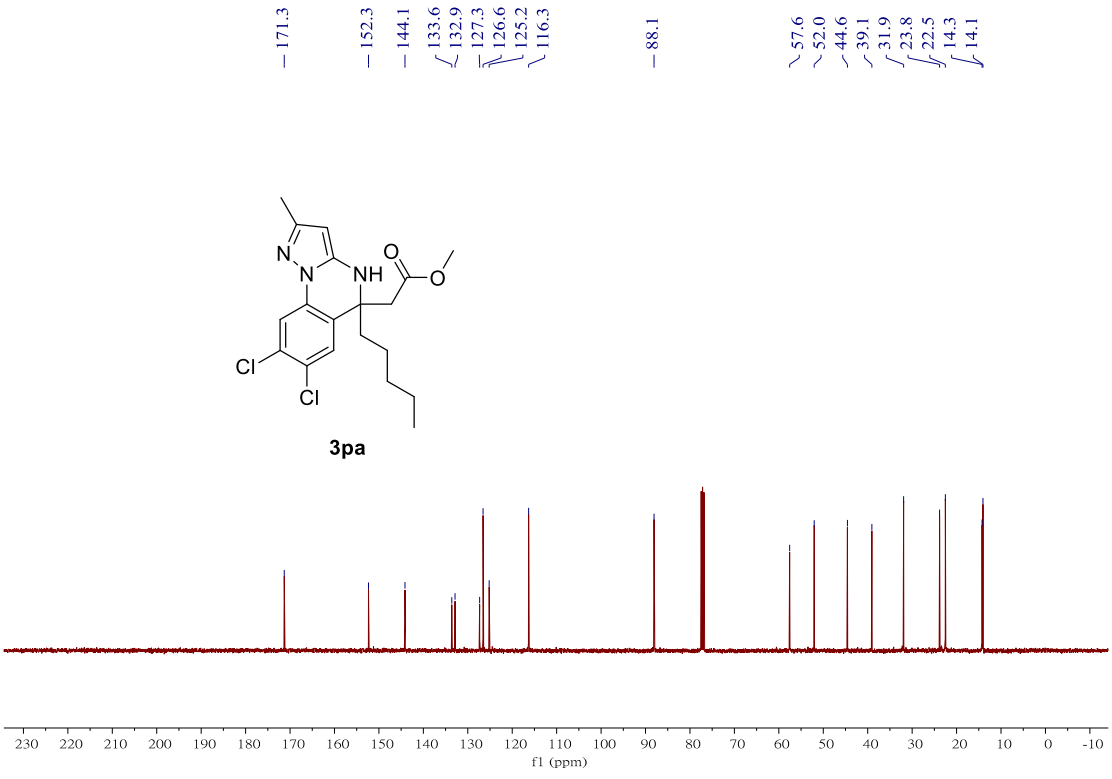
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
356.2347	1	C21H30N3O2	356.2333	4.1	19.7	1	100.00	8.5	even	ok	M+H

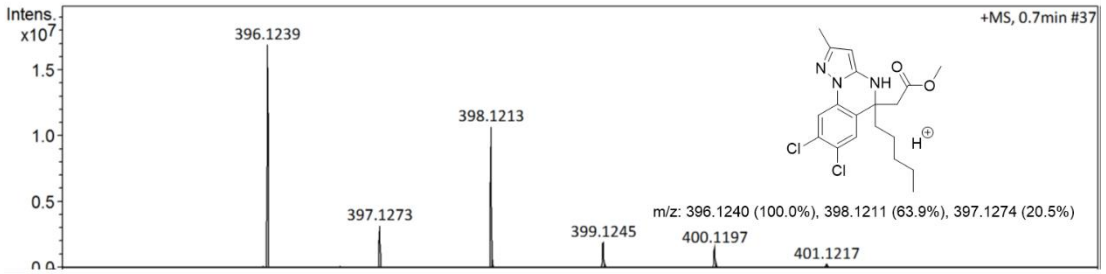
HRMS Mass (ESI) spectrum of compound **3oa**



^{1}H spectrum (400 MHz) of compound **3pa** in $CDCl_3$



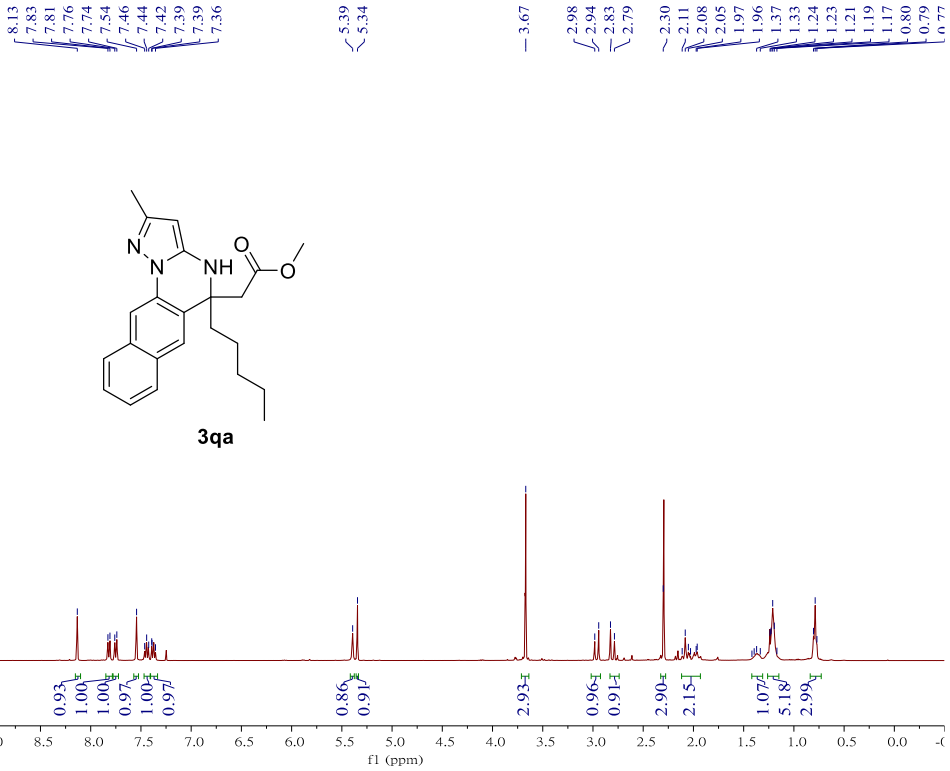
^{13}C{1 H} spectrum (101 MHz) of compound **3pa** in$CDCl_3$



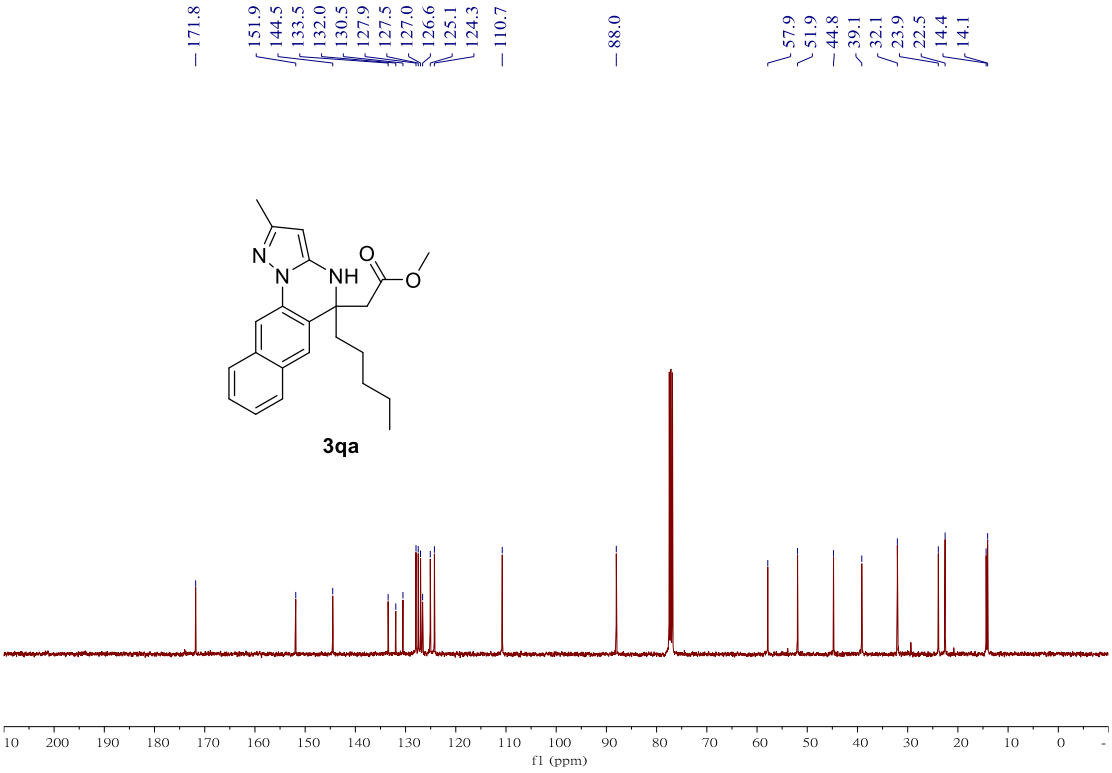
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
396.1239	1	C19H24Cl2N3O2	396.1240	-0.2	25.4	1	100.00	8.5	even	ok	M+H

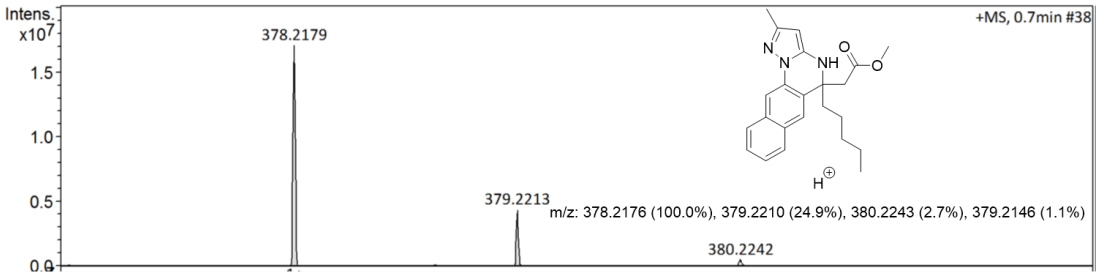
HRMS Mass (ESI) spectrum of compound **3pa**



^{1}H spectrum (400 MHz) of compound **3qa** in $CDCl_3$



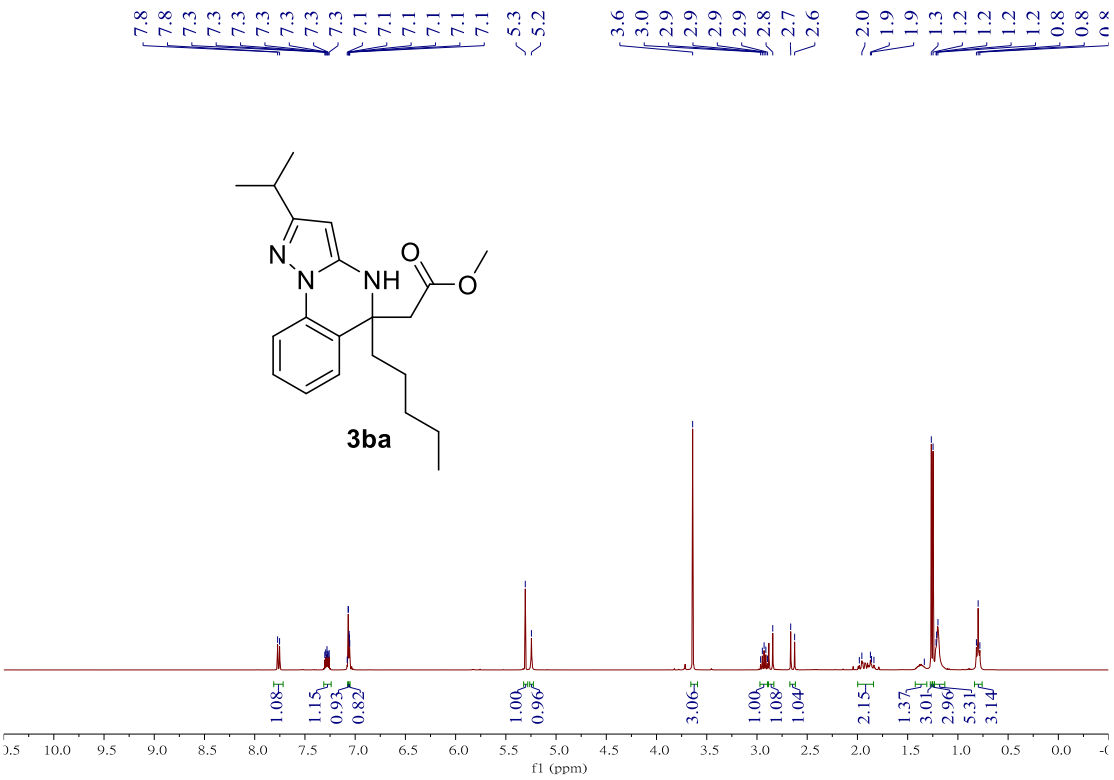
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3qa** in$CDCl_3$



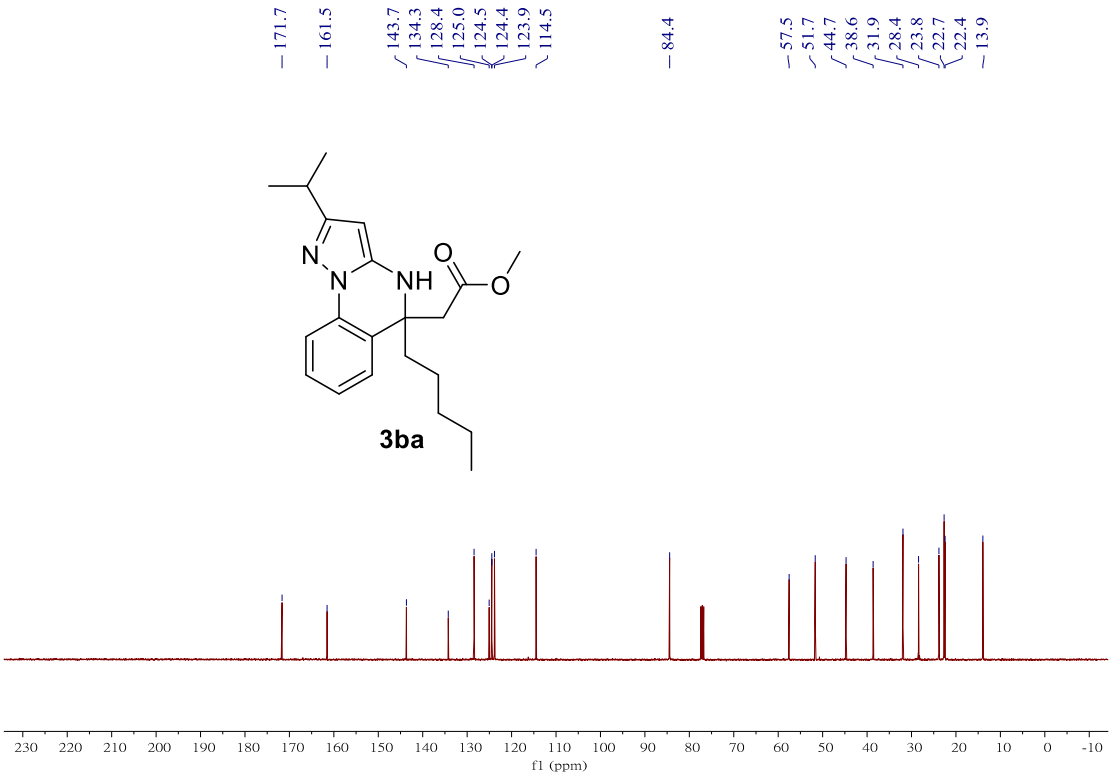
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e¯ Conf	N-Rule	Adduct
378.2179	1	C23H28N3O2	378.2176	0.8	6.1	1	100.00	11.5	even	ok	M+H

