Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Synthesis and biological evaluation of novel carbazolyl glyoxamides as anticancer and antibacterial agents

Venkataramana Reddy P. O,[a] Mukund P. Tantak,[a] Reyna Valdez,[b] Rajnish Prakash Singh,[c] Okram Mukherjee Singh,[d] Rachna Sadana[b*] and Dalip Kumar[a,*]

[a]*Department of Chemistry, Birla Institute of Technology and Science, Pilani 333 031, Rajasthan, India*

[b]*Department of Natural Sciences, University of Houston – Downtown, Houston, TX 77002, United States*

[c]*Department of Biological Sciences, Birla Institute of Technology and Science, Pilani 333031, Rajasthan, India*

[d]*Department of Chemistry, Manipur University, Canchipur, Imphal-795003, Manipur, India*

Table of contents

I Experimental Section

General

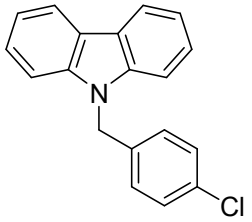
All the reagents were purchased from commercial sources (Sigma-Aldrich, Alfa Aesar, Merck and Spectrochem). Solvents used for all reaction were dried prior to use by standard procedure. The synthesis of all the final compounds was carried out in a CEM Focused microwave. Progress of the reactions was followed by thin layer chromatography (TLC) analysis (Merck, silica gel 60 F254 in aluminium foil). Solvents were evaporated using Büchi rotary evaporator. Melting points were determined with electro thermal capillary melting point apparatus (*E-Z* melting) and were uncorrected. NMR spectra were measured on a Brucker Avance II 400 MHz (400 MHz for ^{1}H and 100 MHz for ^{13}C) instrument using solvents DMSO-d_6 and $CDCl_3$. Chemical shifts are reported in ppm and multiplicities are given as: s (singlet), d (doublet), t (triplet), m (multiplet), dd (double doublet), and coupling constants (*J*) in hertz (Hz). IR spectra were recorded on Shimadzu IR Prestige-21 FT-IR spectrophotometer using KBr pellets. Purity of all the synthesized compounds was > 97% as determined by WATERS 515 HPLC system with a Sunfire C-18 column (5 μm, 4.6 × 250 mm) and PDA detector using a flow rate of 1 mL/min. and a gradient of acetonitrile. HRMS analysis was performed on Bruker Compass Data Analysis 4.1 mass instrument.

II General Experimental procedure

1. General Procedure for the synthesis of 9-(4-chlorobenzyl)-9*H*-carbazoles (11a-c).

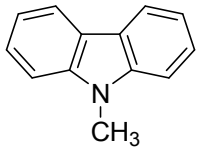
A solution of potassium hydroxide (180 mmol) in 80 mL *N,N*-dimethylformamide (DMF) was stirred at room temperature for 20 min. Carbazole **10** (60 mmol) was added and the mixture was stirred for 40 min at room temperature. A solution of alkyl halide (72 mmol) in DMF (50 mL) was added drop wise with stirring. The resulting reaction mixture was then stirred at room temperature for 12 h. After completion of reaction as indicated by TLC, contents were poured into cold water (500 mL). White precipitate obtained was filtered, washed with cold water (100 mL) and recrystallized from ethanol to give pure **11a-c** in 90-95% yields.

9-(4-Chlorobenzyl)-9*H*-carbazole (11a)



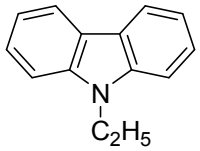
Off white solid; Yield 92%; M.p: 171-172 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, J = 8.0 Hz, 2H), 7.47 (t, J = 8.2 Hz, 2H), 7.37-7.24 (m, 6H), 7.09 (d, J = 8.0 Hz, 2H), 5.51 (s, 2H); IR (KBr, ν, cm^{-1}): 3047, 2938, 1597, 1450, 1327, 748, 725.

9-Methyl-9*H*-carbazole (11b)



Off white solid; Yield 95%; M.p: 95 °C (lit.[1] mp 95-97 °C).

9-Ethyl-9*H*-carbazole (11c)

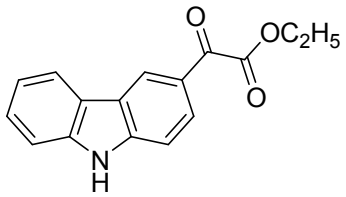


Off white solid; Yield 90%; M.P: 70-72 °C (lit.[2] mp 72-74 °C).

2. General procedure for the synthesis of carbazolyl glyoxalic esters (12a-d)

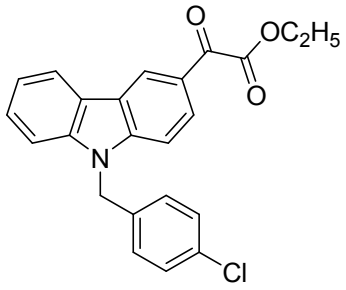
To a solution of dichloromethane (100 mL) at below 5 °C was added $AlCl_3$ (6.85 g, 51.4 mmol) portion wise, followed by ethyl chlorooxalate (9.36 g, 68.5 mmol) and slowly carbazole **11** (34.2 mmol) solution in 50 mL dichloromethane added over a period of 30 min. The reaction mixture was stirred at room temperature for 3 h. After complete disappearance of the starting material as indicated by TLC, contents were added slowly to a solution of ammonium acetate in water (200 mL). The aqueous layer was extracted with DCM (2 × 200 ml) and combined organic layer was concentrated *in vaccuo*. The obtained crude product was purified by column chromatography using ethyl acetate and hexane as eluent to obtain pure compounds **12a-d** as yellow solids in good yields (50-70%).

Ethyl 2-(9*H*-carbazol-3-yl)-2-oxoacetate (12a):



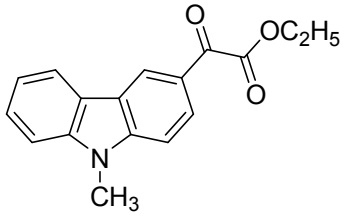
Off white solid; Yield 60%; M.p: 121-122 °C; IR (KBr, *v,* cm^{-1}): 3302, 2901, 1728, 1659, 1628, 1582, 1335, 1250, 1119, 1057, 717, 671.

Ethyl 2-(9-(4-chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxoacetate (12b):



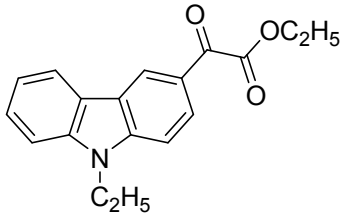
Off white solid; Yield 67%; M.p: 129-131 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 (s, 1H), 8.19 (d, J = 7.7 Hz, 1H), 8.13 (d, J = 8.7 Hz, 1H), 7.52 (t, J = 7.7 Hz, 1H), 7.39 (dd, J = 9.2, 4.6 Hz, 3H), 7.29–7.24 (m, 2H), 7.06 (d, J = 8.3 Hz, 2H), 5.52 (s, 2H), 4.54 (q, J = 7.1 Hz, 2H), 1.49 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.0, 164.9, 144.4, 141.4, 134.7, 133.9, 130.1, 129.1, 128.6, 128.2, 127.6, 127.1, 124.9, 124.6, 123.5, 121.9, 120.5, 108.5, 63.9, 62.4, 46.4; IR (KBr, *v,* cm^{-1}): 3063, 2978, 2932, 1728, 1666, 1589, 1474, 1188, 1026, 841, 802, 748.

Ethyl 2-(9-methyl-9*H*-carbazol-3-yl)-2-oxoacetate (12c)



Yellow oil; Yield 50%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.78 (d, J = 2.1 Hz, 1H), 8.19–8.12 (m, 2H), 7.58–7.54 (m, 1H), 7.44 (t, J = 8.7 Hz, 2H), 7.38–7.32 (m, 1H), 4.54 (q, J = 7.2 Hz, 2H), 3.88 (s, 3H), 1.50 (t, J = 7.2 Hz, 3H).

Ethyl 2-(9-ethyl-9H-carbazol-3-yl)-2-oxoacetate (12d)

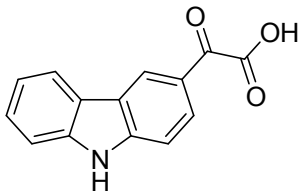


Yellow oil; Yield 57%; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.79 (d, J = 1.3 Hz, 1H), 8.17–8.13 (m, 2H), 7.57–7.53 (m, 1H), 7.44 (t, J = 8.7 Hz, 2H), 7.36–7.31 (m, 1H), 4.54 (q, J = 7.2 Hz, 2H), 4.37 (q, J = 7.2 Hz, 2H), 1.50 (t, J = 7.2 Hz, 3H), 1.46 (t, J = 7.3 Hz, 3H).

3. General procedure for the synthesis of carbazolyl glyoxalic acids (13a-d)

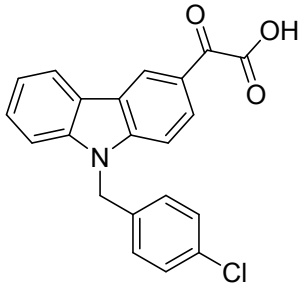
Carbazolyl glyoxalic esters **12** (12.8 mmol) was dissolved in 100 mL THF:H_2O (1:1). Lithium hydroxide monohydrate (2.7 g, 64 mmol) was added to the reaction mixture in portion wise. The resulting reaction mixture was stirred for 90 min at room temperature. Upon completion of the reaction as indicated by TLC, excess of THF was evaporated under *vaccuo* to give residue which was dissolved in water (50 mL) and acidified up to pH~2 using 2N HCl (50 mL). The obtained solid was filtered, washed with water and dried to afford compounds **13a-d** as yellow solids in excellent yields (90-97%).

2-(9*H*-Carbazol-3-yl)-2-oxoacetic acid (13a):



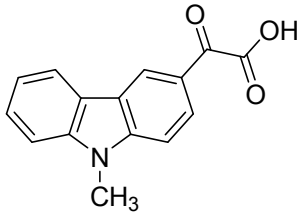
White solid; Yield 90%; M.p: 215-217 °C; IR (KBr, *v*, cm^{-1}): 3358, 2953, 1713, 1659, 1589, 1327, 1180, 918, 795, 741.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxoacetic acid (13b):



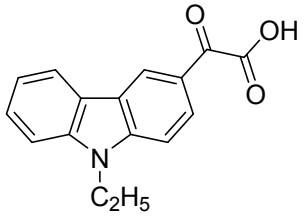
Yield 94%; off white solid; M.p: 183-185 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.83 (s, 1H), 8.35 (d, J = 7.7 Hz, 1H), 8.03 (d, J = 8.5 Hz, 1H), 7.82 (d, J = 8.7 Hz, 1H), 7.70 (d, J = 8.2 Hz, 1H), 7.52 (t, J = 7.6 Hz, 1H), 7.34–7.30 (m, 3H), 7.18 (d, J = 7.9 Hz, 2H), 5.74 (s, 2H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 189.3, 167.9, 144.2, 141.4, 136.5, 132.6, 129.2, 129.1, 127.9, 127.6, 124.2, 123.8, 123.0, 122.9, 121.6, 121.2, 110.8, 110.5, 45.7; IR (KBr, *v*, cm^{-1}): 3232, 2946, 1759, 1660, 1582, 1497, 1342, 1142, 802, 741.

2-(9-Methyl-9*H*-carbazol-3-yl)-2-oxoacetic acid (13c)



Yellow solid; Yield 92%; M.p: 162-163 °C. IR (KBr, *v*, cm^{-1}): 3318, 2953, 1739, 1663, 1580, 1323, 1243, 1180, 908, 795.

2-(9-Ethyl-9*H*-carbazol-3-yl)-2-oxoacetic acid (13d)

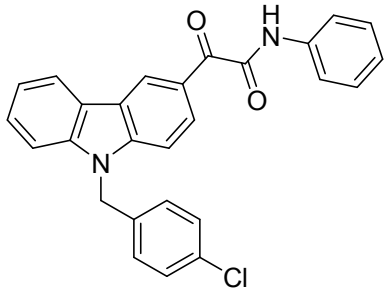


Yellow solid; Yield 97%; M.p: 173 °C. IR (KBr, *v*, cm^{-1}): 3267, 2956, 1725, 1669, 1592, 1455, 1335, 1263, 1188, 803, 741.

4. General procedure for the synthesis of carbazolyl glyoxamides (14a-x)

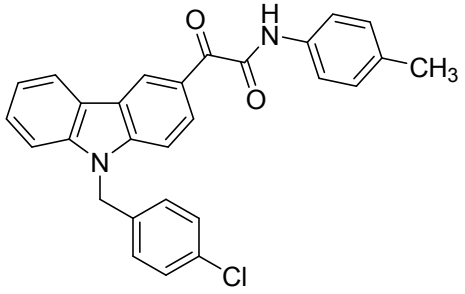
To a 10 mL microwave tube was added carbazole glyoxalic acid **13** (0.275 mmol), HATU (0.12 g, 0.317 mmol), *N,N*-diisopropylethylamine (0.09 g, 0.687 mmol) and an appropriate aryl/heteroarylamine (0.303 mmol) in DMF (2 mL). The tube was sealed with a pressure cap and placed in the microwave cavity. The sample was irradiated for 45 min at 70 °C and then allowed to cool at room temperature. The residue was poured into ice-cold water (30 mL) and stirred for 20 min at room temperature. The solid so obtained was filtered, dried and purified by column chromatography on silica gel using ethylacetate:hexane (3:7) as eluent to obtained pure (**14a-g**, **14j-o** and **14q**) in excellent yields. Some of the compounds (**14h-i** and **14p**) were crystallized from acetone to obtain pure products in 70-91% yields.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxo-*N*-phenylacetamide (14a).