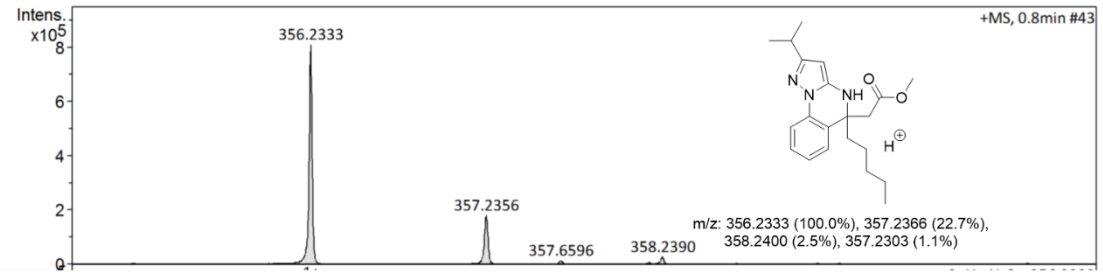
HRMS Mass (ESI) spectrum of compound **3qa**



^{1}H spectrum (400 MHz) of compound **3ba** in $CDCl_3$



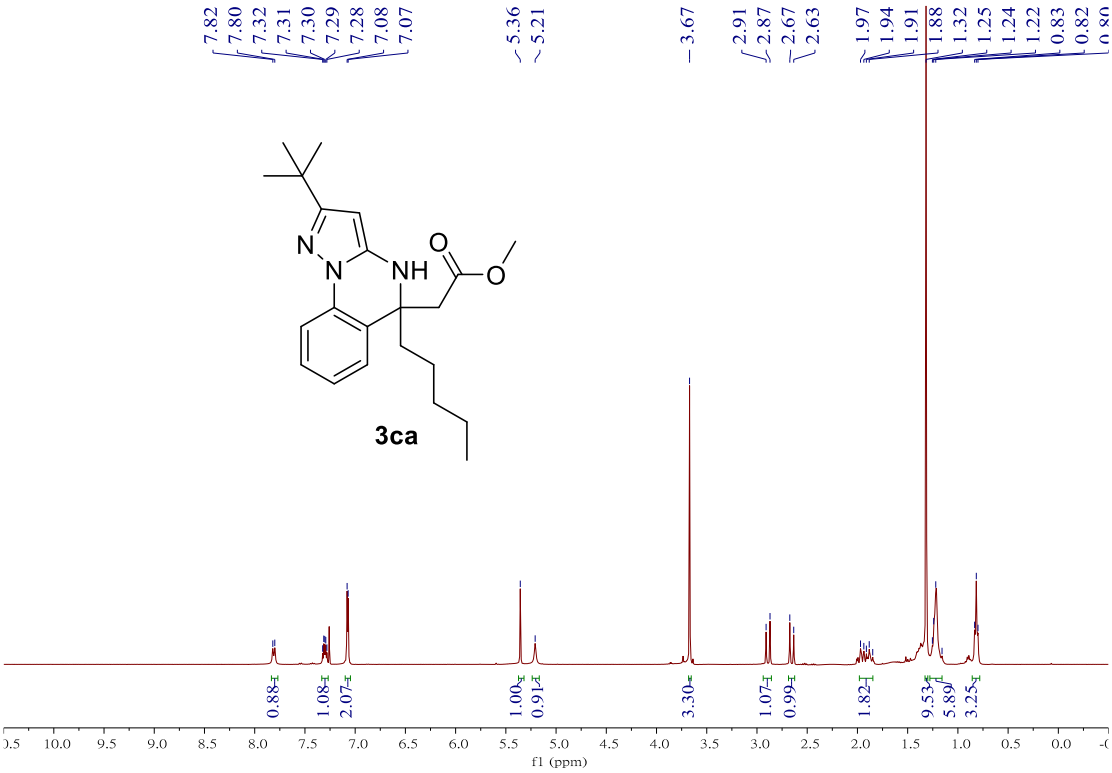
^{13}C{1 H} spectrum (101 MHz) of compound **3ba** in$CDCl_3$



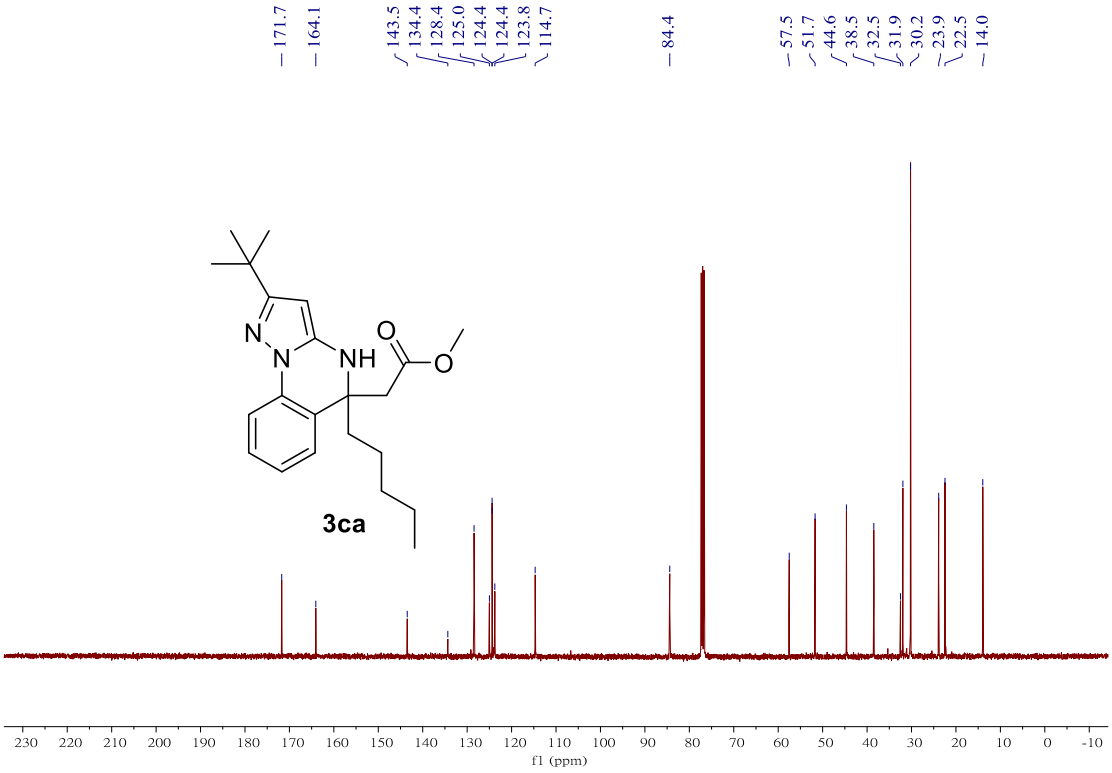
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
356.2333	1	C21H30N3O2	356.2333	0.2	12.4	1	100.00	8.5	even	ok	M+H

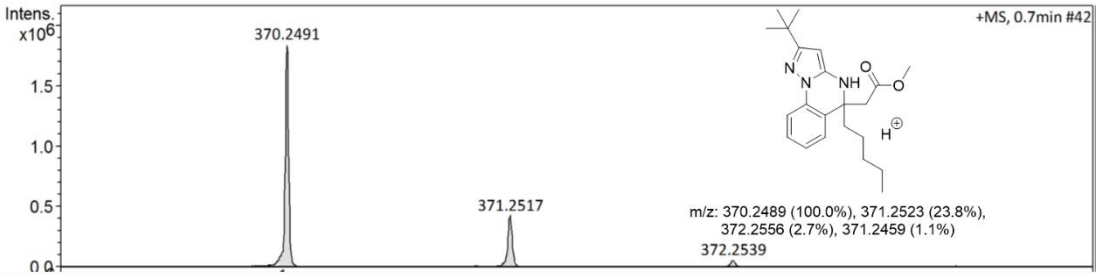
HRMS Mass (ESI) spectrum of compound **3ba**



^{1}H spectrum (400 MHz) of compound **3ca** in $CDCl_3$



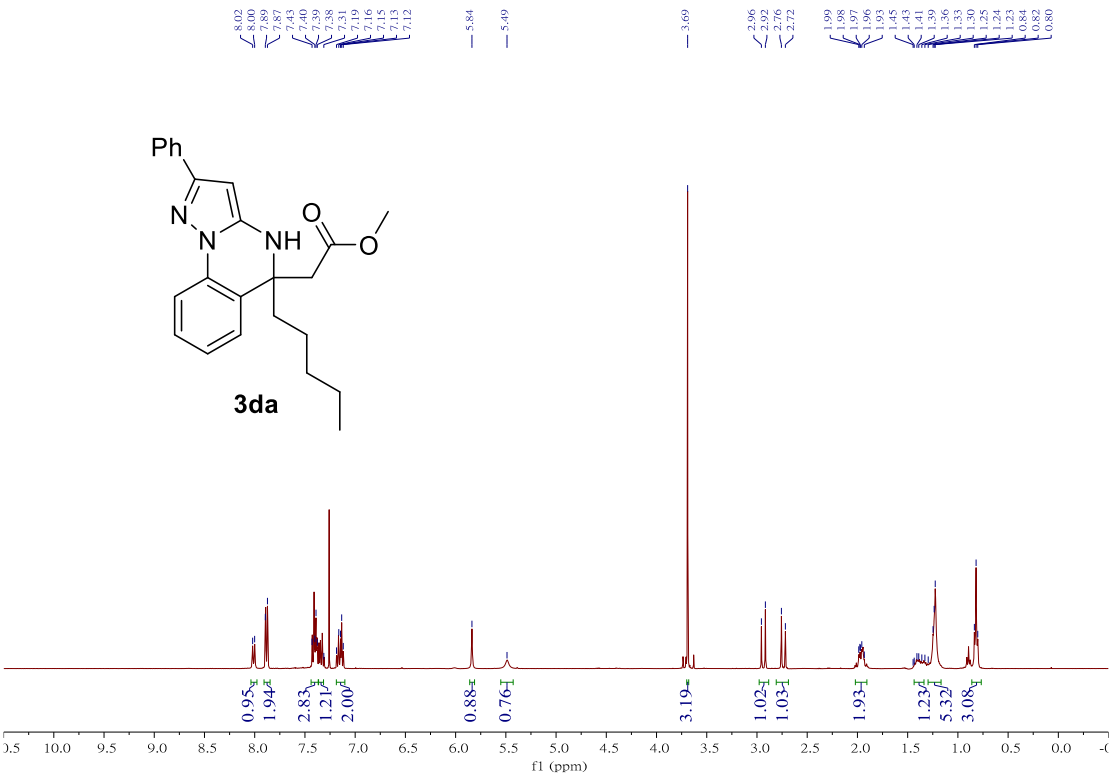
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ca** in$CDCl_3$



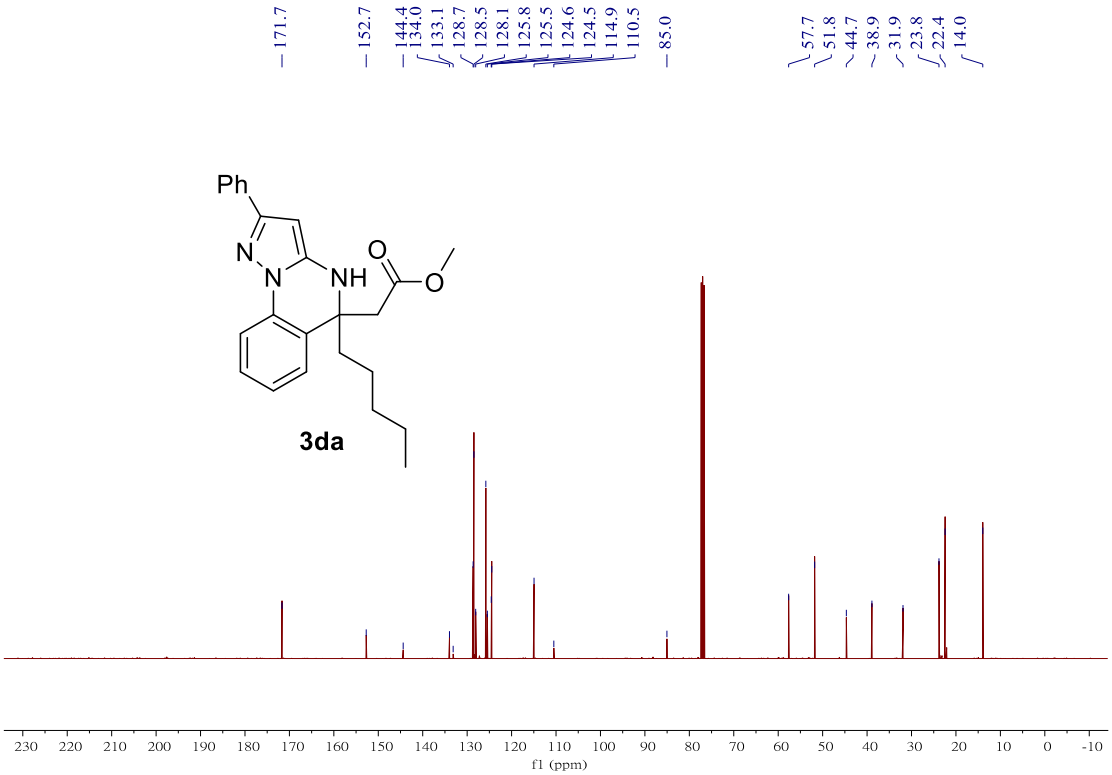
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e¯ Conf	N-Rule	Adduct
370.2491	1	C22H32N3O2	370.2489	-0.6	14.5	1	100.00	8.5	even	ok	M+H

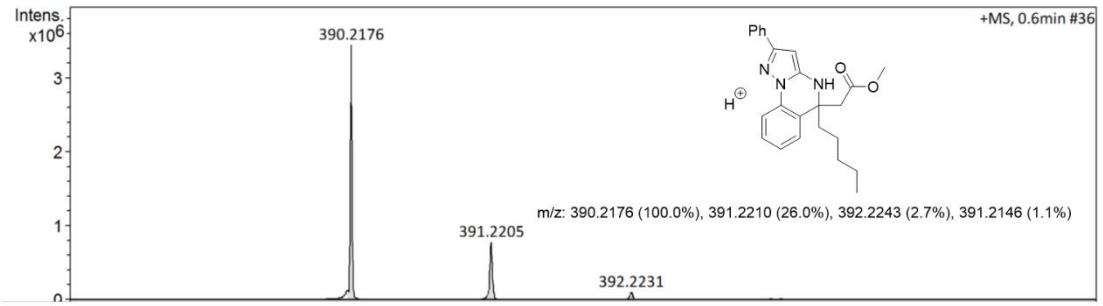
HRMS Mass (ESI) spectrum of compound **3ca**