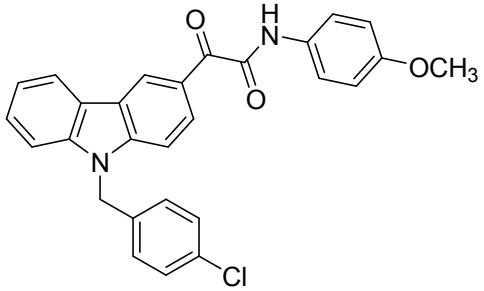
Yellow solid; Yield 70%; M.p: 191-193 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.47 (d, J = 1.3 Hz, 1H), 9.15 (s, 1H), 8.58 (dd, J = 8.8, 1.7 Hz, 1H), 8.25 (dd, J = 7.6, 1.1 Hz, 1H), 7.78 (dd, J = 8.6, 1.0 Hz, 2H), 7.54–7.50 (m, 1H), 7.45 (dd, J = 8.3, 7.5 Hz, 3H), 7.41–7.36 (m, 3H), 7.26 (t, J = 2.6 Hz, 2H), 7.08 (d, J = 8.6 Hz, 2H), 5.55 (s, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.9, 160.0, 144.2, 141.2, 136.9, 134.6, 133.7, 129.8, 129.3, 129.2, 127.7, 127.0, 126.2, 125.2, 125.0, 123.6, 123.1, 121.1, 121.1, 120.0, 109.5, 108.8, 46.24; IR (KBr, ν, cm^{-1}): 3335, 3090, 3052, 2916, 1682, 1653, 1589, 1520, 1435, 1307, 1250, 1134, 1011, 825, 795; Anal. RP-HPLC t_R = 4.641 min, purity 98.55%; HRMS (ESI$^+$) Calculated for $C_{27}H_{20}ClN_2O_2$ $[M + H]^+$, 439.1213; Found 439.1208 and 461.1025 $[M + Na]^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxo-*N*-(p-tolyl)acetamide (14b).



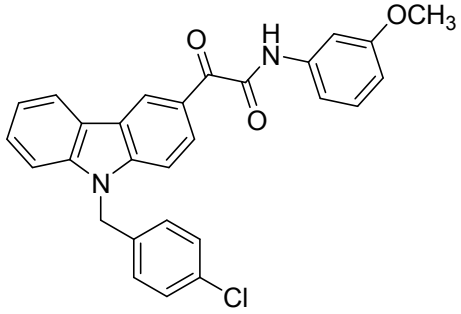
Yellow solid; Yield 72%; M.p: 172-173 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.48 (d, J = 1.6 Hz, 1H), 9.09 (s, 1H), 8.58 (dd, J = 8.8, 1.7 Hz, 1H), 8.27–8.23 (m, 1H), 7.67–7.64 (m, 2H), 7.53-7.49 (m, 1H), 7.44–7.35 (m, 3H), 7.26 (t, J = 2.2 Hz, 3H), 7.24 (s, 1H), 7.09 (d, J = 8.6 Hz, 2H), 5.55 (s, 2H), 2.39 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.0, 159.9, 144.2, 141.1, 134.9, 134.6, 134.3, 133.7, 129.9, 129.7, 129.2, 127.7, 126.9, 126.1, 125.1, 123.6, 123.1, 121.1, 121.0, 119.9, 109.5, 108.7, 46.2, 21.0; IR (KBr, v, cm^{-1}): 3325, 3094, 3055, 2916, 1682, 1651, 1620, 1582, 1520, 1443, 1327, 1265, 1149; Anal. RP-HPLC t_R = 5.317 min, purity 98.10%; HRMS (ESI$^+$) Calculated for $C_{28}H_{21}ClN_2O_2$ $[M + H]^+$, 453.1369; Found 453.1365 and 475.1183 $[M + Na]^+$

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(4-methoxyphenyl)-2-oxoacetamide (14c).



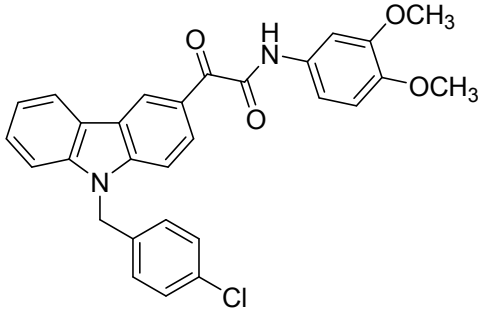
Yellow solid; Yield 72%; M.p: 168-170 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.45 (d, J = 1.5 Hz, 1H), 9.04 (s, 1H), 8.56 (dd, J = 8.8, 1.7 Hz, 1H), 8.22 (d, J = 7.7 Hz, 1H), 7.69–7.65 (m, 2H), 7.51-7.47 (m, 1H), 7.42–7.32 (m, 4H), 7.25–7.23 (m, 1H), 7.06 (d, J = 8.5 Hz, 2H), 6.97–6.94 (m, 2H), 5.52 (s, 2H), 3.84 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.1, 159.8, 157.0, 144.2, 141.1, 134.6, 133.7, 130.1, 129.7, 129.2, 127.7, 126.9, 126.1, 125.1, 123.6, 123.1, 121.6, 121.1, 121.0, 114.4, 109.5, 108.7, 55.5, 46.2; IR (KBr, v, cm^{-1}): 3348, 3055, 2924, 1682, 1643, 1620, 1582, 1528, 1443, 1327, 1250, 1149; Anal. RP-HPLC t_R = 4.368 min, purity 98.67%; HRMS (ESI$^+$) Calculated for $C_{28}H_{22}ClN_2O_3$ $[M + H]^+$, 469.1319; Found 469.1310, 471.1271 $[M + H + 2]^+$ and 491.1129 $[M + Na]^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(3-methoxyphenyl)-2-oxoacetamide (14d).



Yellow solid; Yield 73%; M.p: 106-107 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.43 (s, 1H), 9.11 (s, 1H), 8.57–8.54 (m, 1H), 8.23 (d, J = 7.7 Hz, 1H), 7.52–7.46 (m, 2H), 7.40–7.33 (m, 3H), 7.31–7.28 (m, 2H), 7.24–7.19 (m, 2H), 7.06 (d, J = 8.3 Hz, 2H), 6.77 (dd, J = 7.8, 1.6 Hz, 1H), 5.52 (s, 2H), 3.87 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.8, 160.3, 159.9, 144.2, 141.1, 138.1, 134.6, 133.7, 129.9, 129.7, 129.2, 127.7, 126.9, 126.1, 124.9, 123.5, 123.1, 121.1, 121.0, 112.2, 111.1, 109.5, 108.7, 105.5, 55.4, 46.2; IR (KBr, v, cm^{-1}): 3333, 3055, 2932, 2862, 1693, 1659, 1589, 1528, 1381, 1335, 1265, 1203, 1142, 1088, 1041,849, 795, 725, 687, 679; Anal. RP-HPLC t_R = 4.550 min, purity 98.36%; HRMS (ESI$^+$) Calculated for $C_{28}H_{22}ClN_2O_3$ $[M + H]^+$, 469.1319; Found 469.1313 and 491.1133 $[M + Na]^+$.

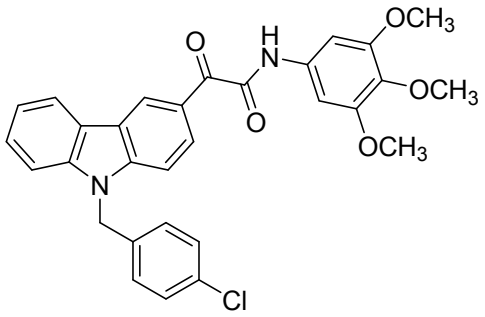
2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(3,4-dimethoxyphenyl)-2-oxoacetamide (14e)



Yellow solid; Yield 70%; M.p: 136-137 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.43 (s, 1H), 9.08 (s, 1H), 8.56 (d, J = 8.7 Hz, 1H), 8.23 (d, J = 7.7 Hz, 1H), 7.55 (d, J = 2.0 Hz, 1H), 7.49 (t, J = 7.7 Hz, 1H), 7.40–7.33 (m, 3H), 7.24 (s, 2H), 7.16 (dd, J = 8.5, 2.1 Hz, 1H), 7.06 (d, J = 8.2 Hz, 2H), 6.89 (d, J = 8.6 Hz, 1H), 5.51 (s, 2H), 3.96 (s, 3H), 3.90 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.0, 159.7, 149.2, 146.5, 144.2, 141.1, 134.6, 133.7, 130.6, 129.7, 129.2, 127.7, 126.9, 126.1, 125.1, 123.6, 123.1, 121.1, 121.0, 112.1, 111.4, 109.5, 108.7, 104.5, 56.1, 56.0, 46.2; IR (KBr, v, cm^{-1}): 3317, 3055, 2924, 2847, 1690, 1651, 1589, 1520, 1458, 1412, 1381, 1335, 1242, 1203, 1134, 1026, 849, 795, 748, 663, 602, 540; Anal. RP-HPLC t_R = 4.031 min, purity 98.17%;

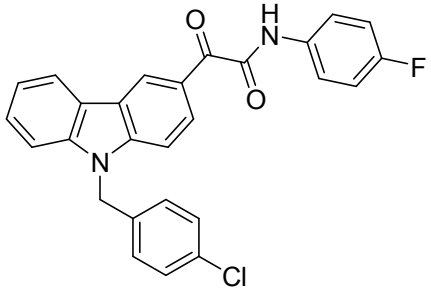
HRMS (ESI$^+$) Calculated for $C_{29}H_{24}ClN_2O_4$ [M + H]$^+$, 499.1424; Found 499.1424, 501.1390 [M + H + 2]$^+$ and 521.1238 [M + Na]$^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxo-*N*-(3,4,5-trimethoxyphenyl)acetamide (14f).



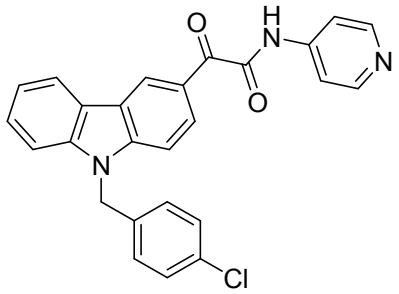
Yellow solid; Yield 71%; M.p: 183-184 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.43 (s, 1H), 9.15 (s, 1H), 8.57 (dd, J = 8.8, 1.6 Hz, 1H), 8.25 (d, J = 7.6 Hz, 1H), 7.55–7.49 (m, 1H), 7.40 (t, J = 8.6 Hz, 3H), 7.29-7.25 (m, 3H), 7.08 (d, J = 8.6 Hz, 3H), 5.53 (s, 2H), 3.94 (s, 6H), 3.89 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.8, 159.9, 153.5, 144.2, 141.1, 135.3, 134.6, 133.7, 133.0, 129.7, 129.1, 127.7, 127.0, 126.0, 124.9, 123.5, 123.1, 121.1, 121.0, 109.5, 108.8, 97.5, 61.0, 56.2, 46.2; IR (KBr, v, cm^{-1}): 3356, 2932, 1690, 1651, 1597, 1528, 1504, 1450, 1412, 1373, 1335, 1296, 1250, 1126, 1011, 802; Anal. RP-HPLC t_R = 4.181 min, purity 98.17%; HRMS (ESI$^+$) Calculated for $C_{30}H_{26}ClN_2O_5$ [M + H]$^+$, 529.1530; Found 529.1531 and 551.1344 [M + Na]$^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(4-fluorophenyl)-2-oxoacetamide (14g).



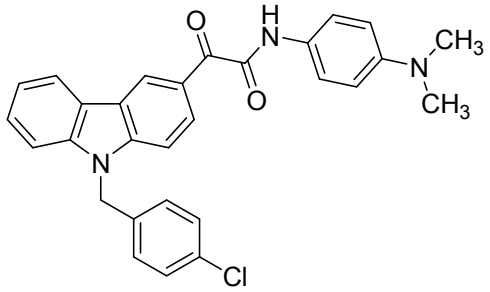
Yellow solid; Yield 75%; M.p: 202-203 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.43 (d, 1.5 Hz, 1H), 9.13 (s, 1H), 8.55 (dd, J = 8.8, 1.6 Hz, 1H), 8.22 (d, J = 7.7 Hz, 1H), 7.74–7.71 (m, 2H), 7.53–7.46 (m, 1H), 7.40–7.33 (m, 3H), 7.24 (s, 2H), 7.14–7.03 (m, 4H), 5.51 (s, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.7, 159.9, 144.2, 141.2, 134.6, 133.7, 133.0, 133.0, 129.7, 129.2, 127.7, 127.0, 126.2, 124.9, 123.6, 123.1, 121.8, 121.7, 121.1, 116.1, 115.9, 113.4, 109.5, 108.8, 46.2; IR (KBr, v, cm^{-1}): 3310, 3055, 2935, 1690, 1651, 1589, 1535, 1497, 1381, 1335, 1265, 1211, 1142, 833, 705.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxo-*N*-(pyridin-4-yl)acetamide (14h).



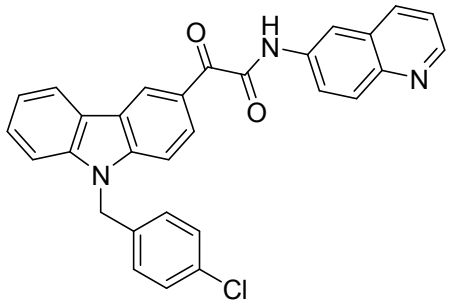
Yellow solid; Yield 91%; M.p: 116-118 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.40 (s, 1H), 9.32 (s, 1H), 8.61 (d, J = 5.0 Hz, 2H), 8.53 (dd, J = 8.8, 1.4 Hz, 1H), 8.22 (d, J = 7.5 Hz, 1H), 7.69 (d, J = 6.1 Hz, 2H), 7.50 (t, J = 7.4 Hz, 1H), 7.31–7.35 (m, 3H), 7.24 (t, J = 4.8 Hz, 2H), 7.06 (d, J = 8.3 Hz, 2H), 5.52 (s, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 184.6, 160.5, 151.0, 144.4, 143.8, 141.2, 134.5, 133.8, 129.8, 129.2, 127.7, 127.2, 126.2, 124.5, 123.5, 123.3, 121.2, 121.1, 113.8, 109.6, 108.9, 46.3; IR (KBr, v, cm^{-1}): 3340, 2924, 1696, 1659, 1489, 1327, 1265, 1142, 1021, 803; Anal. RP-HPLC t_R = 4.306 min, purity 98.02%; HRMS (ESI$^+$) Calculated for $C_{26}H_{19}ClN_3O_2$ $[M + H]^+$, 440.1166; Found 440.1171 and 442.1141 $[M + H + 2]^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(4-(dimethylamino)phenyl)-2-oxoacetamide (14i).



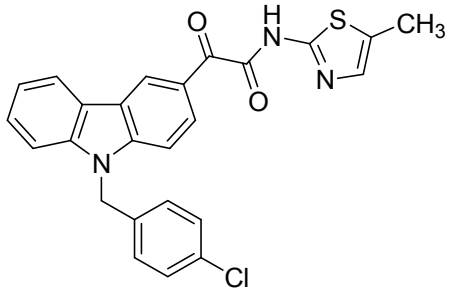
Yellow solid; Yield 71%; M.p: 211-213 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.46 (d, J = 1.3 Hz, 1H), 8.98 (s, 1H), 8.56 (dd, J = 8.8, 1.7 Hz, 1H), 8.24–8.21 (m, 1H), 7.63–7.60 (m, 2H), 7.50-7.46 (m, 1H), 7.42–7.30 (m, 4H), 7.24 (s, 1H), 7.06 (d, J = 8.6 Hz, 2H), 6.79–6.76 (m, 2H), 5.52 (s, 2H), 2.97 (s, 6H); IR (KBr, v, cm^{-1}): 3333, 3047, 2924, 2854, 2800, 1674, 1643, 1582, 1520, 1443, 1350, 1265, 1136, 1011, 949, 895, 825, 795, 748, 694, 617; HRMS (ESI$^+$) Calculated for $C_{29}H_{25}ClN_3O_2$ $[M + H]^+$, 482.1635; Found 482.1621 and 484.1609 $[M + H + 2]^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-2-oxo-*N*-(quinolin-6-yl)acetamide (14j).