^{1}H spectrum (400 MHz) of compound **3da** in $CDCl_3$



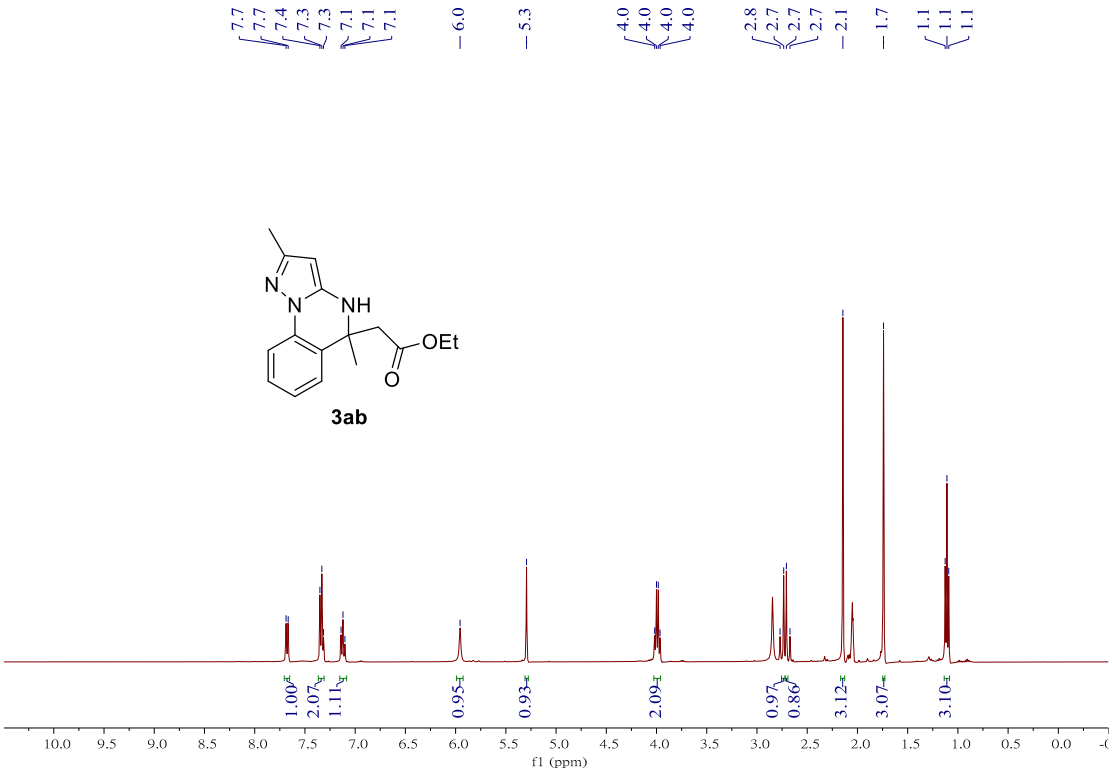
$^{13}C\{1H\}$ spectrum (101 MHz) of compound **3da** in$CDCl_3$



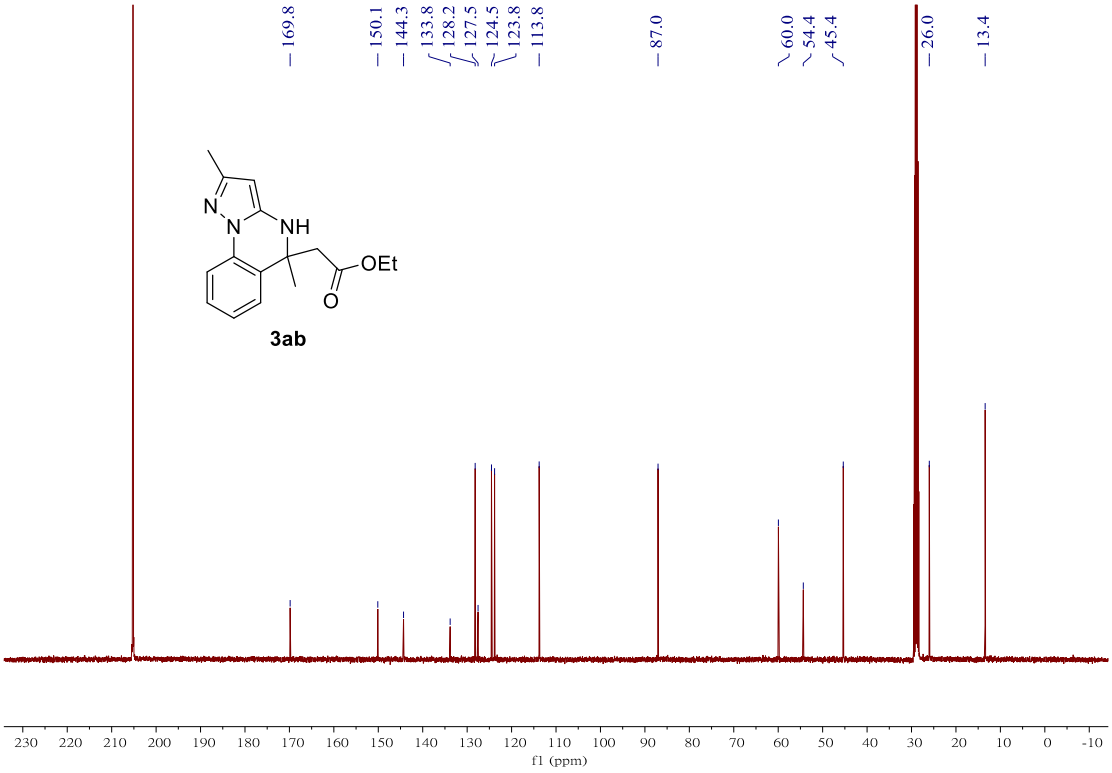
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e¯ Conf	N-Rule	Adduct
390.2176	1	C24H28N3O2	390.2176	0.1	24.8	1	100.00	12.5	even	ok	M+H

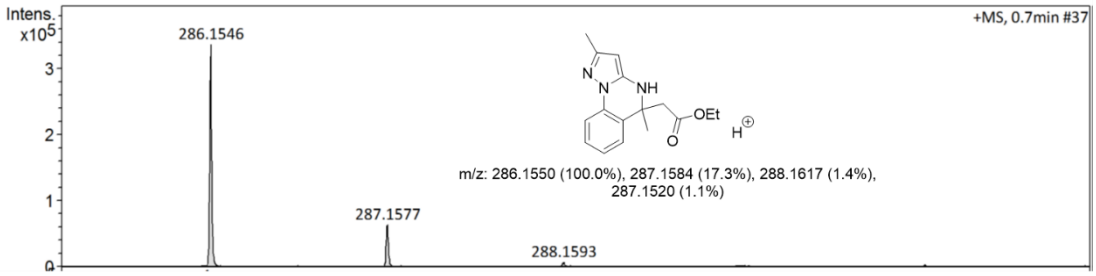
HRMS Mass (ESI) spectrum of compound **3da**



^{1}H spectrum (400 MHz) of compound **3ab** in acetone-d^6



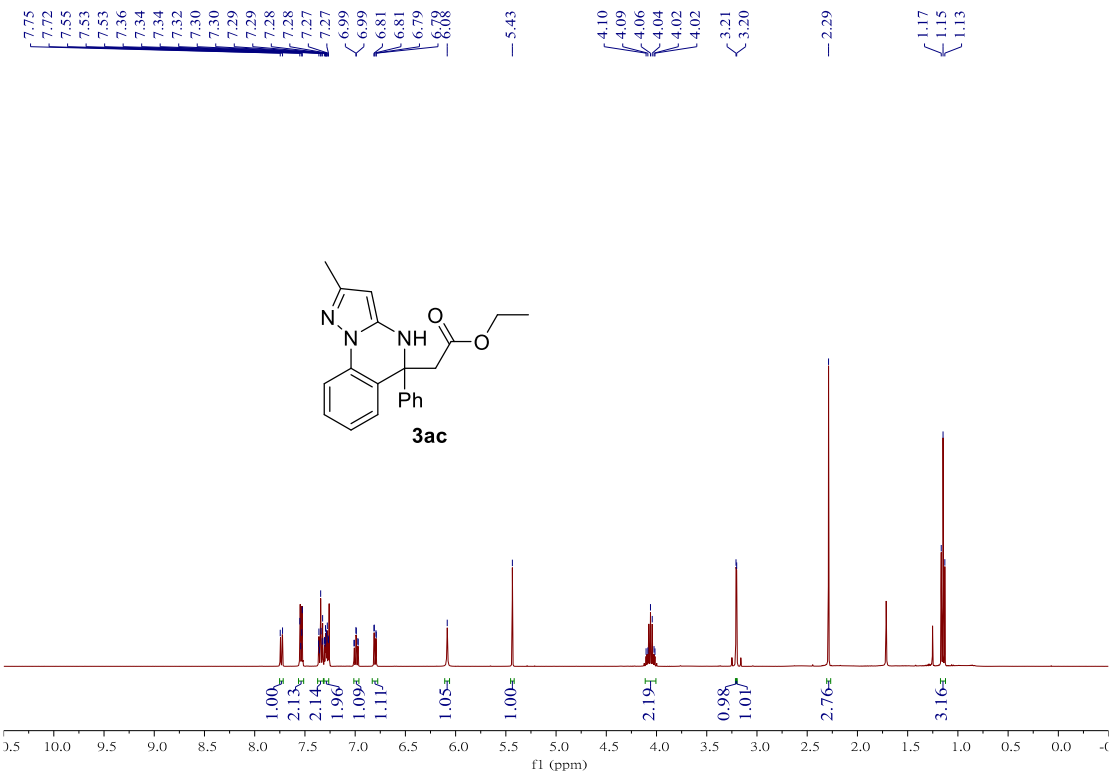
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ab** in acetone-d^6



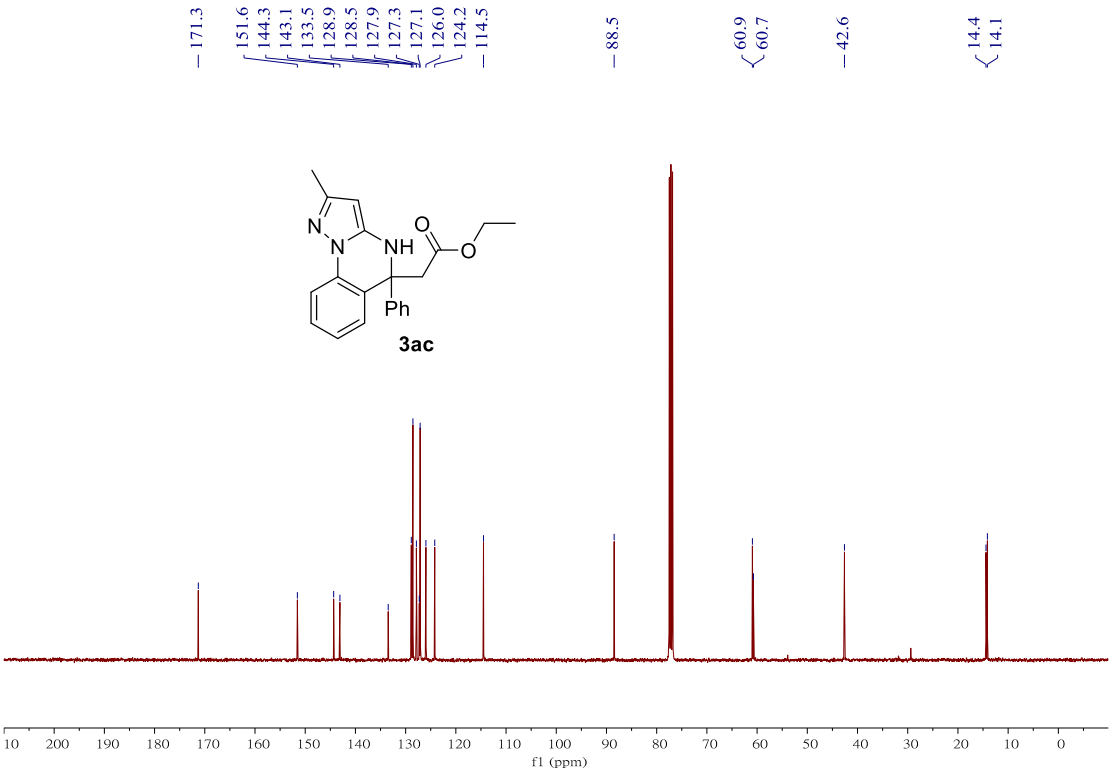
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
286.1546	1	C16H20N3O2	286.1550	-1.3	1.3	1	100.00	8.5	even	ok	M+H

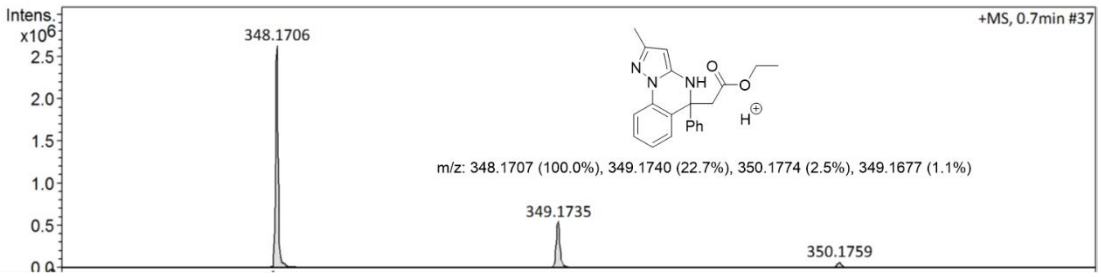
HRMS Mass (ESI) spectrum of compound **3ab**



^{1}H spectrum (400 MHz) of compound **3ac** in $CDCl_3$



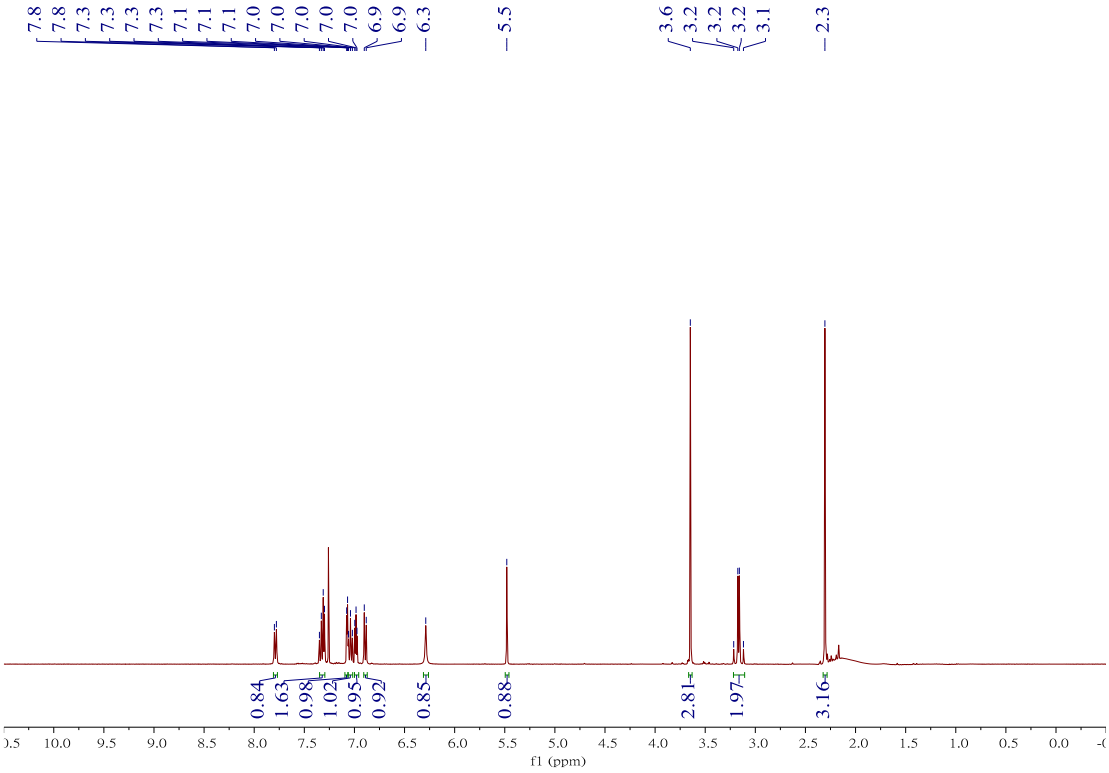
^{13}C{1 H} spectrum (101 MHz) of compound **3ac** in$CDCl_3$



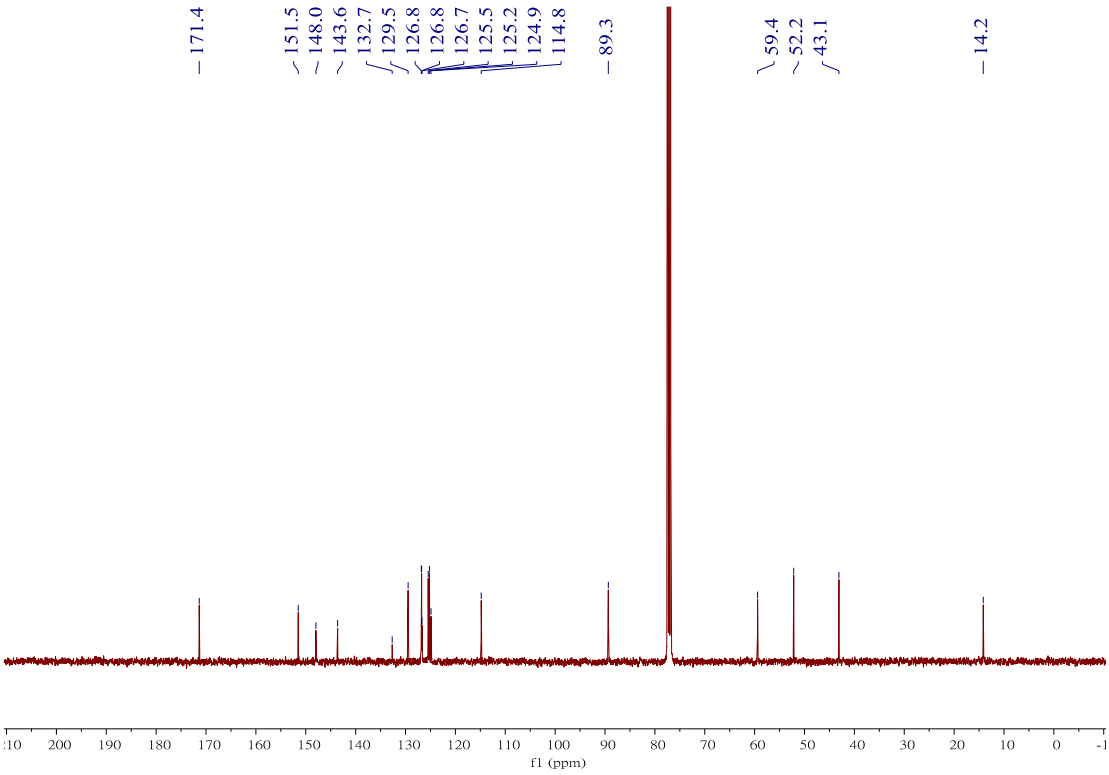
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e¯ Conf	N-Rule	Adduct
348.1706	1	C21H22N3O2	348.1707	0.2	20.6	1	100.00	12.5	even	ok	M+H

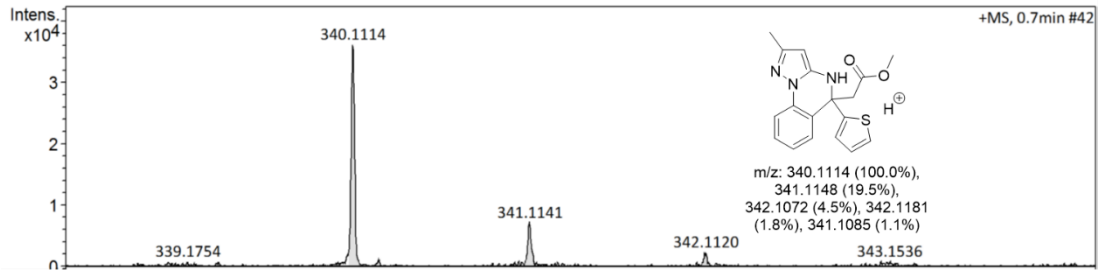
HRMS Mass (ESI) spectrum of compound **3ac**



^{1}H spectrum (400 MHz) of compound **3ad** in $CDCl_3$



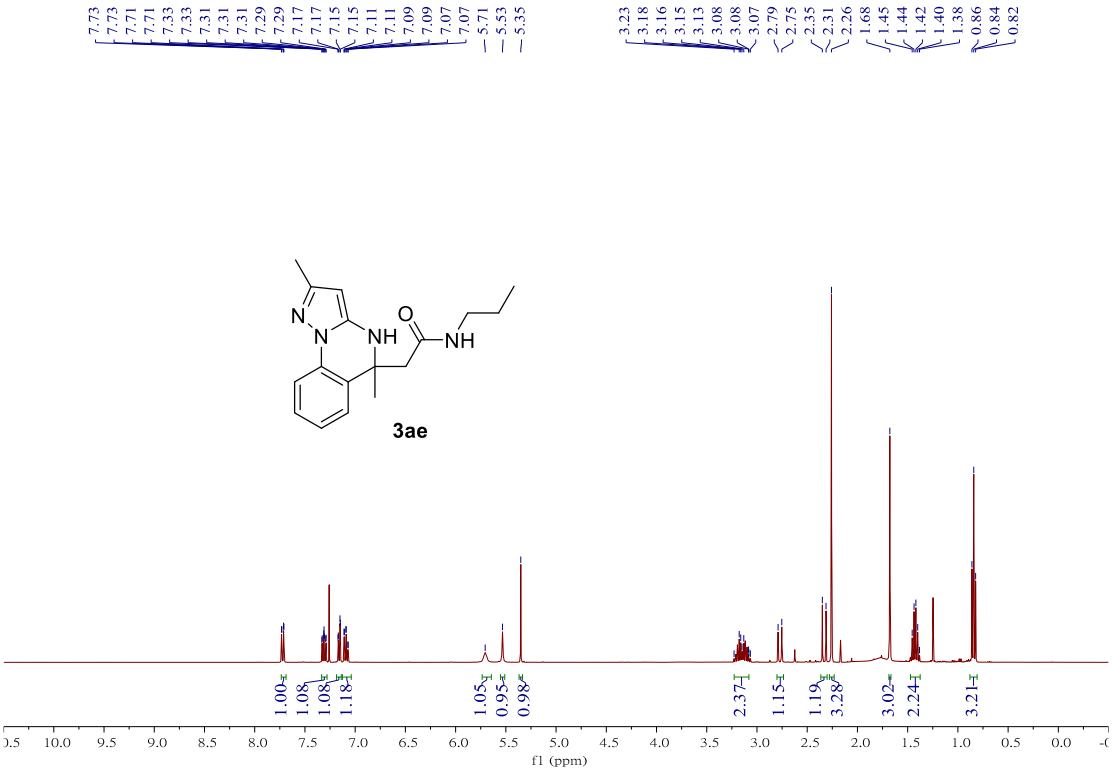
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ad** in$CDCl_3$



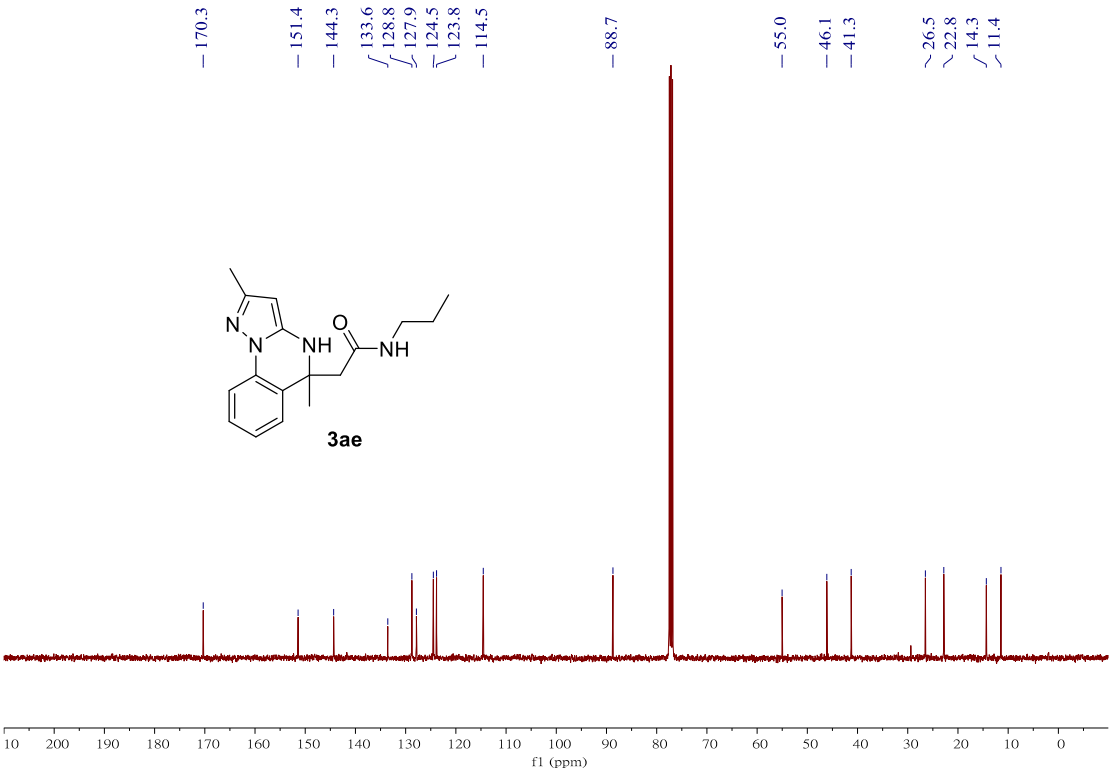
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
340.1114	1	C18H18N3O2S	340.1114	0.1	11.3	1	100.00	11.5	even	ok	M+H

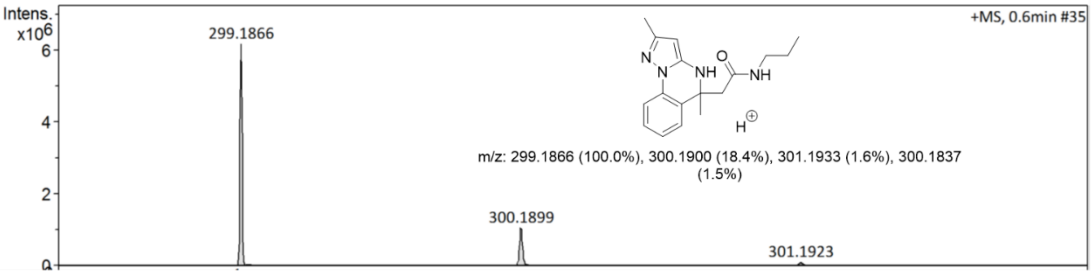
HRMS Mass (ESI) spectrum of compound **3ad**



^{1}H spectrum (400 MHz) of compound **3ae** in $CDCl_3$



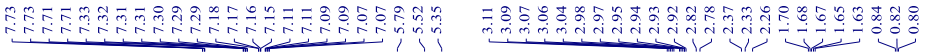
^{13}C{1 H} spectrum (101 MHz) of compound **3ae** in$CDCl_3$

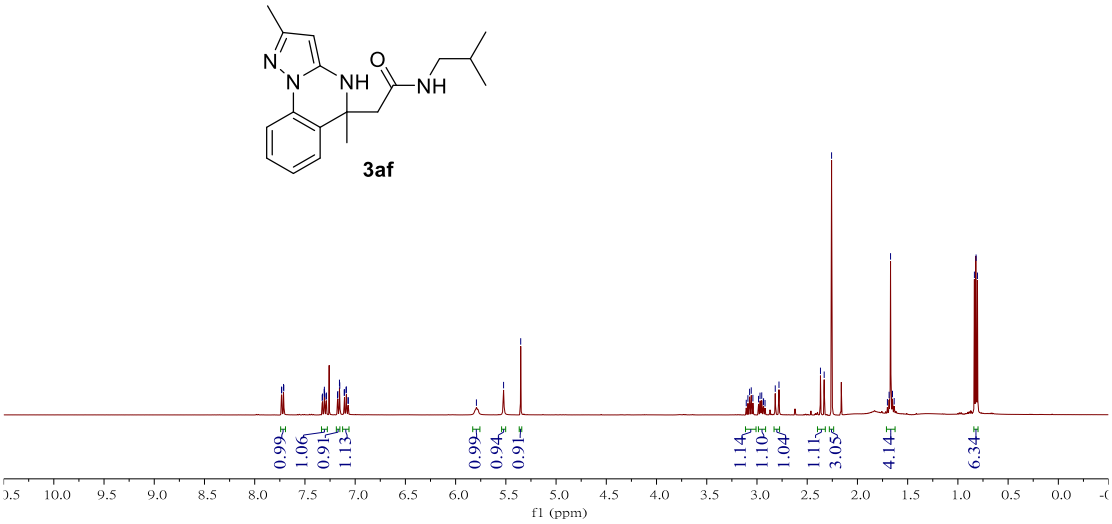


Display Report

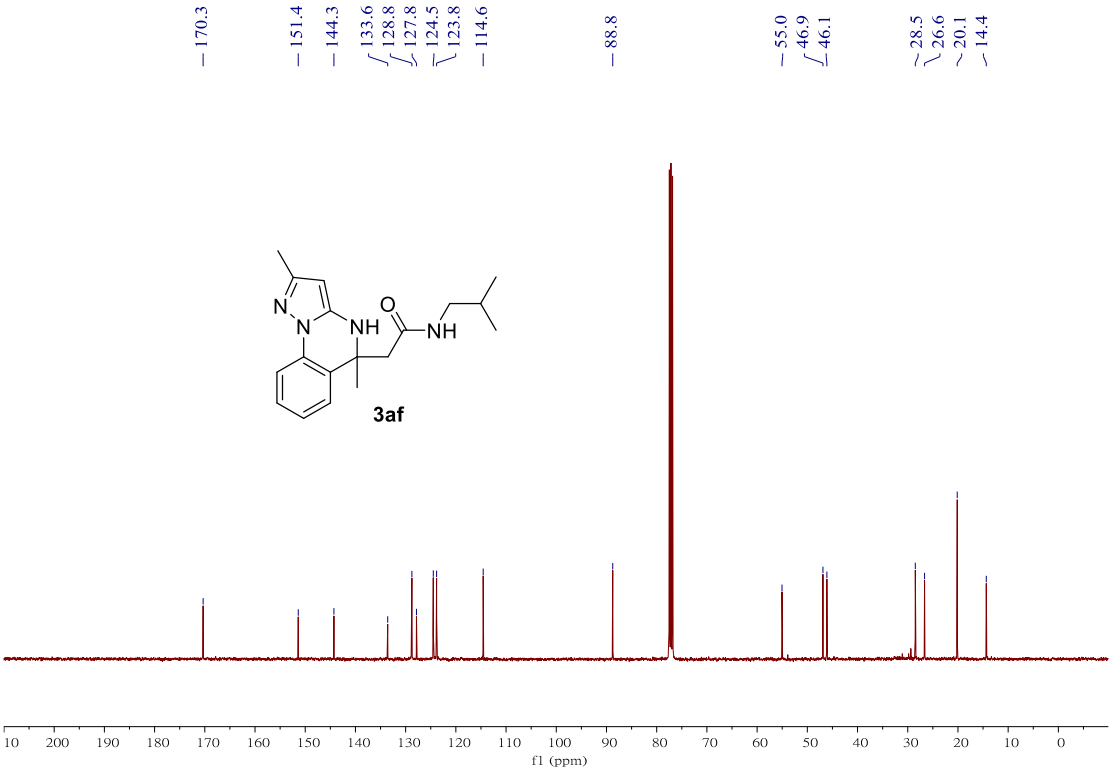
Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
299.1866	1	C17H23N4O	299.1866	-0.0	17.7	1	100.00	8.5	even	ok	M+H