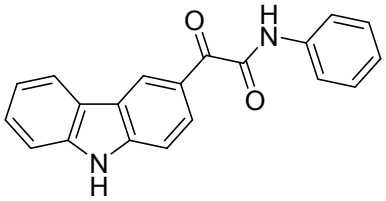
Yellow solid; Yield 70%; M.p: 129-131 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.44 (d, 1.3 Hz, 2H), 8.89 (dd, J = 4.3, 1.6 Hz, 1H), 8.61–8.55 (m, 2H), 8.25–8.18 (m, 2H), 8.16 (d, J = 9.0 Hz, 1H), 7.79 (dd, J = 9.0, 2.4 Hz, 1H), 7.52–7.41 (m, 2H), 7.41–7.30 (m, 3H), 7.23 (t, J = 2.1 Hz, 2H), 7.05 (d, J = 8.5 Hz, 2H), 5.49 (s, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.4, 160.3, 149.5, 145.4, 144.3, 141.1, 136.4, 134.9, 134.5, 133.7, 130.2, 130.1, 129.8, 129.2, 128.8, 127.7, 127.1, 126.2, 124.8, 123.5, 123.4, 123.2, 121.9, 121.1, 116.5, 109.5, 108.8, 46.2; IR (KBr, v, cm^{-1}): 3356, 2932, 1690, 1651, 1597, 1528, 1504, 1450, 1412, 1373, 1335, 1296, 1250, 1126, 1011, 802; Anal. RP-HPLC t_R = 4.911 min, purity 97.89%; HRMS (ESI$^+$) Calculated for $C_{30}H_{21}ClN_3O_2$ [M + H]$^+$, 490.1322; Found 490.1327 and 492.1304 [M + H + 2]$^+$.

2-(9-(4-Chlorobenzyl)-9*H*-carbazol-3-yl)-*N*-(5-methylthiazol-2-yl)-2-oxoacetamide (14k).



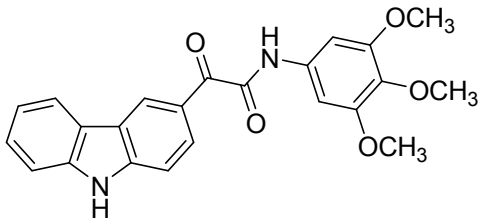
Yellow solid; Yield 74%; M.p: 178-179 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.63 (s, 1H), 9.48 (d, J = 1.3 Hz, 1H), 8.60 (dd, J = 8.8, 1.5 Hz, 1H), 8.25 (d, J = 8.2 Hz, 1H), 7.52 (t, J = 7.3 Hz, 1H), 7.46–7.32 (m, 4H), 7.26 (s, 1H), 7.08 (d, J = 8.3 Hz, 2H), 6.70 (s, 1H), 5.53 (s, 2H), 2.44 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.9, 159.3, 156.1, 148.4, 144.4, 141.2, 134.5, 133.8, 129.7, 129.2, 128.7, 127.7, 127.1, 126.2, 124.6, 123.5, 123.3, 121.2, 109.6, 109.2, 108.9, 46.3, 17.1; IR (KBr, v, cm^{-1}): 3317, 3055, 2932, 1690, 1651, 1589, 1528, 1489, 1257, 1142, 1011, 802; Anal. RP-HPLC t_R = 4.562 min, purity 99.82%; HRMS (ESI$^+$) Calculated for $C_{25}H_{19}ClN_3O_2S$ [M + H]$^+$, 460.0886; Found 460.0888.

2-(9*H*-Carbazol-3-yl)-2-oxo-*N*-phenylacetamide (14l).



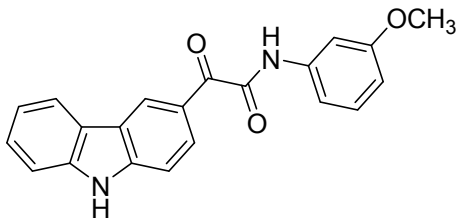
Yellow solid; Yield 70%; M.p: 221-222 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.41 (s, 1H), 9.12 (s, 1H), 8.55 (dd, J = 8.7, 1.5 Hz, 1H), 8.43 (s, 1H), 8.18 (d, J = 7.7 Hz, 1H), 7.76 (d, J = 7.7 Hz, 2H), 7.53–7.46 (m, 3H), 7.43 (t, J = 7.9 Hz, 2H), 7.36–7.30 (m, 1H), 7.21 (t, J = 7.4 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 187.4, 162.4, 143.9, 140.6, 137.5, 128.8, 128.3, 126.4, 125.1, 124.6, 124.0, 123.1, 122.8, 120.4, 120.2, 120.0, 111.4, 110.9; IR (KBr, v, cm^{-1}): 3348, 3055, 2932, 1674, 1651, 1589, 1528, 1443, 1335, 1296, 1265, 1257, 1165, 1134, 1011, 787, 748, 687, 602, 548; Anal. RP-HPLC t_R = 3.335 min, purity 98.25%; HRMS (ESI$^+$) Calculated for $C_{20}H_{15}N_2O_2$ $[M + H]^+$, 315.1133; Found 315.1129 and 337.0949 $[M + Na]^+$.

2-(9*H*-Carbazol-3-yl)-2-oxo-*N*-(3,4,5-trimethoxyphenyl)acetamide (14m).



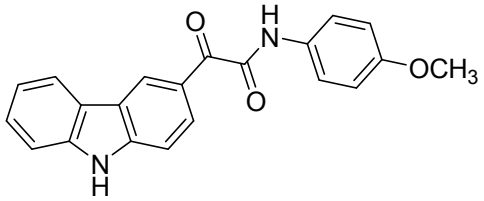
Yellow solid; Yield 72%; M.p: 207-208 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.39 (s, 1H), 9.08 (s, 1H), 8.55 (dd, J = 8.7, 1.7 Hz, 1H), 8.47 (s, 1H), 8.19 (d, J = 7.8 Hz, 1H), 7.51–7.45 (m, 3H), 7.35–7.31 (m, 1H), 7.07 (s, 2H), 3.93 (s, 6H), 3.86 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.9, 160.0, 153.5, 143.5, 140.0, 135.3, 133.1, 129.5, 126.9, 126.1, 124.9, 123.6, 123.3, 120.9, 120.8, 111.1, 110.6, 97.6, 61.0, 56.2; IR (KBr, v, cm^{-1}): 3340, 3301, 3055, 2932, 2839, 1690, 1651, 1597, 1528, 1458, 1412, 1373, 1335, 1234, 1203, 1126, 995, 802, 733, 617; Anal. RP-HPLC t_R = 3.113 min, purity 98.72%; HRMS (ESI$^+$) Calculated for $C_{23}H_{21}N_2O_5$ $[M + H]^+$, 405.1450; Found 405.1451 and 427.1273 $[M + Na]^+$.

2-(9*H*-Carbazol-3-yl)-*N*-(3-methoxyphenyl)-2-oxoacetamide (14n).



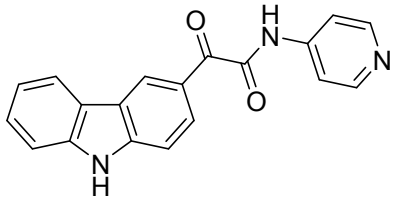
Yellow solid; Yield 72%; M.p: 171-173 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.40 (s, 1H), 9.10 (s, 1H), 8.55 (dd, J = 8.7, 1.4 Hz, 1H), 8.43 (s, 1H), 8.18 (d, J = 7.8 Hz, 1H), 7.49 (dd, J = 8.5, 3.8 Hz, 3H), 7.35–7.29 (m, 2H), 7.22 (d, J = 8.0 Hz, 1H), 6.77 (dd, J = 7.9, 1.8 Hz, 1H), 6.38–6.21 (m, 1H), 3.87 (s, 3H); IR (KBr, ν, cm^{-1}): 3379, 3317, 3070, 2962, 2831, 1690, 1651, 1597, 1535, 1497, 1450, 1335, 1242, 1203, 1149, 1034, 795, 687; Anal. RP-HPLC t_R = 3.251 min, purity 98.37%; HRMS (ESI$^+$) Calculated for $C_{21}H_{17}N_2O_3$ $[M + H]^+$, 345.1239; Found 345.1237 and 367.1058 $[M + Na]^+$

2-(9*H*-Carbazol-3-yl)-*N*-(4-methoxyphenyl)-2-oxoacetamide (14o).



Yellow solid; Yield 70%; M.p: 199-201 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.41 (s, 1H), 9.04 (s, 1H), 8.54 (dd, J = 8.7, 1.7 Hz, 1H), 8.43 (s, 1H), 8.17 (d, J = 7.8 Hz, 1H), 7.71–7.67 (m, 1H), 7.67–7.65 (m, 1H), 7.48 (dd, J = 5.8, 2.1 Hz, 3H), 7.34–7.30 (m, 1H), 6.98–6.96 (m, 1H), 6.96–6.93 (m, 1H), 3.84 (s, 3H); IR (KBr, ν, cm^{-1}): 3294, 3256, 3094, 2962, 2831, 1692, 1659, 1597, 1504, 1450, 1412, 1335, 1281, 1234, 1134, 1103, 1011, 802, 795, 679; Anal. RP-HPLC t_R = 3.138 min, purity 99.62%; HRMS (ESI$^+$) Calculated for $C_{21}H_{17}N_2O_3$ $[M + H]^+$, 345.1239; Found 345.1238 and 367.1059 $[M + Na]^+$

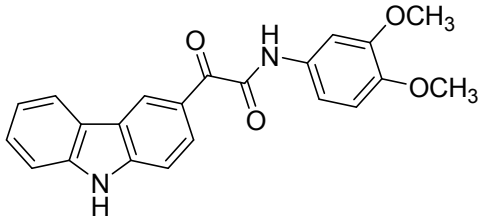
2-(9*H*-Carbazol-3-yl)-2-oxo-*N*-(pyridin-4-yl)acetamide (14p).



Yellow solid; Yield 71%; M.p >300 ºC; ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.97 (s, 1H), 11.34 (s, 1H), 8.91 (d, J = 1.4 Hz, 1H), 8.56 (d, J = 6.0 Hz, 2H), 8.31 (d, J = 7.8 Hz, 1H), 8.10 (dd, J =

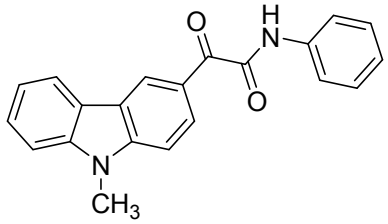
8.6, 1.7 Hz, 1H), 7.78 (d, *J* = 6.3 Hz, 2H), 7.66 (d, *J* = 8.6 Hz, 1H), 7.59 (d, *J* = 8.1 Hz, 1H), 7.49 (t, *J* = 8.2 Hz, 1H), 7.27 (t, *J* = 7.9 Hz, 1H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 188.6, 165.8, 151.1, 145.2, 144.2, 141.0, 128.1, 127.3, 124.7, 123.6, 123.0, 123.0, 121.5, 120.6, 114.6, 112.2, 112.0; IR (KBr, *v*, cm^{-1}): 3286, 3217, 3094, 2962, 2800, 1705, 1659, 1605, 1566, 1489, 1420, 1342, 1311, 1250, 1196, 1157, 1126, 1011, 802, 787, 748, 679; Anal. RP-HPLC t_R = 3.133 min, purity 98.12%; HRMS (ESI$^+$) Calculated for $C_{19}H_{14}N_3O_2$ [M + H]$^+$, 316.1086; Found 316.1085.

2-(9*H*-Carbazol-3-yl)-*N*-(3,4-dimethoxyphenyl)-2-oxoacetamide (14q).



Yellow solid; Yield 71%; M.p: 202-203 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.41 (s, 1H), 9.07 (s, 1H), 8.55 (dd, *J* = 8.7, 1.7 Hz, 1H), 8.43 (s, 1H), 8.18 (d, *J* = 7.8 Hz, 1H), 7.56 (d, *J* = 2.4 Hz, 1H), 7.51–7.45 (m, 3H), 7.35-7.31 (m, 1H), 7.16 (dd, *J* = 8.6, 2.4 Hz, 1H), 6.90 (d, *J* = 8.6 Hz, 1H), 3.96 (s, 3H), 3.91 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.0, 159.7, 149.2, 146.5, 143.4, 139.9, 130.6, 129.6, 126.9, 126.1, 125.1, 123.6, 123.3, 120.9, 120.9, 112.1, 111.4, 111.1, 110.5, 104.4, 56.1, 56.0; IR (KBr, *v*, cm^{-1}): 3472, 3286, 3086, 2924, 2839, 1692, 1659, 1589, 1450, 1335, 1219, 1134, 1018, 849, 795, 733, 671, 617; Anal. RP-HPLC t_R = 2.996 min, purity 98.66%; HRMS (ESI$^+$) Calculated for $C_{22}H_{19}N_2O_4$ [M + H]$^+$, 375.1344; Found 375.1348 and 397.1164 [M + Na]$^+$.