HRMS Mass (ESI) spectrum of compound **3ae**

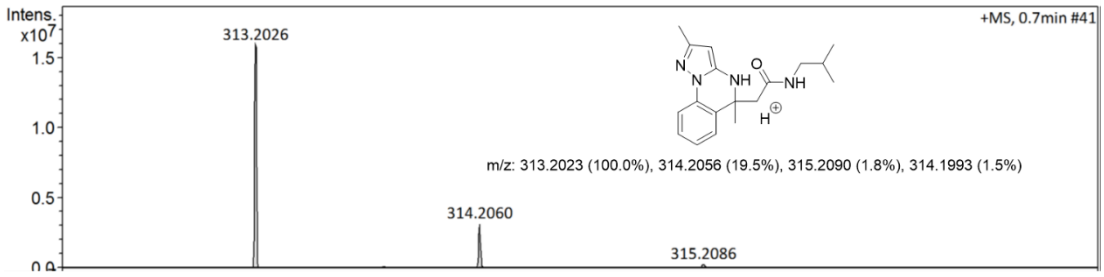




^{1}H spectrum (400 MHz) of compound **3af** in $CDCl_3$



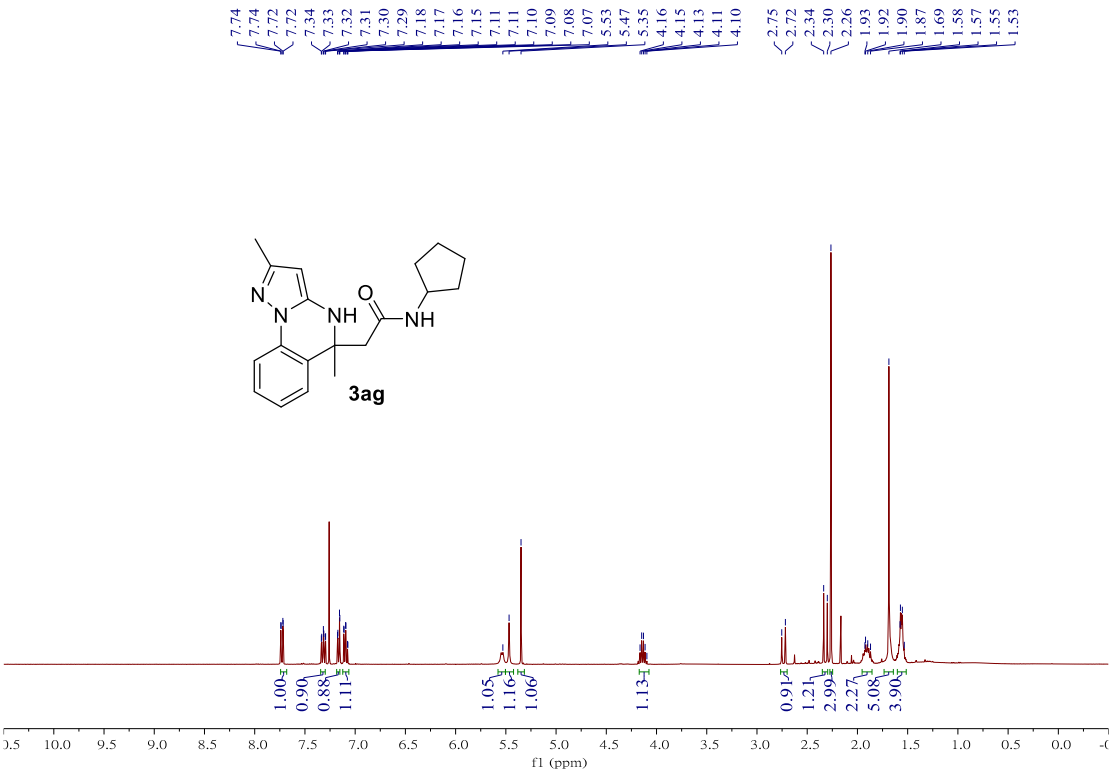
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3af** in$CDCl_3$



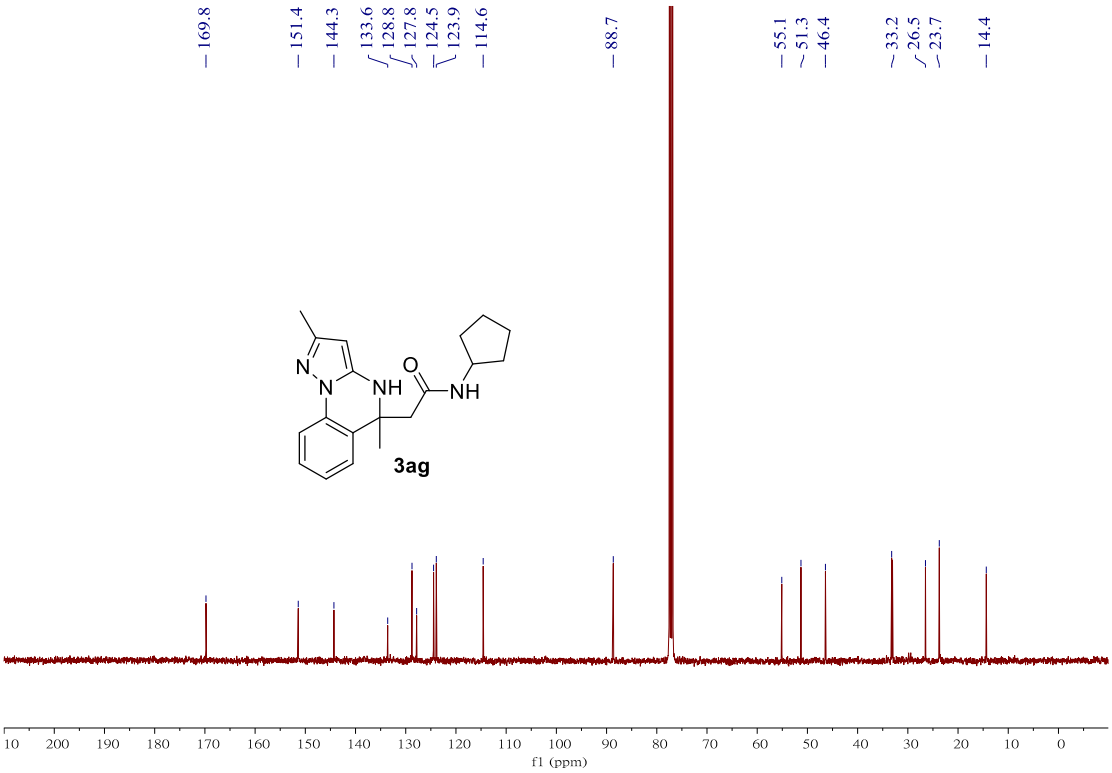
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
313.2026	1	C18H25N4O	313.2023	1.1	9.5	1	100.00	8.5	even	ok	M+H

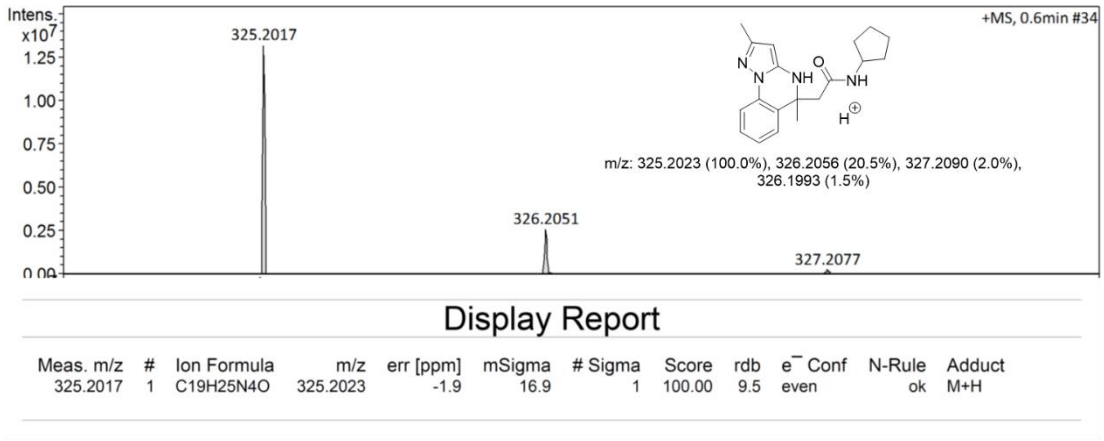
HRMS Mass (ESI) spectrum of compound **3af**



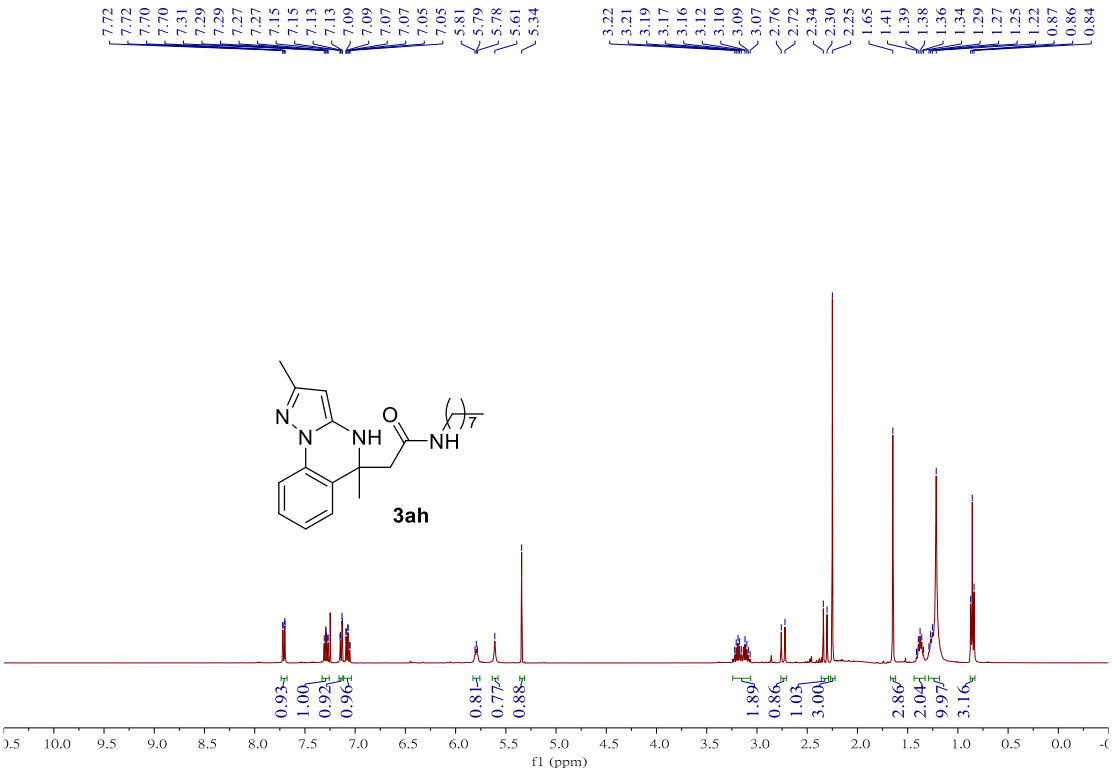
^{1}H spectrum (400 MHz) of compound **3ag** in $CDCl_3$



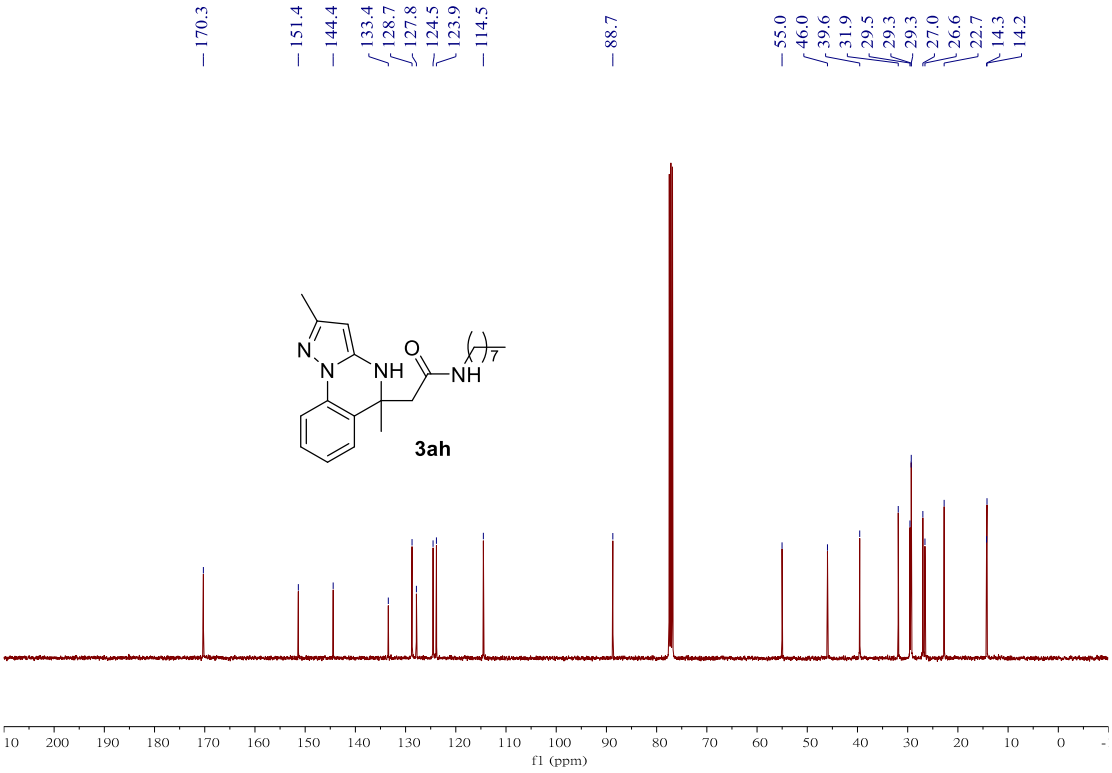
^{13}C{1 H} spectrum (101 MHz) of compound **3ag** in$CDCl_3$