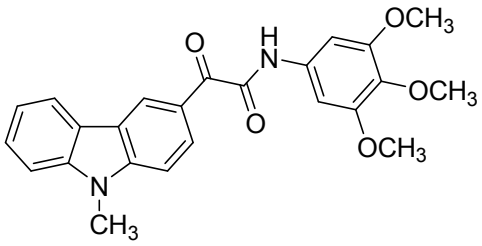
2-(9-Methyl-9*H*-carbazol-3-yl)-2-oxo-*N*-phenylacetamide (14r)



Yellow solid; Yield 78%; M.p: 165-166 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.40 (d, *J* = 1.4 Hz, 1H), 9.18 (s, 1H), 8.60 (dd, *J* = 8.8, 1.7 Hz, 1H), 8.19 (d, *J* = 7.7 Hz, 1H), 7.79 (d, *J* = 7.6 Hz, 2H), 7.56 (t, *J* = 8.2 Hz, 1H), 7.47–7.41 (m, 4H), 7.35 (t, *J* = 7.9 Hz, 1H), 7.23 (t, *J* = 7.4 Hz, 1H), 3.87 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.8, 160.2, 144.6, 141.7, 136.9, 129.5,

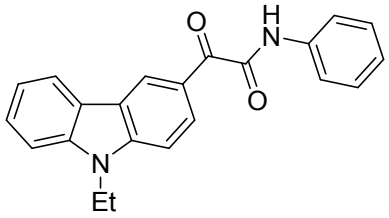
129.2, 126.7, 126.0, 125.1, 124.4, 123.3, 122.7, 120.8, 120.6, 120.0, 109.1, 108.4, 29.4; IR (KBr, *v*, cm^{-1}): 3333, 2924, 2854, 1682, 1643, 1610, 1528, 1443, 1366, 1304, 1257, 1149, 1026, 895; Anal. RP-HPLC t_R = 3.461 min, purity 98.76%; MS (ESI^+) Calculated for $C_{21}H_{17}N_2O_2$ $[M + H]^+$, 329.12; Found 329.12.

2-(9-Methyl-9*H*-carbazol-3-yl)-2-oxo-*N*-(3,4,5-trimethoxyphenyl)acetamide (14s)



Yellow solid; Yield 80%; M.p: 187-188 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.35 (d, *J* = 1.6 Hz, 1H), 9.17 (s, 1H), 8.57 (dd, *J* = 8.8, 1.6 Hz, 1H), 8.18 (d, *J* = 7.7 Hz, 1H), 7.54 (t, *J* = 8.2 Hz, 1H), 7.43–7.38(m, 2H), 7.34 (t, *J* = 7.2 Hz, 1H), 7.08 (s, 2H), 3.92 (s, 6H), 3.88 (s, 3H), 3.84 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.7, 160.1, 153.4, 144.5, 141.6, 135.2, 133.1, 129.4, 126.7, 125.9, 124.3, 123.2, 122.7, 120.8, 120.5, 109.1, 108.4, 97.5, 61.0, 56.2, 29.3; IR (KBr, *v*, cm^{-1}): 3310, 2924, 2854, 1683, 1659, 1607, 1589, 1504,1450, 1373, 1327, 1227, 1126, 895; Anal. RP-HPLC t_R = 2.837 min, purity 99.34%; MS (ESI^+) Calculated for $C_{24}H_{23}N_2O_5$ $[M + H]^+$, 419.16; Found 419.18.

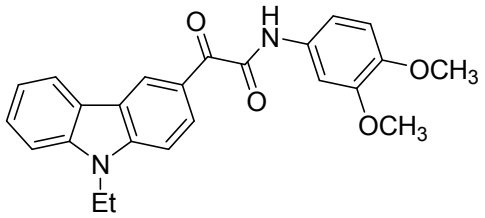
2-(9-Ethyl-9*H*-carbazol-3-yl)-2-oxo-*N*-phenylacetamide (14t)



Yellow solid; Yield 82%; M.p 159-160 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.44 (d, *J* = 1.3 Hz, 1H), 9.18 (s, 1H), 8.62 (dd, *J* = 8.8, 1.7 Hz, 1H), 8.22 (d, *J* = 7.7 Hz, 1H), 7.79 (d, *J* = 7.6 Hz, 2H), 7.59–7.53 (m, 1H), 7.49–7.43 (m, 4H), 7.35 (t, *J* = 7.4 Hz, 1H), 7.26–7.21 (m, 1H), 4.42 (q, *J* = 7.2 Hz, 2H), 1.50 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.8, 160.2, 143.7, 140.7, 136.9, 129.5, 129.2, 126.6, 126.2, 125.1, 124.3, 123.5, 122.9, 121.0, 120.5, 119.9, 109.1,

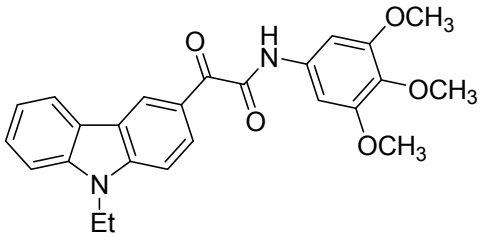
108.4, 37.9, 13.8; IR (KBr, *v*, cm^{-1}): 3310, 2924, 2854, 1690, 1643, 1589, 1535,1497, 1443, 1381, 1335, 1257, 1149, 756; Anal. RP-HPLC t_R = 2.870 min, purity 98.74%; MS (ESI^+) Calculated for $C_{22}H_{19}N_2O_2$ $[M + H]^+$, 343.14; Found 343.19.

_N_-(3,4-Dimethoxyphenyl)-2-(9-ethyl-9_H_-carbazol-3-yl)-2-oxoacetamide (14u)



Yellow solid; Yield 85%; M.p: 110-111 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.41 (d, *J* = 1.4 Hz, 1H), 9.15 (s, 1H), 8.60 (dd, *J* = 8.8, 1.6 Hz, 1H), 8.20 (d, *J* = 7.7 Hz, 1H), 7.58 (d, *J* = 2.4 Hz, 1H), 7.54 (t, *J* = 7.2 Hz, 1H), 7.44 (t, *J* = 8.6 Hz, 2H), 7.34 (t, *J* = 7.4 Hz, 1H), 7.18 (dd, *J* = 8.6, 2.4 Hz, 1H), 6.90 (d, *J* = 8.7 Hz, 1H), 4.39 (q, *J* = 7.2 Hz, 2H), 3.98 (s, 3H), 3.92 (s, 3H), 1.47 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.9, 160.0, 149.2, 146.4, 143.6, 140.6, 130.6, 129.4, 126.6, 126.1, 124.4, 123.5, 122.9, 121.0, 120.4, 112.0, 111.3, 109.1, 108.3, 104.4, 56.0, 37.9, 13.8; IR (KBr, *v*, cm^{-1}): 3338, 2924, 2854, 1724, 1659, 1589, 1443, 1381, 1327, 1250, 1142, 1026, 768; Anal. RP-HPLC t_R = 2.849 min, purity 99.51%; MS (ESI^+) Calculated for $C_{24}H_{23}N_2O_4$ $[M + H]^+$, 403.16; Found 403.21.

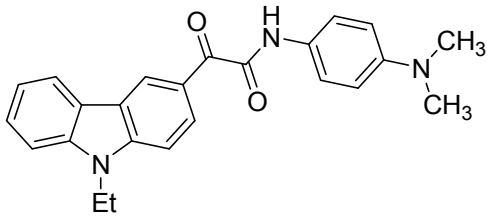
2-(9-Ethyl-9_H_-carbazol-3-yl)-2-oxo-_N_-(3,4,5-trimethoxyphenyl)acetamide (14v)



Yellow solid; Yield 86%; M.p: 175-176 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.39 (d, *J* = 1.4 Hz, 1H), 9.18 (s, 1H), 8.59 (dd, *J* = 8.8, 1.6 Hz, 1H), 8.20 (d, *J* = 7.7 Hz, 1H), 7.54 (t, *J* = 7.7 Hz, 1H), 7.47–7.41 (m, 2H), 7.34 (t, *J* = 7.7 Hz, 1H), 7.10 (s, 2H), 4.38 (q, *J* = 7.2 Hz, 2H), 3.93 (s, 6H), 3.88 (s, 3H), 1.47 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.7, 160.1, 153.5, 143.6, 140.6, 135.2, 133.1, 129.4, 126.6, 126.0, 124.2, 123.4, 122.9, 121.0, 120.5, 109.1, 108.3,

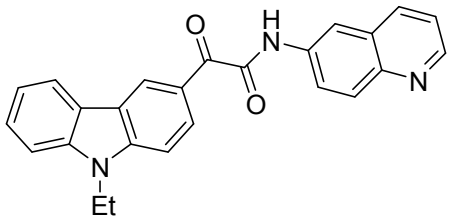
97.6, 61.0, 56.2, 37.9, 13.8; IR (KBr, *v*, cm^{-1}): 3279, 2932, 2854, 1736, 1659, 1607, 1589, 1504,1450, 1389, 1342, 1234, 1126,1049, 995; Anal. RP-HPLC t_R = 2.866 min, purity 98.57%; MS (ESI^+) Calculated for $C_{25}H_{25}N_2O_5$ $[M + H]^+$, 433.17; Found 433.18.

_N_-(4-(dimethylamino)phenyl)-2-(9-ethyl-9H-carbazol-3-yl)-2-oxoacetamide (14w)



Yellow solid; Yield 73%; M.p: 173-174 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.45 (d, *J* = 1.3 Hz, 1H), 9.04 (s, 1H), 8.63 (dd, *J* = 8.8, 1.6 Hz, 1H), 8.21 (d, *J* = 7.7 Hz, 1H), 7.65 (d, *J* = 9.0 Hz, 2H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.49–7.43 (m, 2H), 7.34 (t, *J* = 7.0 Hz, 1H), 6.80 (d, *J* = 9.0 Hz, 2H), 4.41 (q, *J* = 7.2 Hz, 2H), 2.99 (s, 6H), 1.49 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.3, 159.8, 148.3, 143.6, 140.6, 129.5, 126.7, 126.6, 126.1, 124.7, 123.6, 122.8, 121.4, 121.0, 120.4, 112.9, 109.1, 108.3, 40.8, 37.9, 13.8; IR (KBr, *v*, cm^{-1}): 3290, 2924, 2854, 1723, 1666, 1582,1448, 1350, 1234, 1126, 1065, 895; Anal. RP-HPLC t_R = 2.862 min, purity 99.71%; MS (ESI^+) Calculated for $C_{24}H_{24}N_3O_2$ $[M + H]^+$, 386.18; Found 386.24.

2-(9-Ethyl-9*H*-carbazol-3-yl)-2-oxo-*N*-(quinolin-6-yl)acetamide (14x)



Yellow solid; Yield 78%; M.p: 191-192 ºC; ^1H NMR (400 MHz, $CDCl_3$) δ 9.49 (s, 1H), 9.42 (d, *J* = 1.3 Hz, 1H), 8.89 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.64–8.56 (m, 2H), 8.19 (t, *J* = 7.1 Hz, 2H), 8.14 (d, *J* = 8.0 Hz, 1H), 7.80 (dd, *J* = 9.0, 2.4 Hz, 1H), 7.57–7.52 (m, 1H), 7.47–7.40 (m, 3H), 7.34 (t, *J* = 7.5 Hz, 1H), 4.37 (q, *J* = 7.2 Hz, 2H), 1.47 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 185.3, 160.5, 149.8, 145.8, 143.7, 140.6, 136.0, 134.9, 130.5, 129.5, 128.8, 126.7, 126.2, 124.2, 123.4, 123.2, 122.9, 121.8, 121.0, 120.6, 116.5, 109.2, 108.4, 37.9, 13.8; IR (KBr, *v*, cm^{-1}): 3348, 2924, 2854, 1690, 1651, 1582,1466, 1327, 1234, 1126, 1065, 887; Anal. RP-

HPLC t_R = 2.852 min, purity 98.11%; MS (ESI^+) Calculated for $C_{25}H_{20}N_3O_2$ $[M + H]^+$, 394.15; Found 394.16.

III. Cytotoxicity assay

Cell culture. U937 (Histiocytic lymphoma), and breast (MCF-7 and MDA-MB-231) cancer cell lines were cultured in DMEM supplemented with 10% fetal bovine serum and 50 μg/mL of streptomycin and penicillin. Jurkat (Human T lymphocyte) cell were cultured in RPMI supplemented with 10% fetal bovine serum and 50 μg/mL of streptomycin and penicillin. All the cell lines were maintained in 5% CO_2 environment at 37 °C.

Cell viability assay. Cells were seeded in a 96-well plate at a density of 100,000/mL and grown for overnight. Cells were treated with various carbazolyl glyoxamides at a final concentration of 10 μM and incubated for 48 h. Cell viability assay was performed using a MTT cell proliferation kit from ATCC (#30-1010K). In summary, 10 μL MTT reagent was added to each well, and cells were placed back in incubator for 4 h. 100 μL of detergent (from kit) was added and absorbance data was collected at 570 nm using Biotek synergy 2 spectrophotometer. Percentage of cell survival data was calculated using the following formula;

% cell survival = (100/At*As)

Where At and As are the absorbances of wells treated with test compounds and solvent control respectively.

Caspase assay. 1,00,000 cells were plated in a 24 well plate and treated with 1 μM compounds **14i-m** and **14q** for 24 h later, sample (100 μL) was taken and analyzed as per kit (Promega G7790). Fluorescence for the samples was measured at 0 min and 180 min. Camptothecin was used as a positive control for inducing apoptotic cell death.

IV. Antibacterial activity

All the synthesized carbazolyl glyoxamides **14a-x** were screened for antibacterial activity against the Gram-negative bacteria *Escherichia coli* (MTCC 1652), *Pseudomonas putida* (MTCC 102) and Gram-positive bacteria *Staphylococcus aureus* (MTCC 96) and *Bacillus subtilis* (MTCC 121).The minimal inhibitory concentrations (MIC) and Zone of inhibition (ZOI) of the compounds were determined *in vitro* by the modified microbroth dilution method as per defined

by the National Committee for Clinical Laboratory Standards (1993). Bacterial culture were grown in Mueller–Hinton broth (Himedia Laboratories, India) medium and bacterial suspension was adjusted to 1×10^5 CFU/mL. All compounds were dissolved in dimethylsulfoxide (DMSO) and two fold serial dilution of each compound was prepared to obtain the required concentrations of 256, 128, 64, 32, 16, 8, 4, 2, 1, 0.5 µg/mL.Serial diluted test samples of each compound (75 µL) were added in 96 well micro-trays. The same amount of test microorganism was added to micro-trays well under aseptic condition to obtain a final volume of 150 µL and incubated at 37 °C for 24 h. MIC value is defined as the lowest concentration of compound that inhibit the visible growth of bacteria. A control test with solvent DMSO at the same dilution was also performed to ensure that the solvent had no effect on bacterial growth. All assays were performed in duplicate sets. A broad spectrum antibiotic 'chloramphenicol' effective against Gram-positive and Gram-negative bacterium was used as positive control.

Cell viability assay

The effect of selected compounds on bactericidal activity was evaluated by quantifying bacterial cell number at different time intervals after treating with different concentrations of selected compounds. The time kill curve was determined for compounds against log phase (1×10^5 CFU/mL) freshly grown cultures of *E. coli* and *P. putida.* Bacterial cultures were treated with compound at different concentration (4, 8, 12 and 16 µg mL^{-1}) from 2-8 h and the percentage in reduction of bacterial cell viability was measured by standard plate count assay. The number of cells in the control was assumed to be 100%. The decrease in cellular viability in treated samples was calculated with respect to the control. All treatments were performed in triplicate sets.

LDH assay

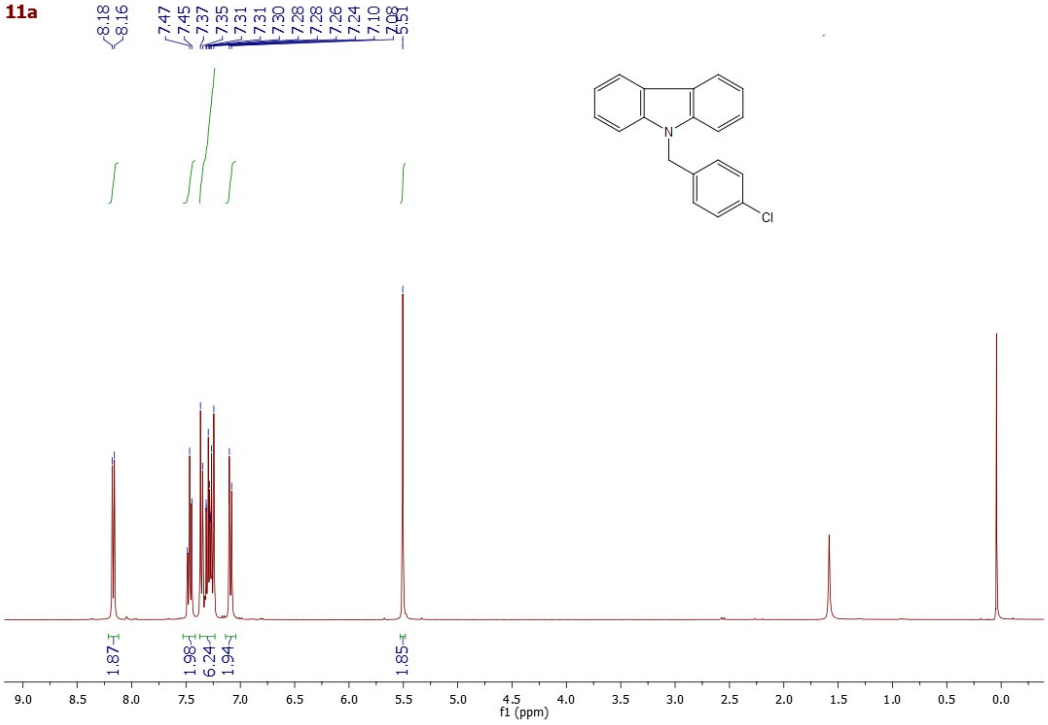
50,000 Cells per 100 microliter were plated per well in a 96-well format and were treated with 20 micro molar doxorubicin and test compound. After 40 h, samples were processed and analyzed for LDH activity using LDH cytotoxicity kit from Cayman chemicals (cat no 601170).

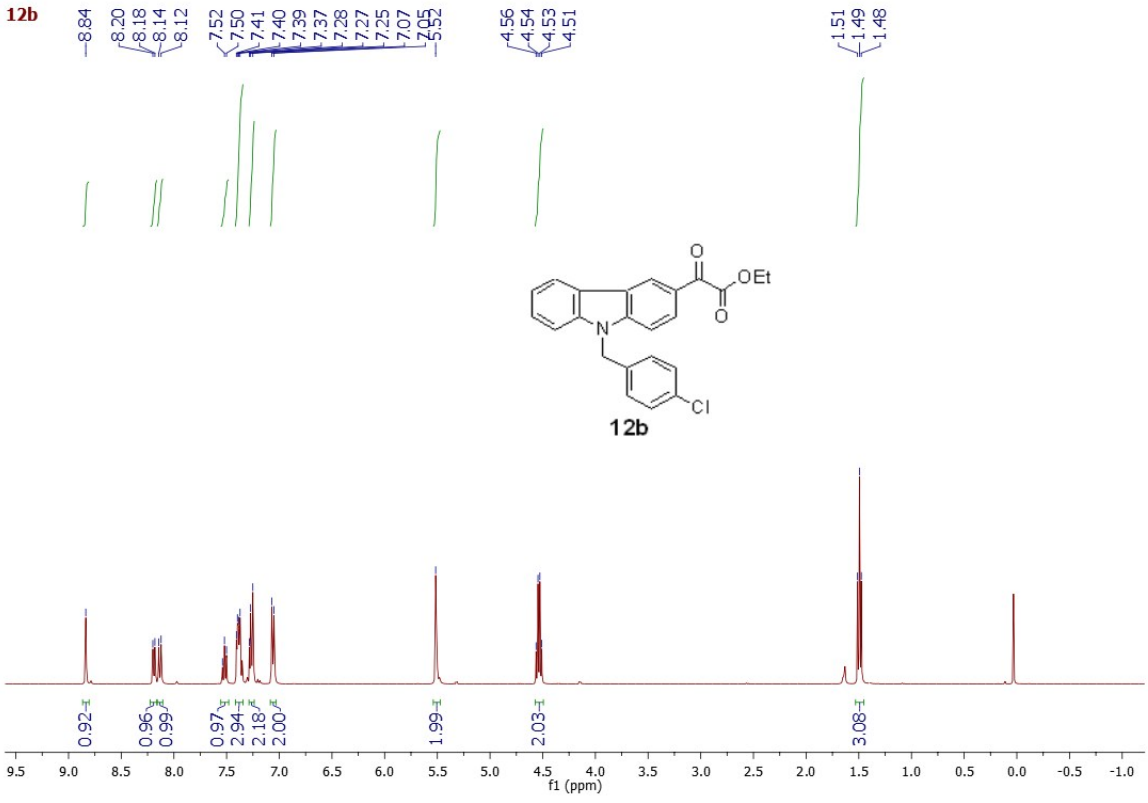
V. References

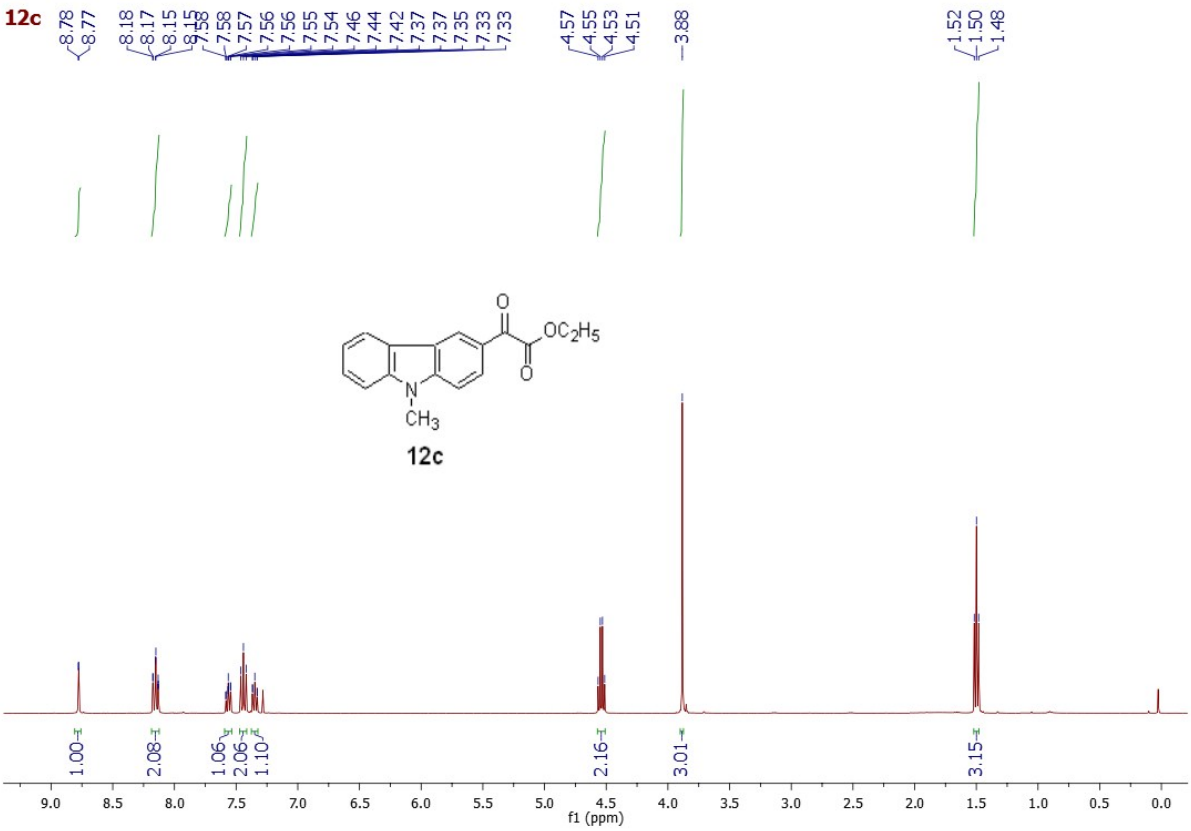
1 B. P.Bandgar, L. K. Adsul, S. V. Lonikar, H. V. Chavan, S. N. Shringare, S. A. Patil, S. S. Jalde, B. A. Koti, N. A. Dhole and R. N. Gacche, *J. Enzyme Inhib. Med. Chem*, 2013, **28**, 593.

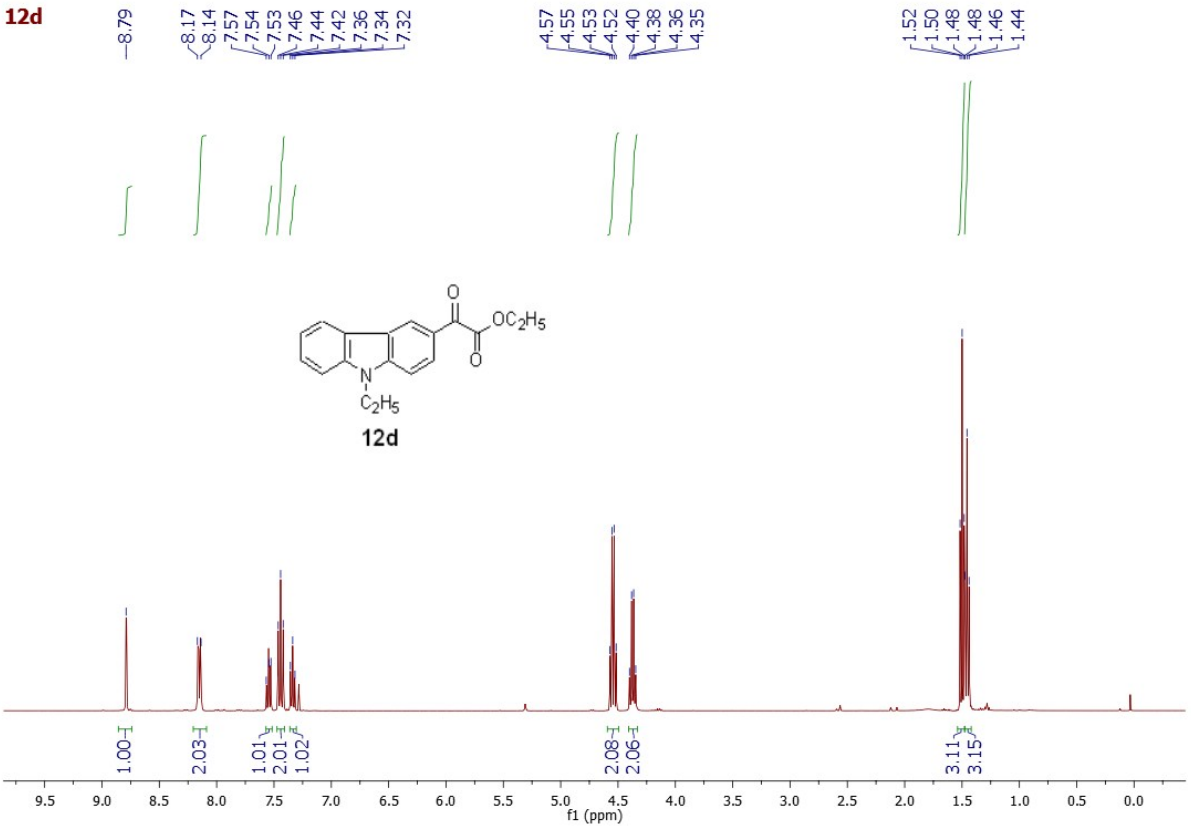
2 G. Bai, J. Li, D. Li, C. Dong, X. Han and P. Lin, *Dyes Pigments*, 2007, **75**, 93.