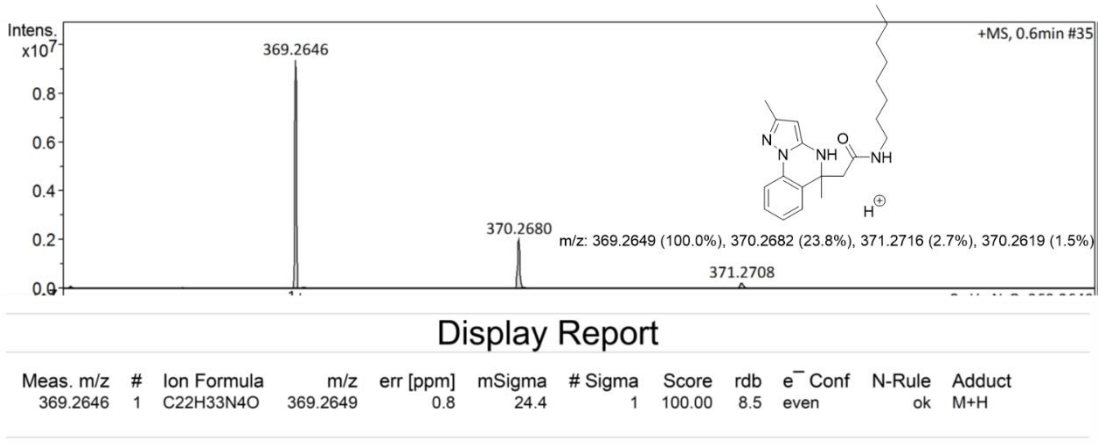
HRMS Mass (ESI) spectrum of compound **3ag**



^{1}H spectrum (400 MHz) of compound **3ah** in $CDCl_3$



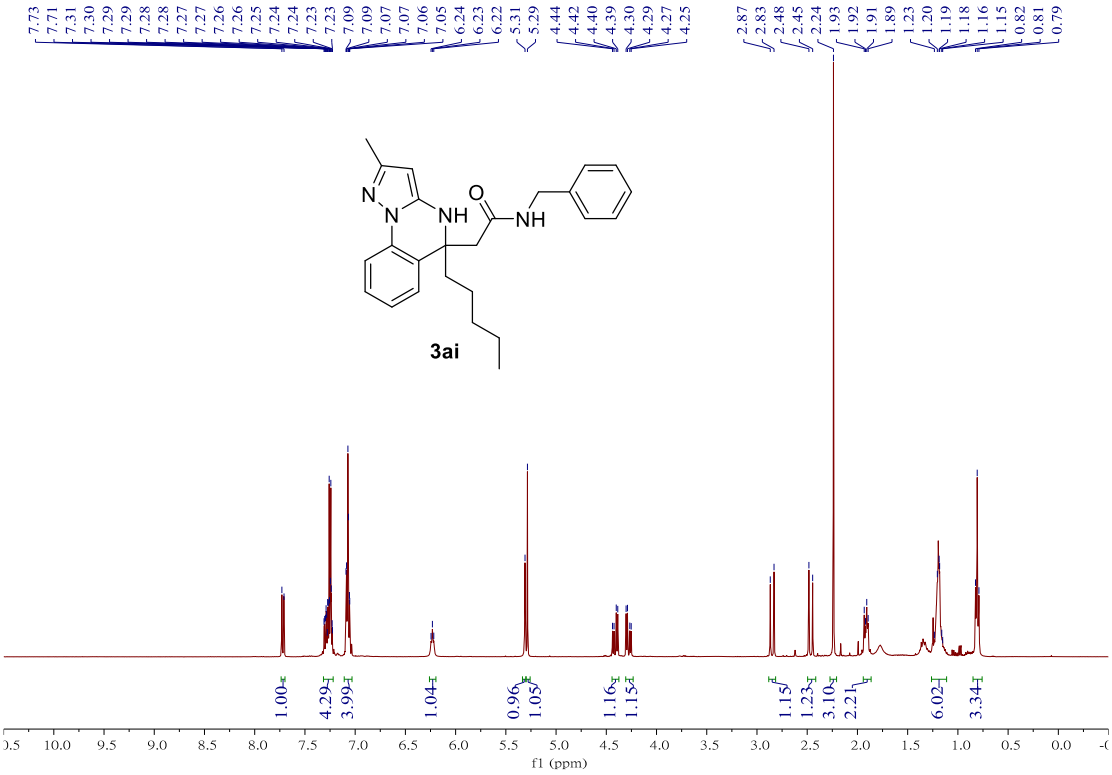
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3ah** in$CDCl_3$



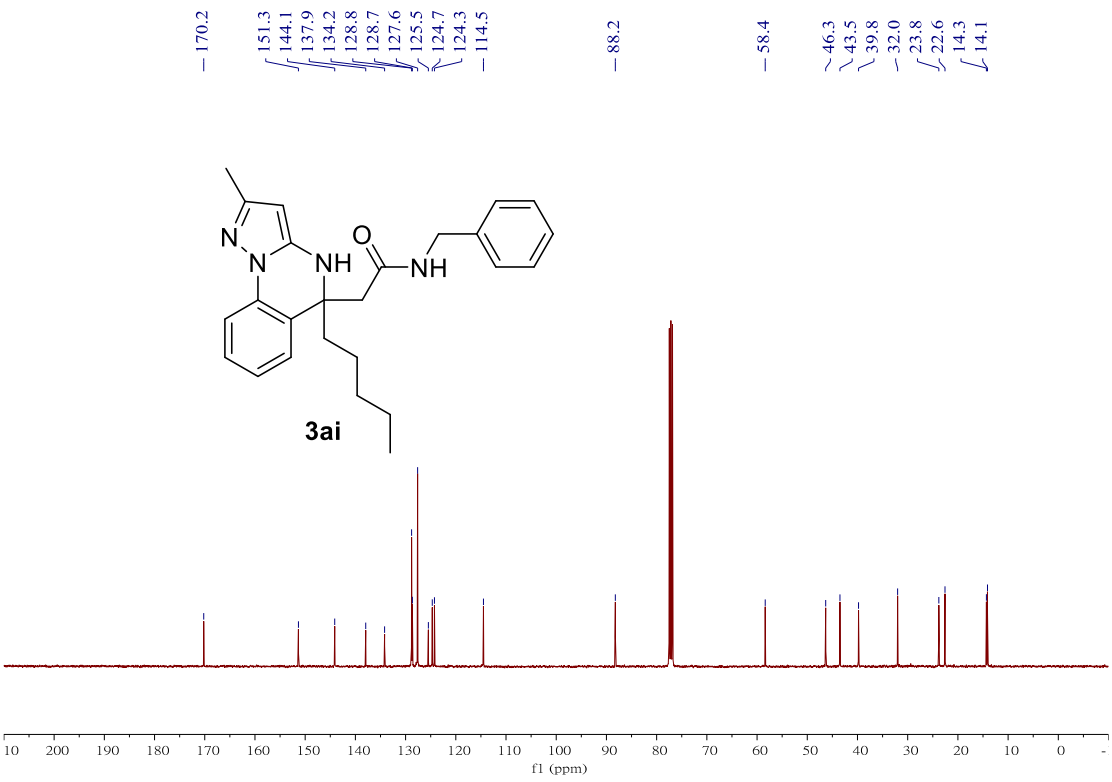
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
369.2646	1	C22H33N4O	369.2649	0.8	24.4	1	100.00	8.5	even	ok	M+H

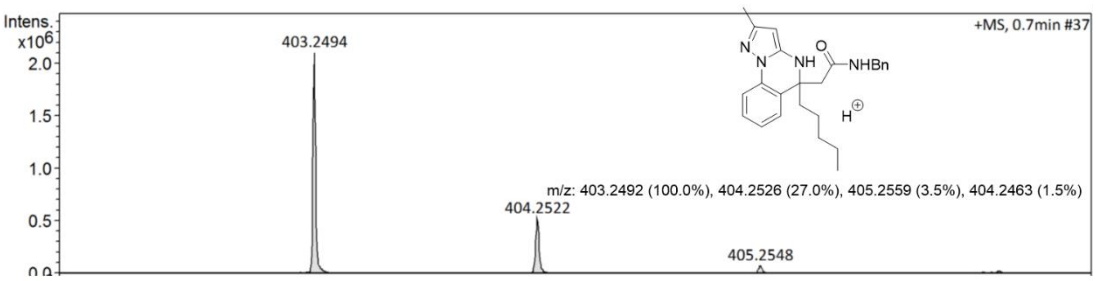
HRMS Mass (ESI) spectrum of compound **3ah**



^{1}H spectrum (400 MHz) of compound **3ai** in $CDCl_3$



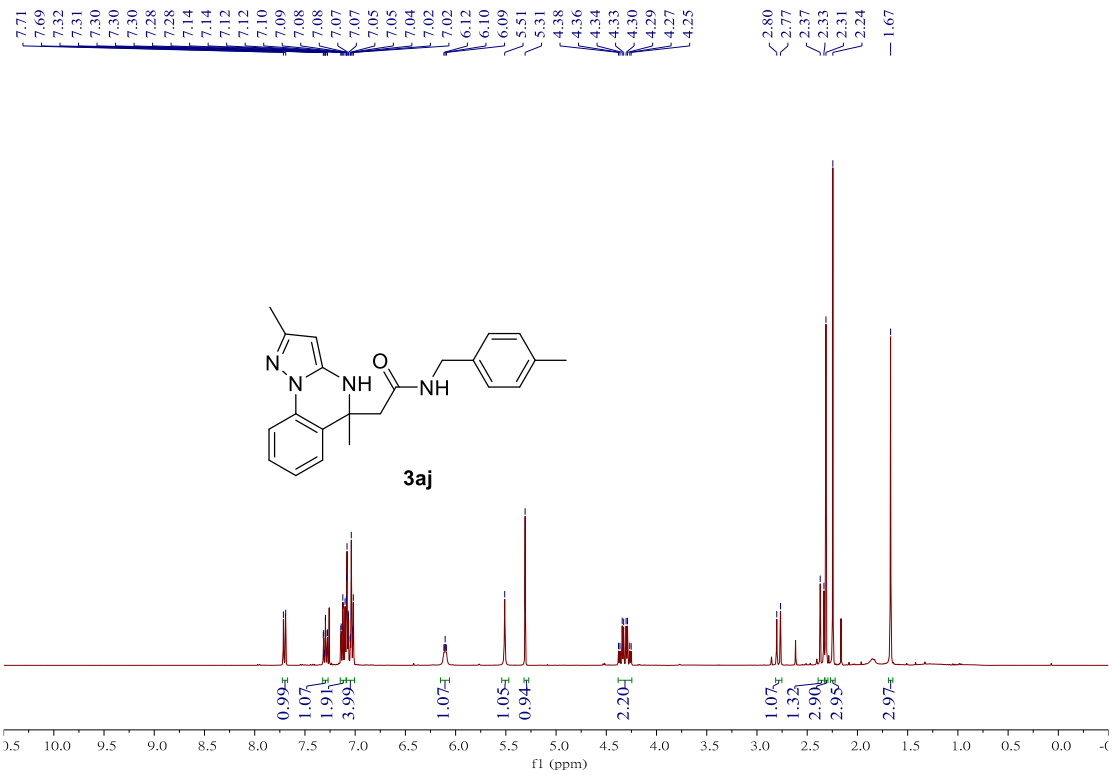
^{13}C{1 H} spectrum (101 MHz) of compound **3ai** in$CDCl_3$



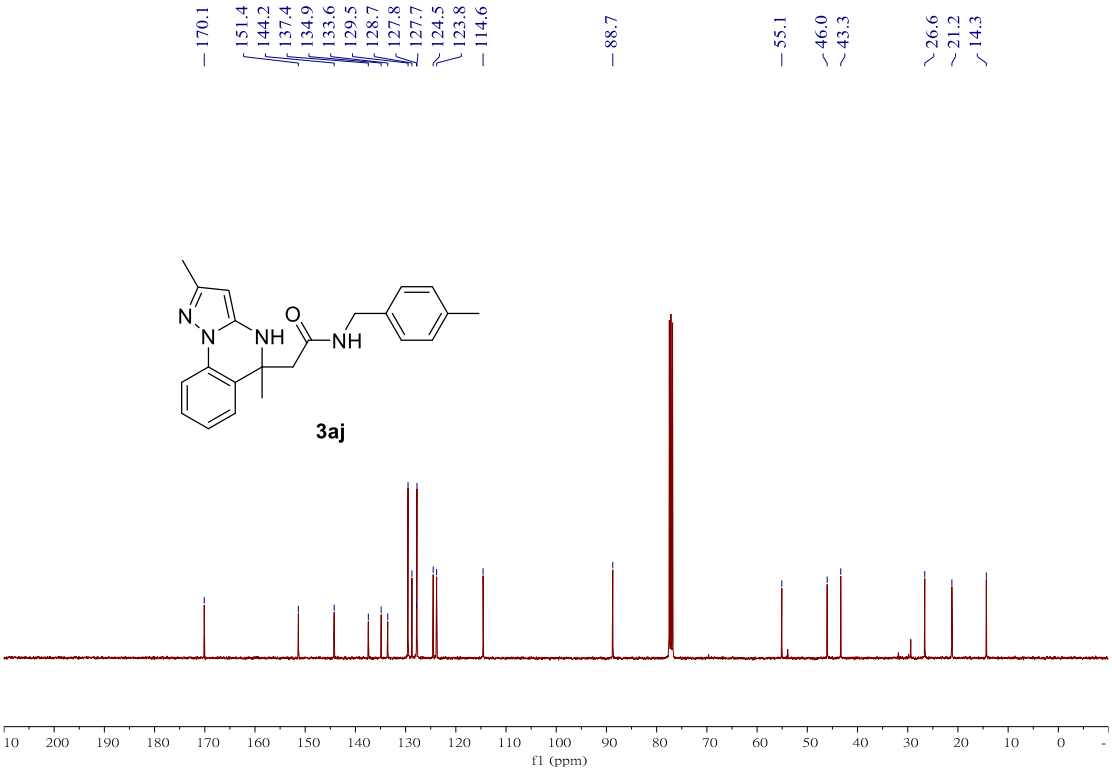
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
403.2494	1	C25H31N4O	403.2492	-0.4	20.3	1	100.00	12.5	even	ok	M+H

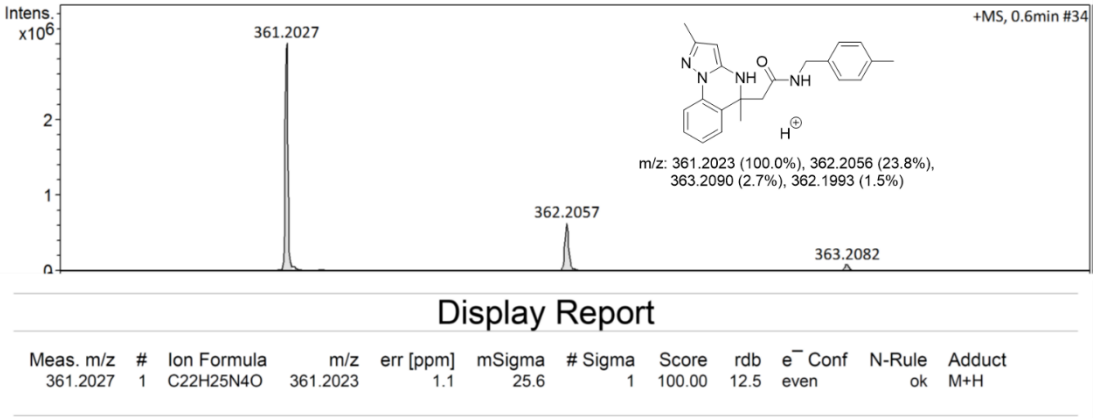
HRMS Mass (ESI) spectrum of compound **3ai**