VI. ^{1}H, ^{13}C and MS Spectra and HPLC traces of final compounds

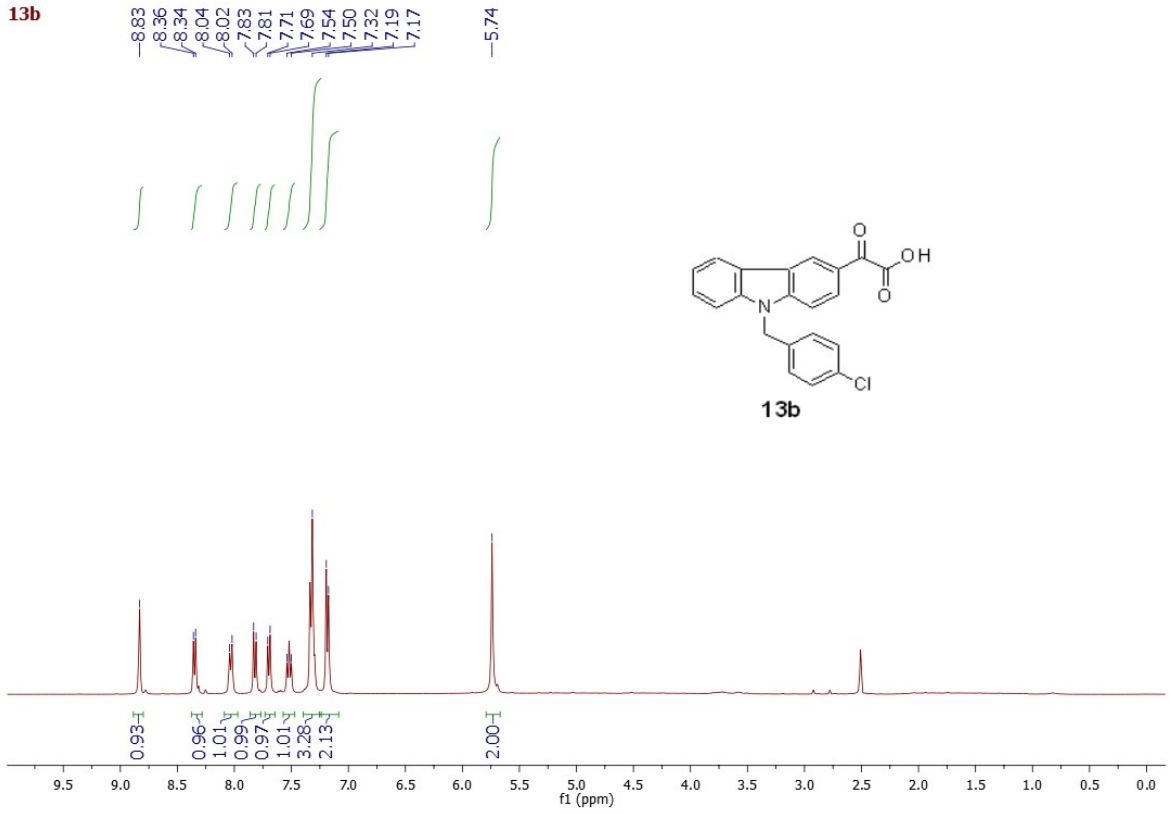




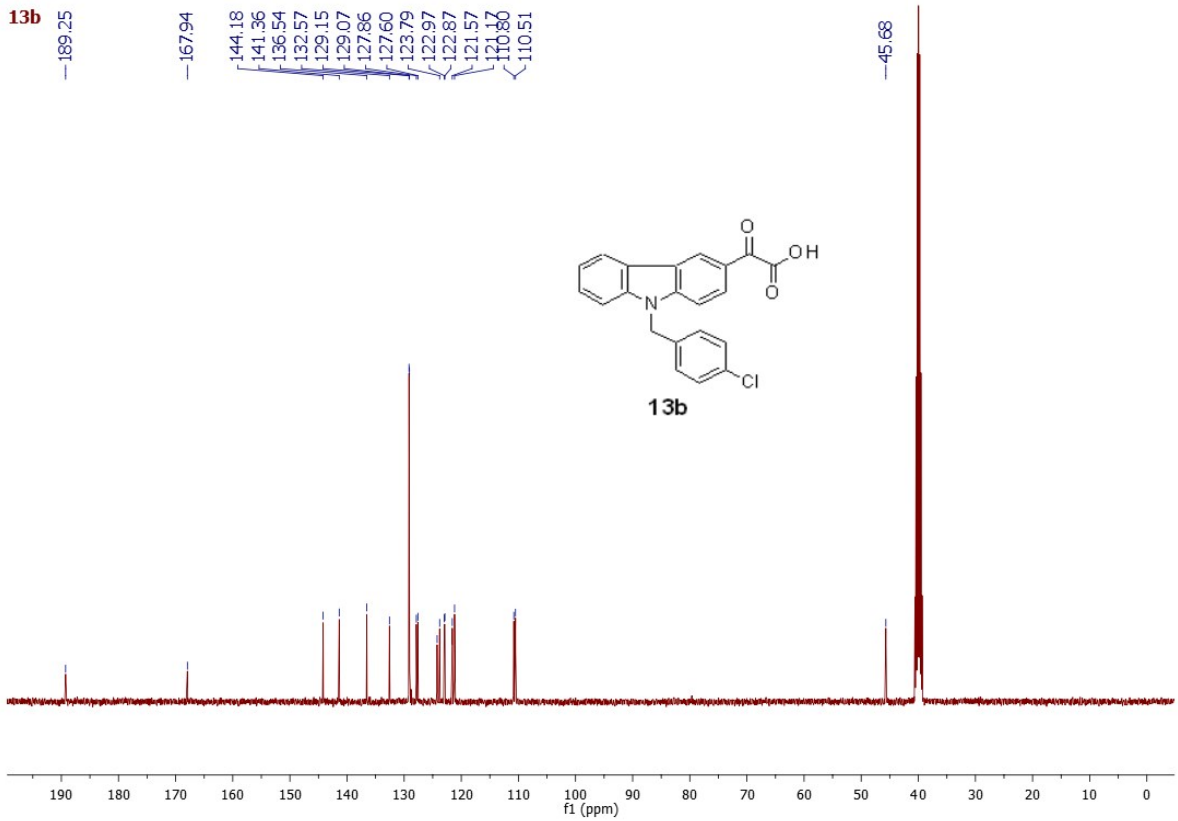

12c
8.78
8.77
8.18
8.17
8.15
8.15
7.58
7.58
7.57
7.56
7.56
7.55
7.54
7.46
7.44
7.42
7.37
7.37
7.35
7.33
7.33
4.57
4.55
4.53
4.51
3.88
1.52
1.50
1.48
O
OC2H5
O
N
CH3
12c
1.00
2.08
1.06
2.06
1.10
2.16
3.01
3.15
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


12d
8.79
8.17
8.14
7.57
7.54
7.53
7.46
7.44
7.42
7.36
7.34
7.32
4.57
4.55
4.53
4.52
4.40
4.38
4.36
4.35
1.52
1.50
1.48
1.48
1.46
1.44
O
OC2H5
O
N
C2H5
12d
1.00
2.03
1.01
2.01
1.02
2.08
2.06
3.11
3.15
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

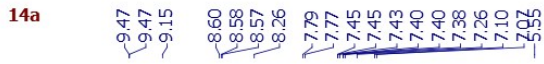
13b

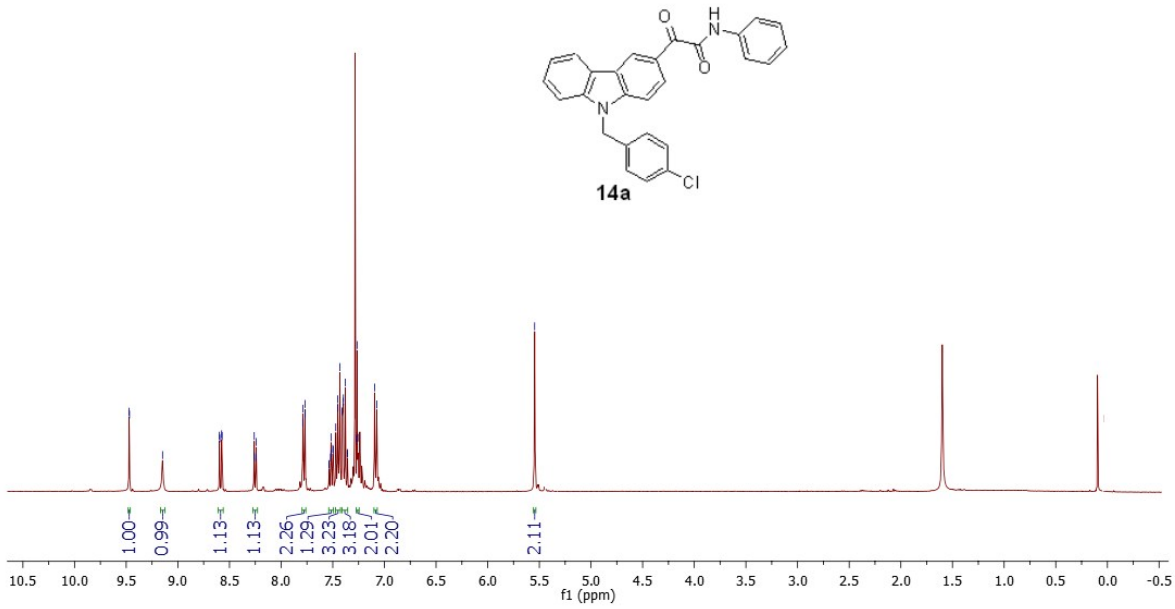

8.83
8.36
8.34
8.04
8.02
7.83
7.81
7.71
7.69
7.54
7.50
7.32
7.19
7.17
5.74
O
OH
O
N
Cl
13b
0.93
0.96
1.01
0.99
0.97
1.01
3.28
2.13
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

13b

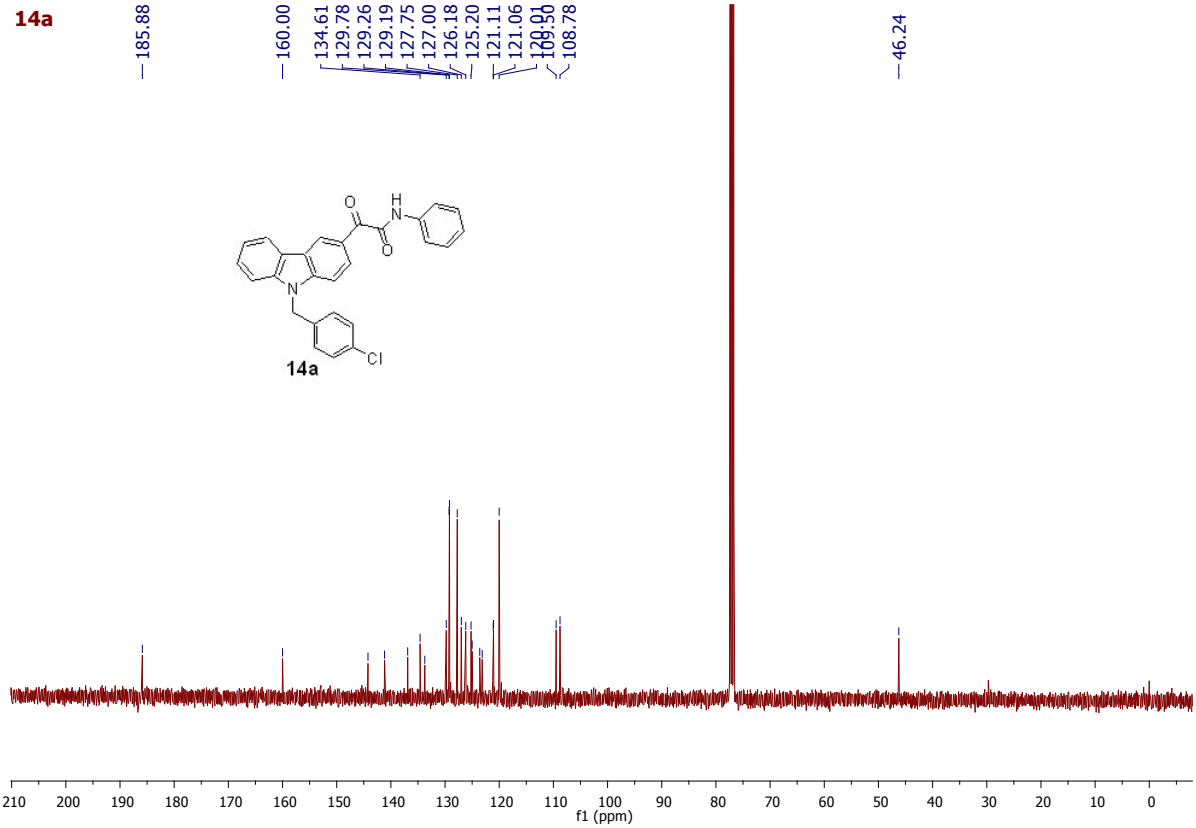

189.25
167.94
144.18
141.36
136.54
132.57
129.15
129.07
127.86
127.60
123.79
122.97
122.87
121.57
121.17
110.80
110.51
45.68
O
OH
O
N
Cl
13b
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

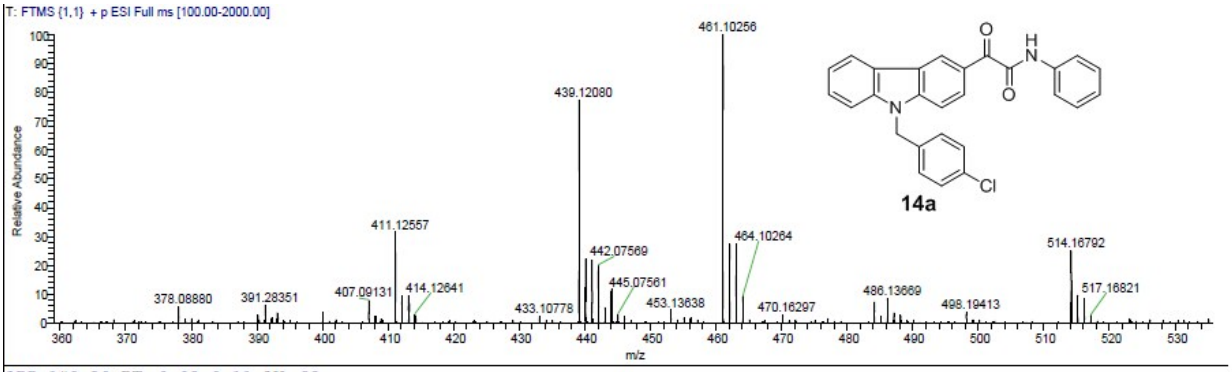
14a


9.47
9.47
9.15
8.60
8.58
8.57
8.26
7.79
7.77
7.45
7.45
7.43
7.40
7.40
7.38
7.26
7.10
7.07
5.55


O
H
N
O
N
Cl
14a
1.00
0.99
1.13
1.13
2.26
1.29
3.23
3.18
2.01
2.20
2.11
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

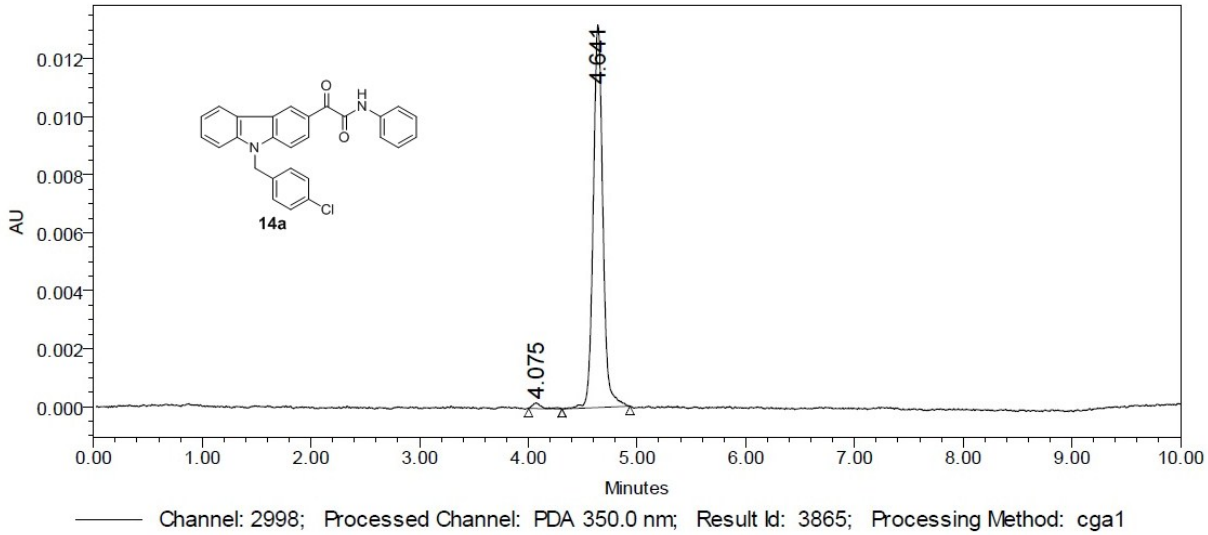
14a


185.88
160.00
134.61
129.78
129.26
129.19
127.75
127.00
126.18
125.20
121.11
121.06
120.01
109.50
108.78
46.24
O
H
N
O
N
Cl
14a
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



ARP-1#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 435.34-444.29

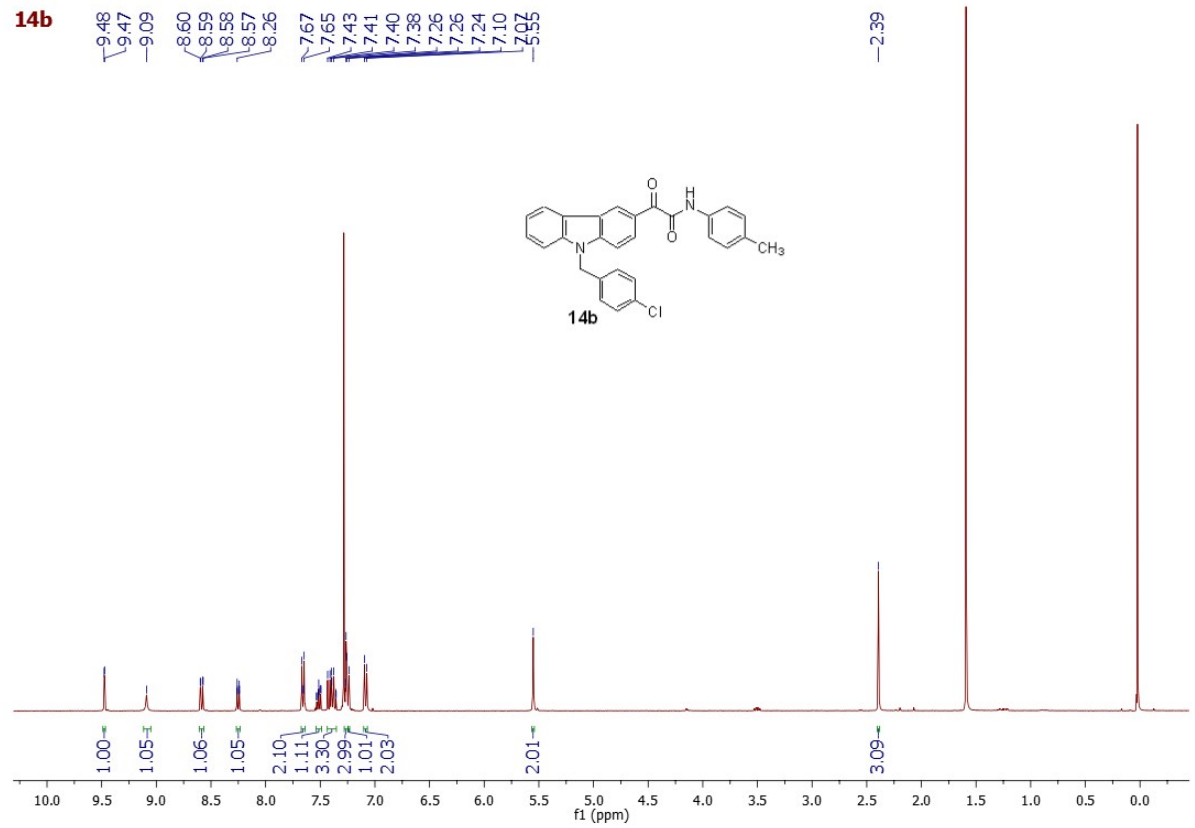
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
439.12103	267402.9	100.00	439.12078	0.56	18.5	$C_{27}H_{20}O_2N_2Cl$

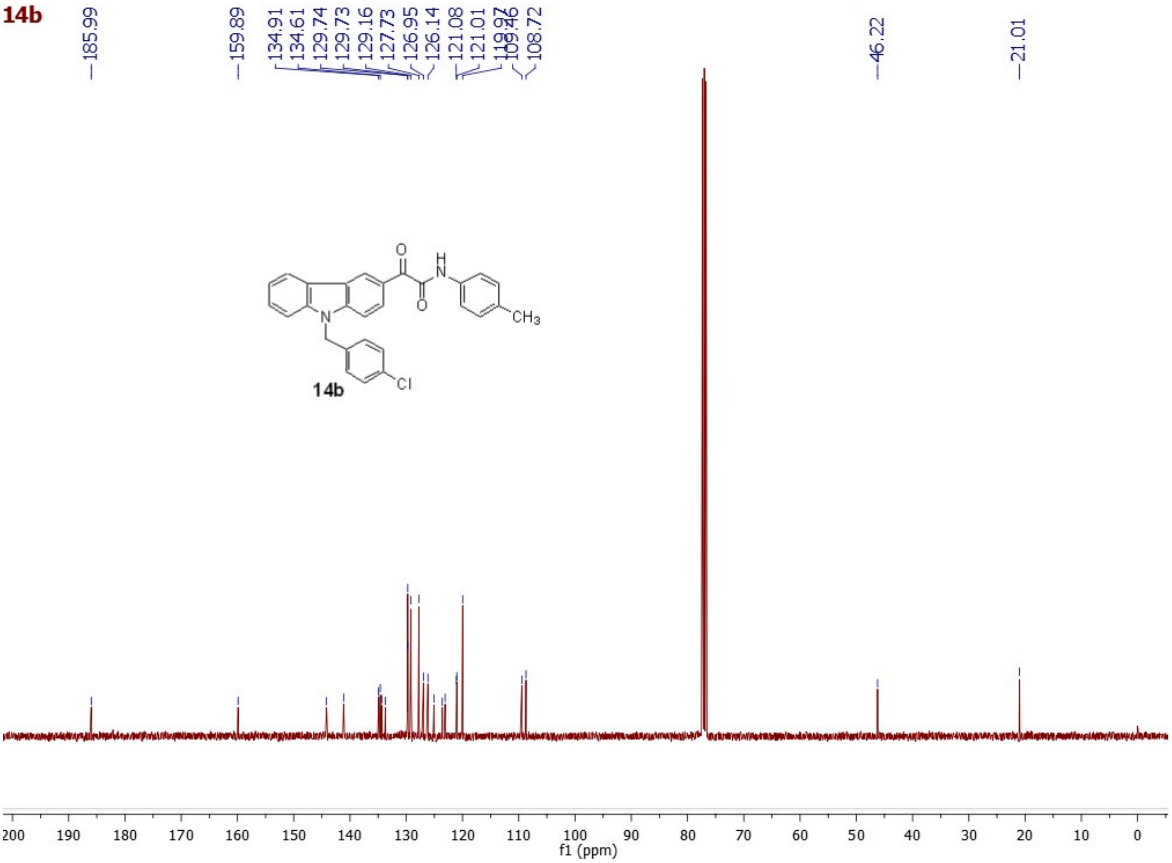


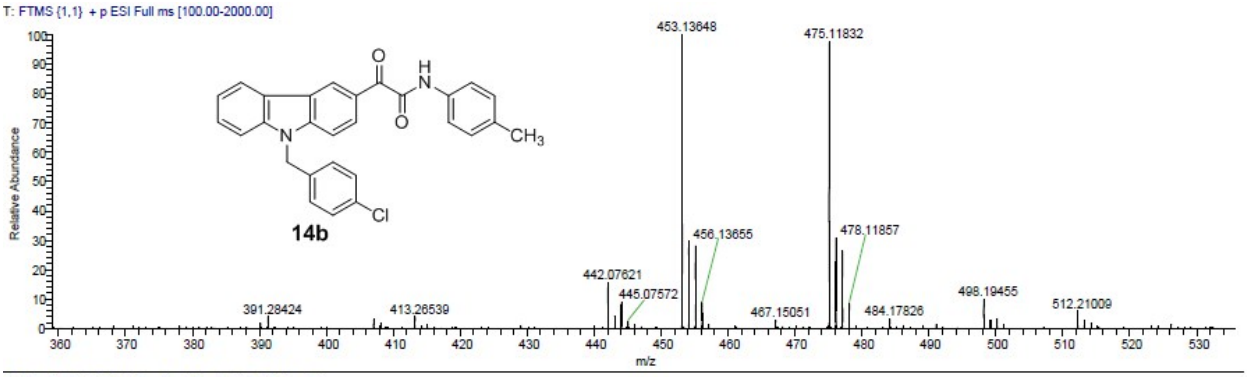
Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 3865; Processing Method: cga1

Processed Channel Descr.: PDA 350.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	4.075	1194	1.45	194
2	PDA 350.0 nm	4.641	81123	98.55	13204

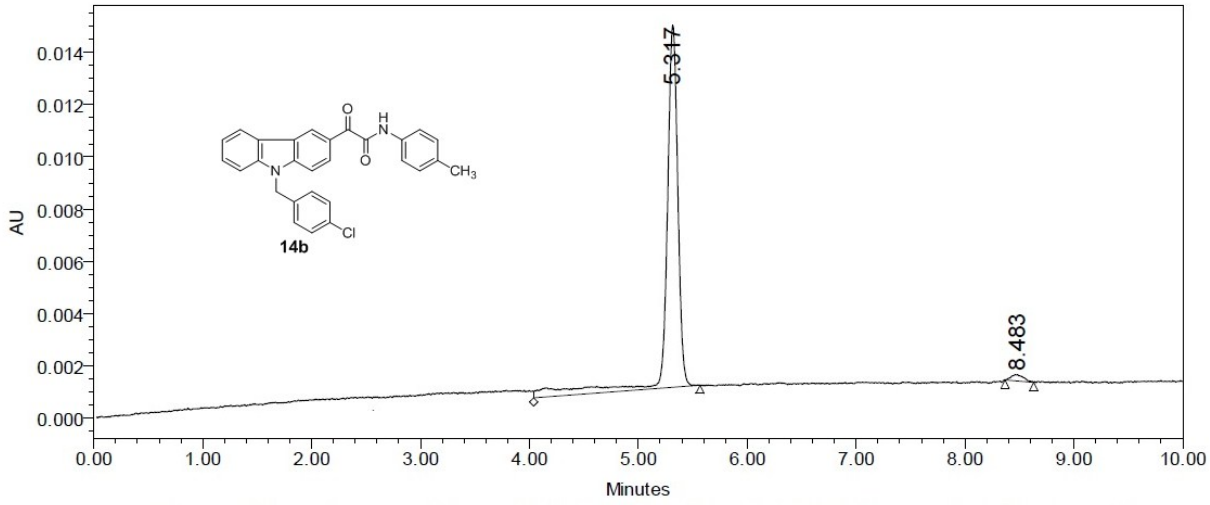

14b
9.48
9.47
9.09
8.60
8.59
8.58
8.57
8.26
7.67
7.65
7.43
7.41
7.40
7.38
7.26
7.26
7.24
7.10
7.07
5.55
2.39
14b
1.00
1.05
1.06
1.05
2.10
1.11
3.30
2.99
1.01
2.03
2.01
3.09
f1 (ppm)


14b
185.99
159.89
134.91
134.61
129.74
129.73
129.16
127.73
126.95
126.14
121.08
121.01
109.46
108.72
46.22
21.01
14b
f1 (ppm)



ARP-2#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 452.18-453.58

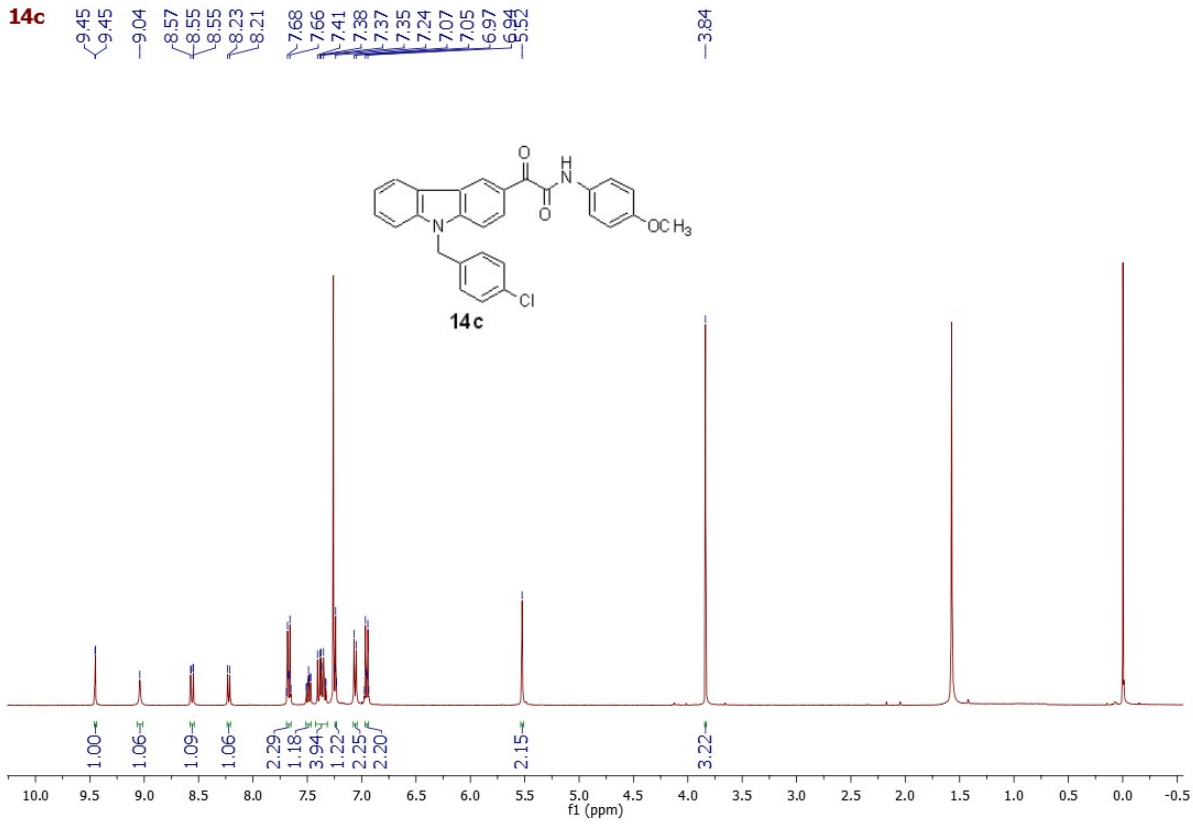
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
453.13662	626576.2	100.00	453.13643	0.40	18.5	$C_{28}H_{22}O_2N_2Cl$