^{1}H spectrum (400 MHz) of compound **3aj** in $CDCl_3$



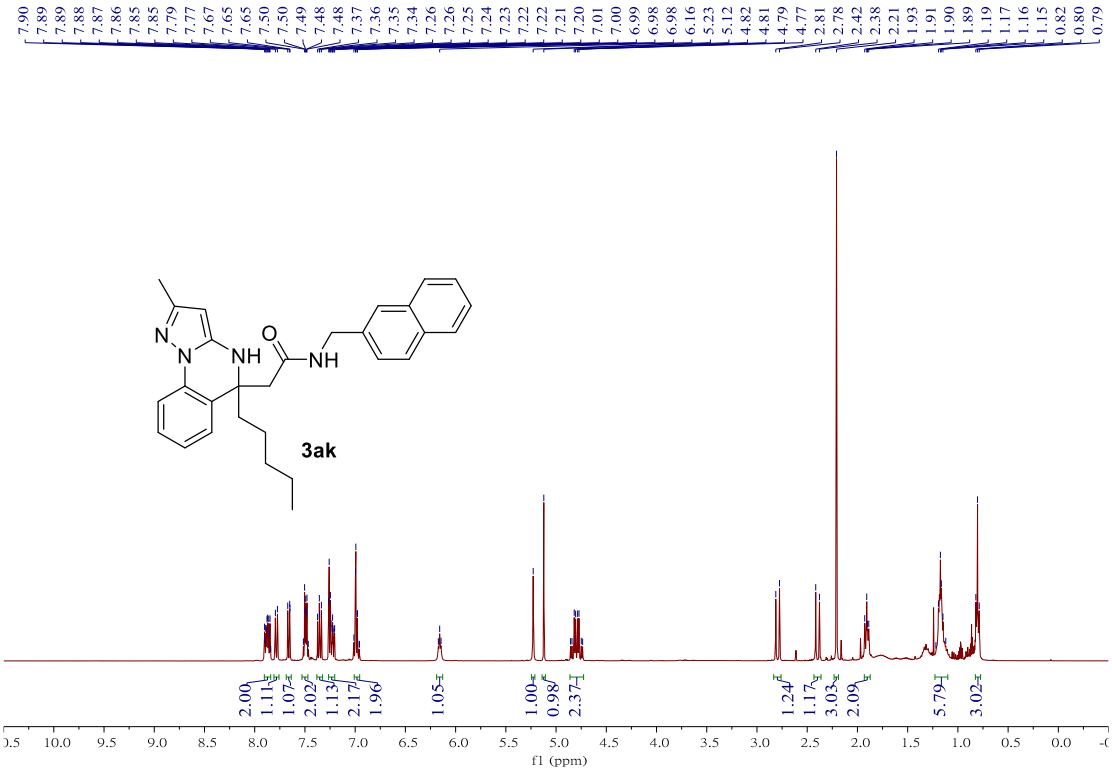
$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3aj** in$CDCl_3$



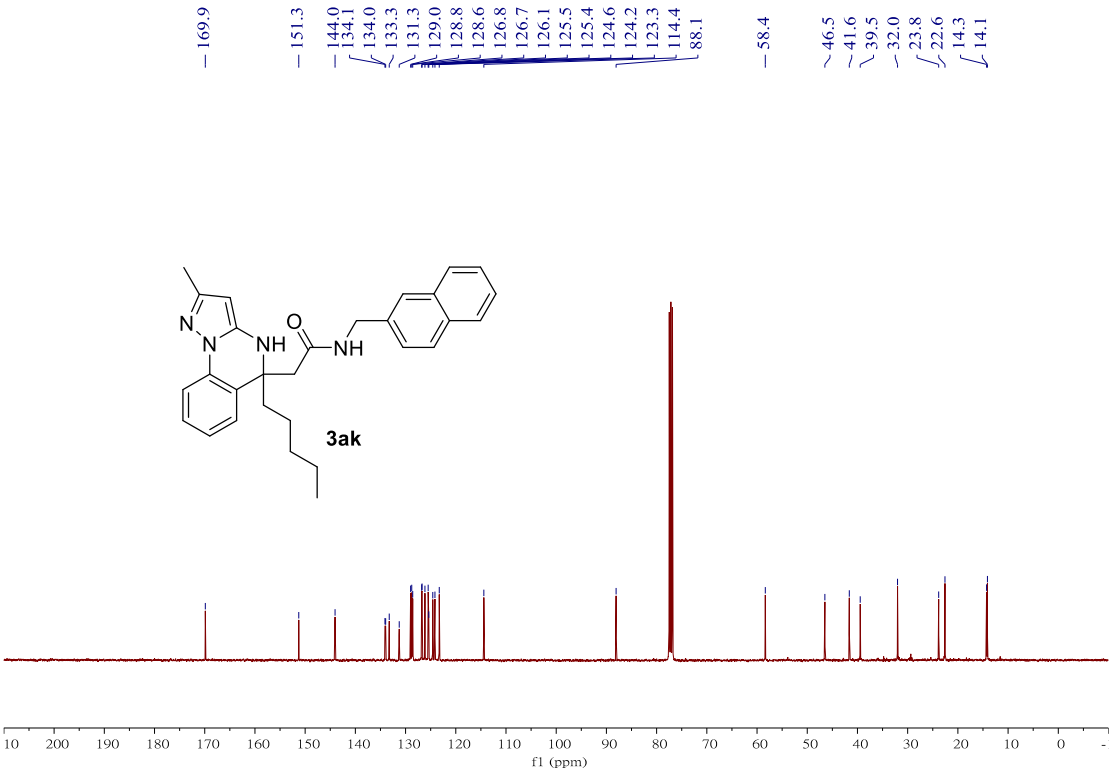
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
361.2027	1	C22H25N4O	361.2023	1.1	25.6	1	100.00	12.5	even	ok	M+H

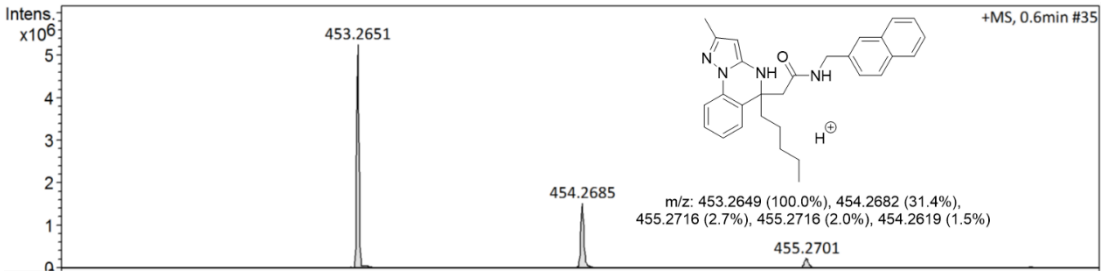
HRMS Mass (ESI) spectrum of compound **3aj**



^{1}H spectrum (400 MHz) of compound **3ak** in $CDCl_3$



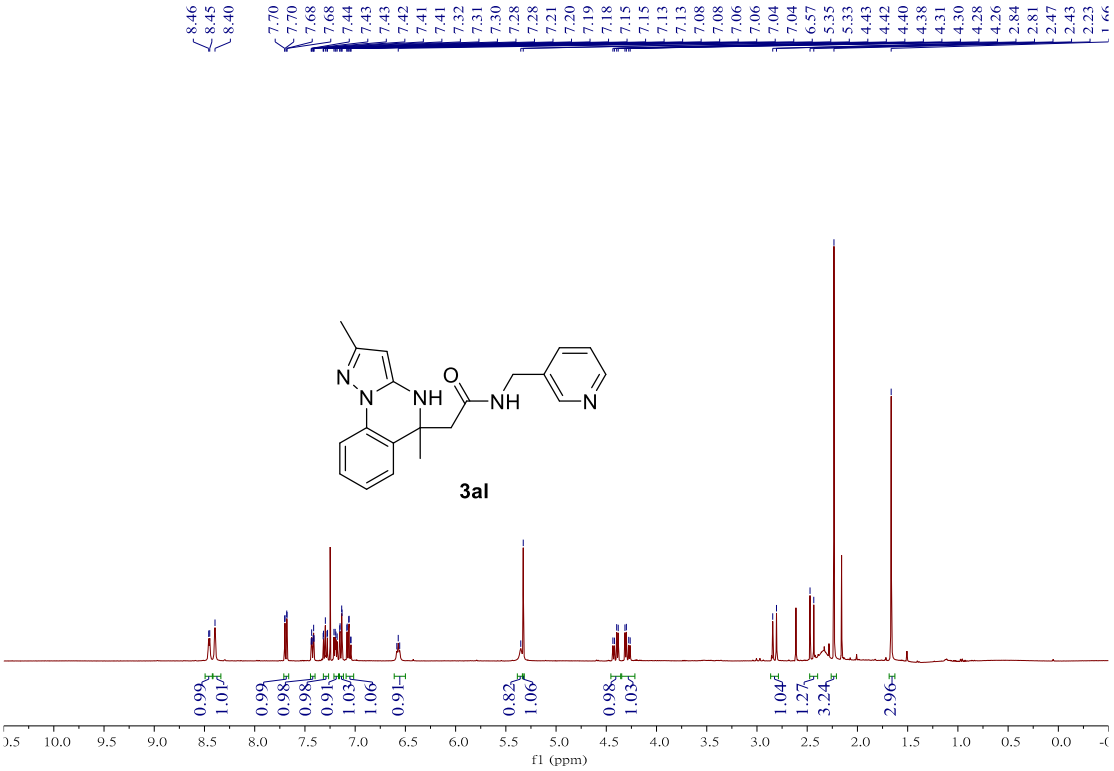
^{13}C{1 H} spectrum (101 MHz) of compound **3ak** in$CDCl_3$



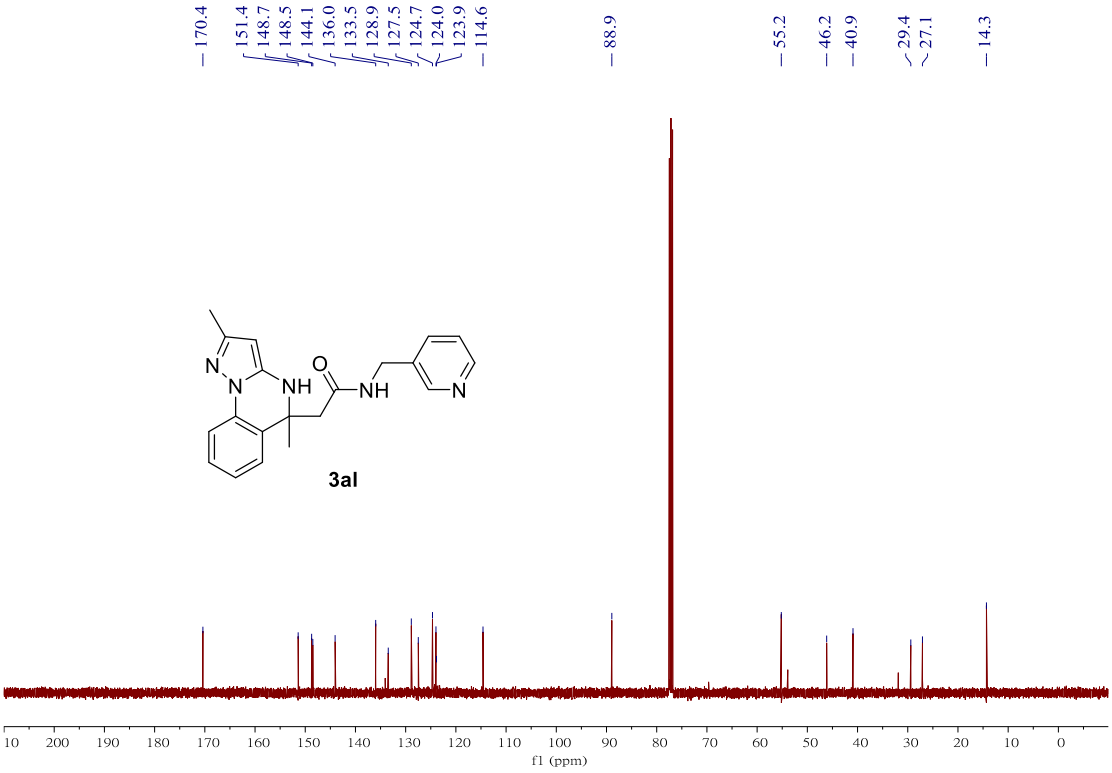
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
453.2651	1	C29H33N4O	453.2649	0.6	22.4	1	100.00	15.5	even	ok	M+H

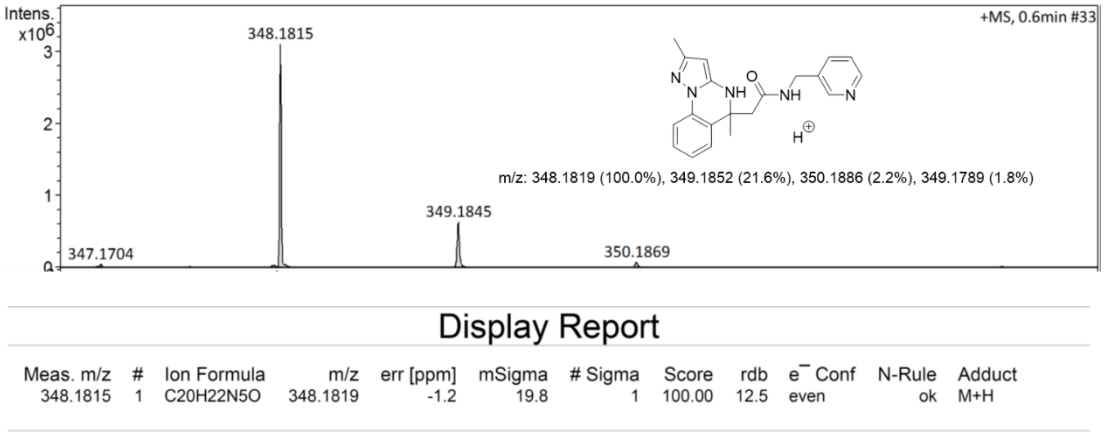
HRMS Mass (ESI) spectrum of compound **3ak**



^{1}H spectrum (400 MHz) of compound **3al** in $CDCl_3$



$^{13}C\{1\ H\}$ spectrum (101 MHz) of compound **3al** in$CDCl_3$



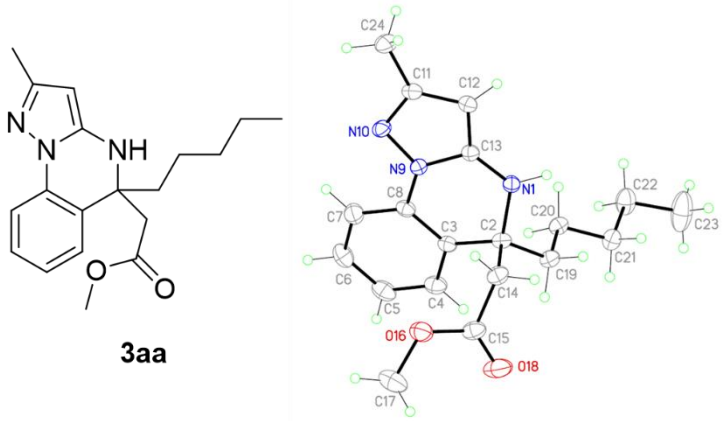
Display Report

Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule	Adduct
348.1815	1	C20H22N5O	348.1819	-1.2	19.8	1	100.00	12.5	even	ok	M+H

HRMS Mass (ESI) spectrum of compound **3al**

9. X-Ray Crystallographic Data

X-ray single crystallographic data of the compounds **3aa**



CCDC 2247902

Table 1 Crystal data and structure refinement for 230307lt_auto.

Identification code	230307lt_auto
Empirical formula	$C_{19}H_{26}N_3O_2$
Formula weight	328.43
Temperature/K	103(6)
Crystal system	monoclinic
Space group	Ia
a/Å	10.83365(16)
b/Å	14.19083(19)
c/Å	11.90925(15)
α/°	90
β/°	97.2955(13)
γ/°	90
Volume/Å^3	1816.09(4)
Z	4
ρ_{calc}g/cm^3	1.201
μ/mm^{-1}	0.628
F(000)	708.0
Crystal size/mm^3	0.16 × 0.14 × 0.04
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	9.742 to 134.12
Index ranges	-12 ≤ h ≤ 12, -16 ≤ k ≤ 16, -14 ≤ l ≤ 13
Reflections collected	13765
Independent reflections	2734 [R_{int} = 0.0243, R_{sigma} = 0.0199]

Data/restraints/parameters	2734/2/221
Goodness-of-fit on F^2	1.056
Final R indexes [I>=2σ (I)]	R_1 = 0.0290, wR_2 = 0.0785
Final R indexes [all data]	R_1 = 0.0296, wR_2 = 0.0790
Largest diff. peak/hole / e $Å^{-3}$	0.18/-0.37
Flack parameter	-0.04(11)

Table 2 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters ($Å^2$×10^3) for 230307lt_auto. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
C2	5248.5(19)	3236.2(14)	4710.9(19)	20.4(4)
C3	5349.6(18)	3958.4(14)	3775.4(18)	19.8(4)
C4	6199(2)	4702.8(15)	3904(2)	25.7(5)
C5	6372(2)	5277.5(16)	2991(2)	30.1(5)
C6	5695(2)	5127.1(16)	1946(2)	32.4(5)
C7	4820(2)	4402.4(16)	1799(2)	27.2(5)
C8	4658.9(18)	3830.0(14)	2711.0(19)	20.0(4)
C11	2195.4(19)	2289.0(15)	1928.0(19)	22.4(5)
C12	2374.7(19)	2111.3(14)	3103.1(19)	20.4(4)
C13	3398.0(18)	2646.2(14)	3511.4(18)	18.2(4)
C14	6195(2)	2418.4(15)	4573(2)	24.8(5)
C15	7469(2)	2782.1(15)	4417(2)	27.5(5)
C17	8787(2)	3185(2)	3049(3)	45.1(7)
C19	5473.2(19)	3647.2(15)	5903.4(19)	22.7(5)
C20	4563.3(18)	4425.4(14)	6140.7(19)	21.7(4)
C21	4698(2)	4696.8(16)	7383(2)	25.4(5)
C22	3676(2)	5357.7(16)	7676(2)	32.9(6)
C23	3731(4)	5523(2)	8936(3)	60.0(10)
C24	1227(2)	1881.2(18)	1056(2)	31.6(5)
N1	3985.0(15)	2836.1(12)	4558.5(15)	20.8(4)
N9	3783.8(15)	3093.1(12)	2605.6(15)	18.4(4)

Table 2 Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($Å^2 \times 10^3$) for 230307lt_auto. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
N10	3033.7(16)	2883.5(12)	1618.0(15)	21.4(4)
O16	7635.6(15)	2769.6(11)	3316.9(15)	31.4(4)
O18	8229.4(16)	3070.0(14)	5158.1(17)	41.6(5)

Table 3 Anisotropic Displacement Parameters ($Å^2 \times 10^3$) for 230307lt_auto. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
C2	15.8(9)	21.0(10)	24.0(12)	-1.4(8)	0.8(8)	-0.7(7)
C3	16.4(9)	20.7(9)	22.4(11)	-2.8(8)	3.6(8)	-0.8(8)
C4	21.4(10)	24.9(10)	30.7(13)	-6.3(9)	2.9(9)	-3.6(8)
C5	26.2(11)	24.8(10)	40.8(15)	-2.7(10)	9.6(11)	-7.8(9)
C6	35.5(12)	27.9(11)	35.6(14)	5.9(10)	11.7(11)	-5.7(10)
C7	27.7(12)	29.0(11)	25.2(13)	0.7(9)	4.7(10)	-2.3(9)
C8	17.4(9)	19.6(9)	23.5(11)	-4.4(8)	5.0(8)	-0.9(8)
C11	16.7(10)	23.9(10)	26.4(12)	-4.7(9)	2.0(9)	0.3(8)
C12	17.9(10)	20.0(9)	23.4(11)	-1.8(8)	3.7(9)	-1.1(7)
C13	16.6(9)	17.5(9)	20.7(11)	-2.0(7)	3.1(8)	1.3(7)
C14	23.3(11)	23.1(10)	26.9(12)	-2.6(9)	-1.2(9)	1.0(8)
C15	22.0(11)	27.6(10)	32.1(13)	-7.0(9)	0.1(10)	4.7(9)
C17	30.0(13)	51.9(16)	56(2)	-5.1(13)	17.7(14)	-3.9(11)
C19	20.3(10)	24.0(10)	22.8(12)	-1.9(8)	-0.8(9)	-0.6(8)
C20	21.0(10)	21.5(10)	21.8(11)	-0.5(8)	-0.6(9)	-1.1(8)
C21	28.2(11)	25.4(10)	22.3(12)	0.3(9)	1.6(9)	2.7(8)
C22	44.8(14)	28.1(11)	26.5(13)	3.7(9)	7.9(11)	10.6(10)
C23	99(3)	54.0(17)	29.8(16)	6.4(13)	18.2(17)	38.4(18)
C24	25.6(12)	41.0(13)	26.8(13)	-6.7(10)	-2.2(10)	-7.1(10)
N1	19.4(9)	24.8(8)	18.2(10)	-0.6(7)	2.6(7)	-6.7(7)
N9	16.7(8)	21.0(8)	17.5(9)	-0.8(7)	1.5(7)	-2.0(6)
N10	21.0(9)	26.7(9)	16.2(9)	-2.8(7)	0.5(7)	-1.1(7)

Table 3 Anisotropic Displacement Parameters ($Å^2×10^3$) for 230307lt_auto. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
O16	23.0(8)	37.2(9)	34.5(10)	-4.1(8)	5.3(7)	-0.9(7)
O18	23.0(8)	57.2(11)	42.8(12)	-18.3(9)	-3.0(8)	1.6(8)

Table 4 Bond Lengths for 230307lt_auto.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
C2	C3	1.528(3)	C11	N10	1.326(3)
C2	C14	1.571(3)	C12	C13	1.380(3)
C2	C19	1.526(3)	C13	N1	1.353(3)
C2	N1	1.472(3)	C13	N9	1.362(3)
C3	C4	1.396(3)	C14	C15	1.508(3)
C3	C8	1.400(3)	C15	O16	1.345(3)
C4	C5	1.391(3)	C15	O18	1.200(3)
C5	C6	1.378(4)	C17	O16	1.452(3)
C6	C7	1.395(3)	C19	C20	1.530(3)
C7	C8	1.385(3)	C20	C21	1.517(3)
C8	N9	1.406(2)	C21	C22	1.525(3)
C11	C12	1.411(3)	C22	C23	1.512(4)
C11	C24	1.496(3)	N9	N10	1.375(2)

Table 5 Bond Angles for 230307lt_auto.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C3	C2	C14	108.15(18)	C13	C12	C11	104.74(18)
C19	C2	C3	113.86(17)	N1	C13	C12	134.2(2)
C19	C2	C14	110.51(17)	N1	C13	N9	118.79(17)
N1	C2	C3	108.69(17)	N9	C13	C12	106.90(19)
N1	C2	C14	108.12(16)	C15	C14	C2	112.33(17)
N1	C2	C19	107.35(17)	O16	C15	C14	110.74(19)
C4	C3	C2	122.3(2)	O18	C15	C14	125.4(2)
C4	C3	C8	117.81(19)	O18	C15	O16	123.9(2)
C8	C3	C2	119.57(17)	C2	C19	C20	114.66(17)

Table 5 Bond Angles for 230307lt_auto.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C5	C4	C3	120.7(2)	C21	C20	C19	112.25(17)
C6	C5	C4	120.4(2)	C20	C21	C22	113.38(19)
C5	C6	C7	120.2(2)	C23	C22	C21	112.6(2)
C8	C7	C6	119.0(2)	C13	N1	C2	120.76(18)
C3	C8	N9	117.03(18)	C13	N9	C8	123.14(18)
C7	C8	C3	121.86(19)	C13	N9	N10	111.68(16)
C7	C8	N9	121.11(19)	N10	N9	C8	123.77(17)
C12	C11	C24	128.0(2)	C11	N10	N9	104.53(17)
N10	C11	C12	112.15(18)	C15	O16	C17	115.7(2)
N10	C11	C24	119.8(2)				

Table 6 Torsion Angles for 230307lt_auto.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
C2	C3	C4	C5	172.1(2)	C12	C13	N9	C8	168.02(18)
C2	C3	C8	C7	-172.62(19)	C12	C13	N9	N10	1.1(2)
C2	C3	C8	N9	7.7(3)	C13	N9	N10	C11	-1.1(2)
C2	C14	C15	O16	-99.8(2)	C14	C2	C3	C4	-88.2(2)
C2	C14	C15	O18	78.3(3)	C14	C2	C3	C8	85.6(2)
C2	C19	C20	C21	170.86(17)	C14	C2	C19	C20	-177.67(17)
C3	C2	C14	C15	47.9(2)	C14	C2	N1	C13	-78.3(2)
C3	C2	C19	C20	60.4(2)	C14	C15	O16	C17	174.6(2)
C3	C2	N1	C13	38.9(2)	C19	C2	C3	C4	35.1(3)
C3	C4	C5	C6	0.8(3)	C19	C2	C3	C8	-151.16(18)
C3	C8	N9	C13	14.4(3)	C19	C2	C14	C15	-77.4(2)
C3	C8	N9	N10	179.66(17)	C19	C2	N1	C13	162.47(17)
C4	C3	C8	C7	1.4(3)	C19	C20	C21	C22	-171.06(18)
C4	C3	C8	N9	-178.29(18)	C20	C21	C22	C23	172.8(2)
C4	C5	C6	C7	0.7(4)	C24	C11	C12	C13	178.9(2)
C5	C6	C7	C8	-1.1(4)	C24	C11	N10	N9	-178.34(19)
C6	C7	C8	C3	0.0(3)	N1	C2	C3	C4	154.68(19)
C6	C7	C8	N9	179.7(2)	N1	C2	C3	C8	-31.6(3)
C7	C8	N9	C13	-165.36(19)	N1	C2	C14	C15	165.39(19)

Table 6 Torsion Angles for 230307lt_auto.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
C7	C8	N9	N10	-0.1(3)	N1	C2	C19	C20	-60.0(2)
C8	C3	C4	C5	-1.8(3)	N1	C13	N9	C8	-8.2(3)
C8	N9	N10	C11	-167.83(18)	N1	C13	N9	N10	-175.10(17)
C11	C12	C13	N1	174.7(2)	N9	C13	N1	C2	-21.1(3)
C11	C12	C13	N9	-0.7(2)	N10	C11	C12	C13	0.1(2)
C12	C11	N10	N9	0.6(2)	O18	C15	O16	C17	-3.6(3)
C12	C13	N1	C2	163.9(2)					

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for 230307lt_auto.

Atom	*x*	*y*	*z*	U(eq)
H4	6662.9	4817.87	4622.04	31
H5	6960.09	5776.69	3087.83	36
H6	5825.38	5518.05	1324.08	39
H7	4340.92	4302.91	1083.64	33
H12	1896.68	1711.87	3520.91	24
H14A	6261.77	2010.65	5252.89	30
H14B	5872.99	2028.49	3910.87	30
H17A	8814.6	3149.69	2230.41	68
H17B	9495.83	2839.91	3445.6	68
H17C	8828.85	3846	3289.01	68
H19A	6329.23	3904.01	6030.84	27
H19B	5421.14	3131.21	6454.89	27
H20A	4710.5	4987.92	5684.36	26
H20B	3701.57	4207.45	5903.31	26
H21A	5514.95	5005.88	7586.46	31
H21B	4687.77	4117.31	7844.13	31
H22A	3753.73	5969.74	7292.45	39
H22B	2855.18	5086.08	7386.4	39
H23A	3028.09	5918.84	9083.84	90
H23B	4513.11	5840.32	9216.85	90
H23C	3687.7	4917.17	9324.02	90

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for 230307lt_auto.

Atom	*x*	*y*	*z*	U(eq)
H24A	403.13	2106.64	1190.27	47
H24B	1250.51	1192.01	1105.66	47
H24C	1392.13	2077.93	300.43	47
H1	3606.96	2718.9	5155.24	25
H10	3095.88	3096.18	933.36	26

Experimental

Single crystals of $C_{19}H_{26}N_3O_2$ **[230307lt_auto]** were **[]**. A suitable crystal was selected and **[]** on a **XtaLAB Synergy R, DW system, HyPix-Arc 150** diffractometer. The crystal was kept at 103(6) K during data collection. Using Olex2 [1], the structure was solved with the SHELXT [2] structure solution program using Intrinsic Phasing and refined with the SHELXL [3] refinement package using Least Squares minimisation.

1. Dolomanov, O.V., Bourhis, L.J., Gildea, R.J, Howard, J.A.K. & Puschmann, H. (2009), J. Appl. Cryst. 42, 339-341.
2. Sheldrick, G.M. (2015). Acta Cryst. A71, 3-8.
3. Sheldrick, G.M. (2015). Acta Cryst. C71, 3-8.

Crystal structure determination of [230307lt_auto]

Crystal Data for $C_{19}H_{26}N_3O_2$ (M =328.43 g/mol): monoclinic, space group Ia (no. 9), a = 10.83365(16) Å, b = 14.19083(19) Å, c = 11.90925(15) Å, β = 97.2955(13)°, V = 1816.09(4) Å^3, Z = 4, T = 103(6) K, μ(Cu Kα) = 0.628 mm^{-1}, *Dcalc* = 1.201 g/cm^3, 13765 reflections measured (9.742° ≤ 2Θ ≤ 134.12°), 2734 unique (R_{int} = 0.0243, R_{sigma} = 0.0199) which were used in all calculations. The final R_1 was 0.0290 (I > 2σ(I)) and wR_2 was 0.0790 (all data).

Refinement model description

Number of restraints - 2, number of constraints - unknown.

Details:

1. Fixed Uiso

 At 1.2 times of:

  All C(H) groups, All C(H,H) groups, All N(H) groups

 At 1.5 times of:

  All C(H,H,H) groups

2.a Secondary CH2 refined with riding coordinates:

 C14(H14A,H14B), C19(H19A,H19B), C20(H20A,H20B), C21(H21A,H21B), C22(H22A,H22B)

2.b Aromatic/amide H refined with riding coordinates:
C4(H4), C5(H5), C6(H6), C7(H7), C12(H12), N1(H1), N10(H10)
2.c Idealised Me refined as rotating group:
C17(H17A,H17B,H17C), C23(H23A,H23B,H23C), C24(H24A,H24B,H24C)
This report has been created with Olex2, compiled on 2023.02.24 svn.rf166f9f3 for OlexSys.
Please let us know if there are any errors or if you would like to have additional features.