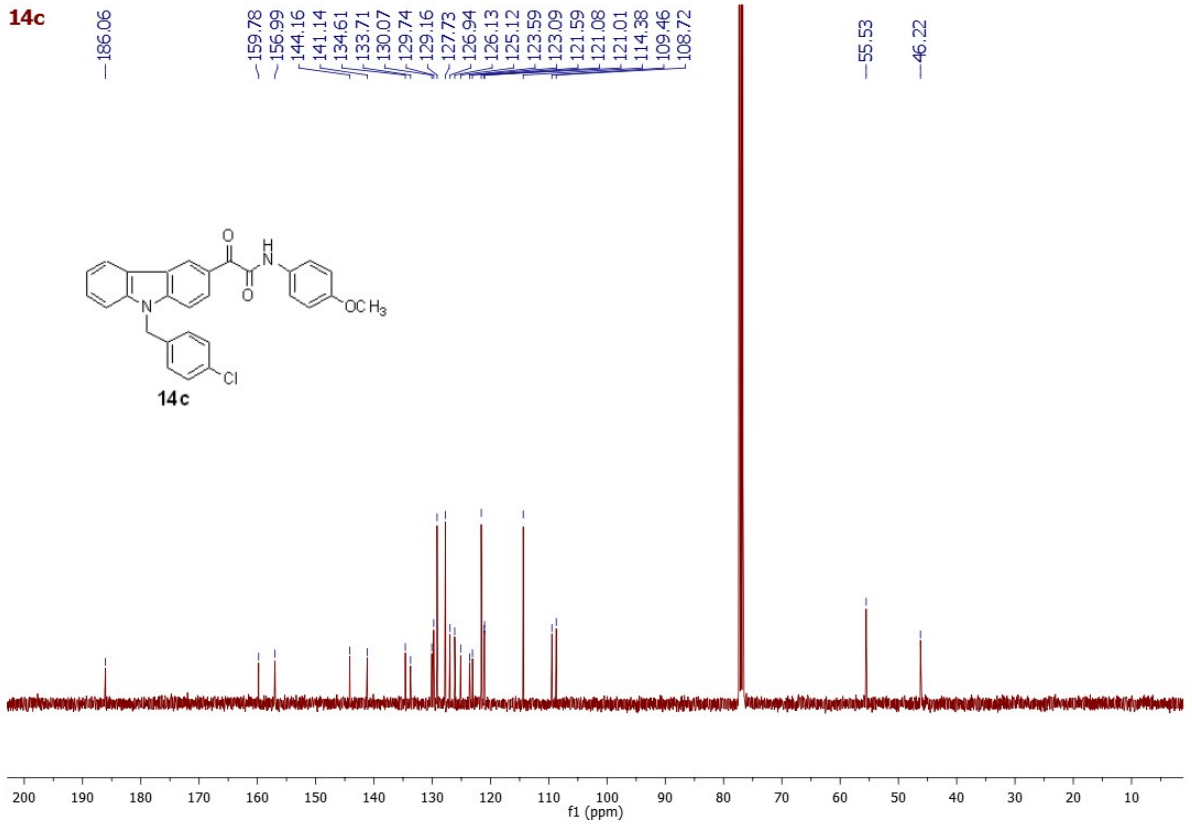


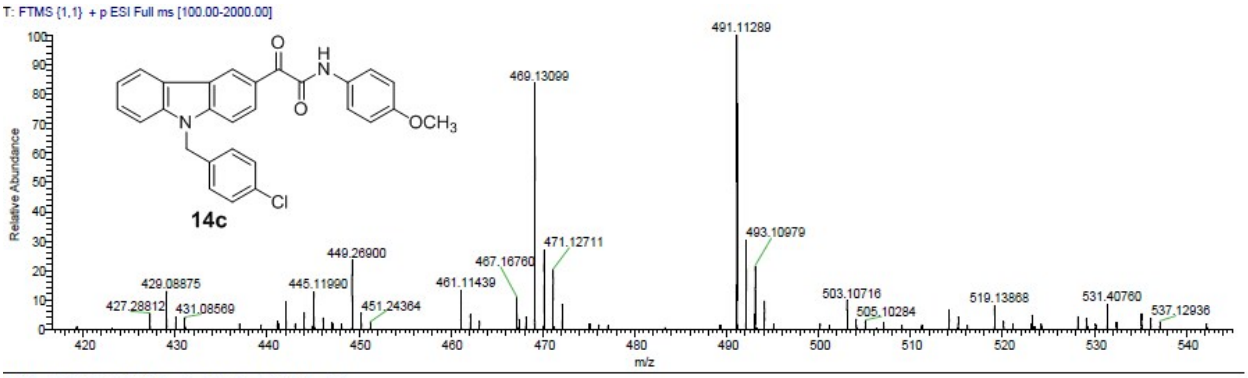
Channel: 2998; Processed Channel: PDA 340.0 nm; Result Id: 3984; Processing Method: cga2

Processed Channel Descr.: PDA 340.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 340.0 nm	5.317	102327	98.10	13851
2	PDA 340.0 nm	8.483	1978	1.90	249

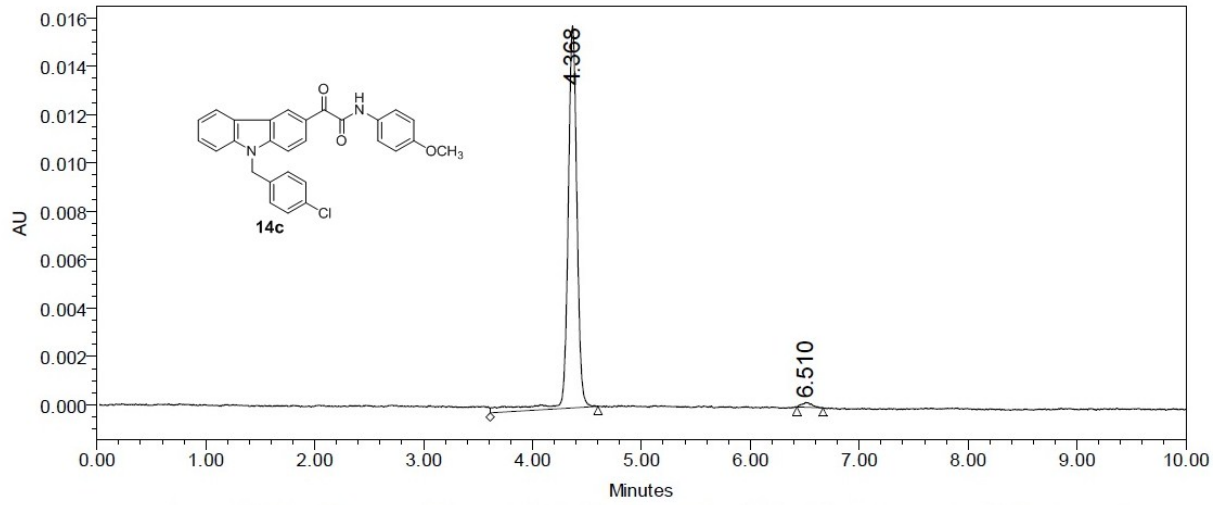

14c
9.45
9.45
9.04
8.57
8.55
8.55
8.23
8.21
7.68
7.66
7.41
7.38
7.37
7.35
7.24
7.07
7.05
6.97
6.94
5.52
3.84
O
H
N
O
N
OCH3
Cl
14c
1.00
1.06
1.09
1.06
2.29
1.18
3.94
1.22
2.25
2.20
2.15
3.22
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


14c
186.06
159.78
156.99
144.16
141.14
134.61
133.71
130.07
129.74
129.16
127.73
126.94
126.13
125.12
123.59
123.09
121.59
121.08
121.01
114.38
109.46
108.72
55.53
46.22
O
H
N
O
N
OCH3
Cl
14c
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)



ARP-3CG#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 467.94-469.55

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
469.13148	383894.2	100.00	469.13135	0.28	18.5	$C_{28}H_{22}O_3N_2Cl$

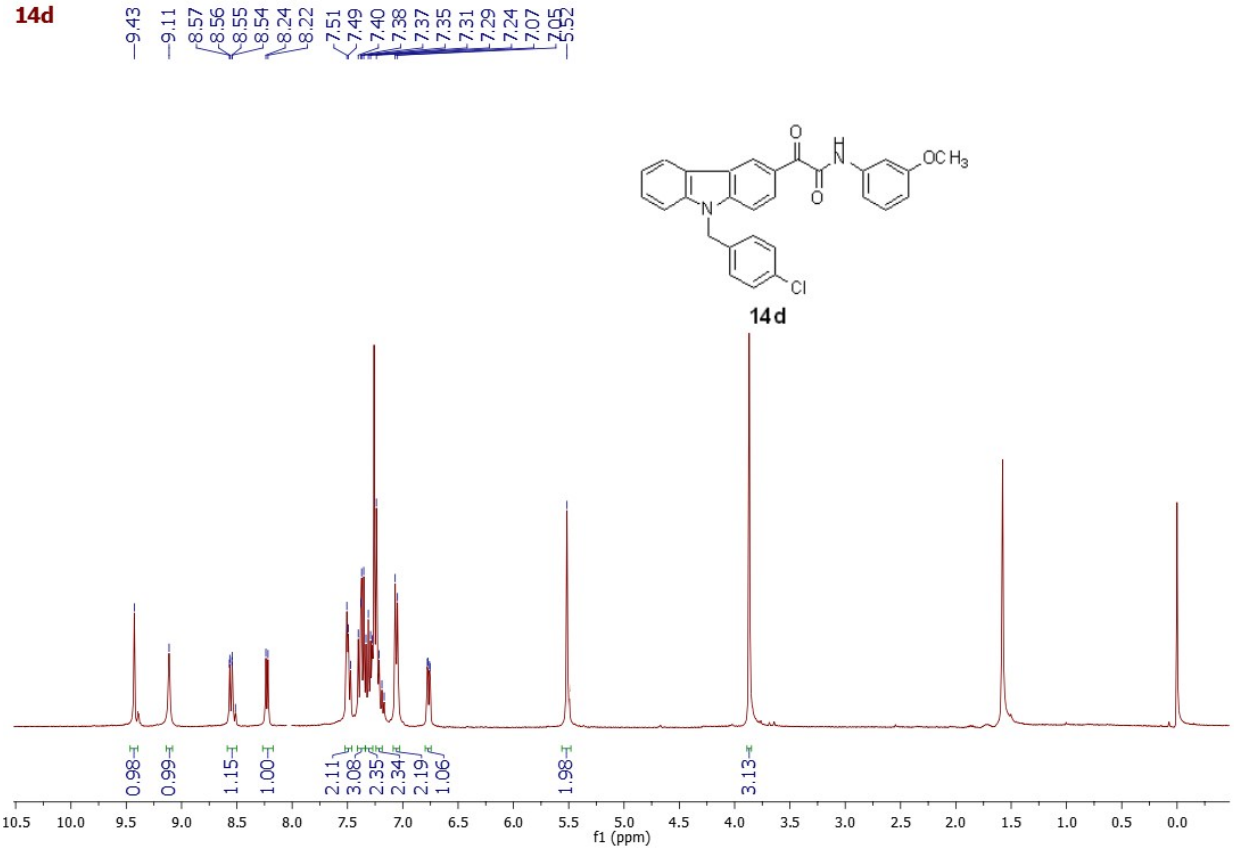


Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 4018; Processing Method: cga3a

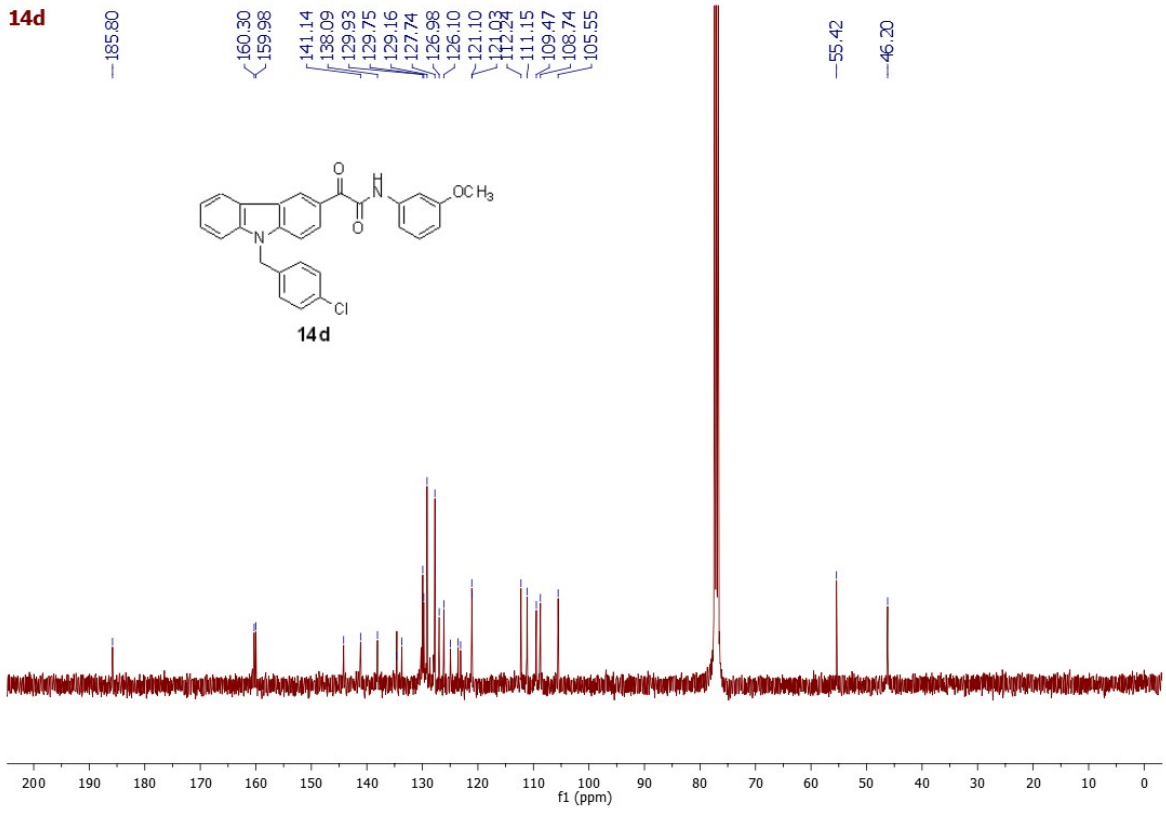
Processed Channel Descr.: PDA 350.0 nm

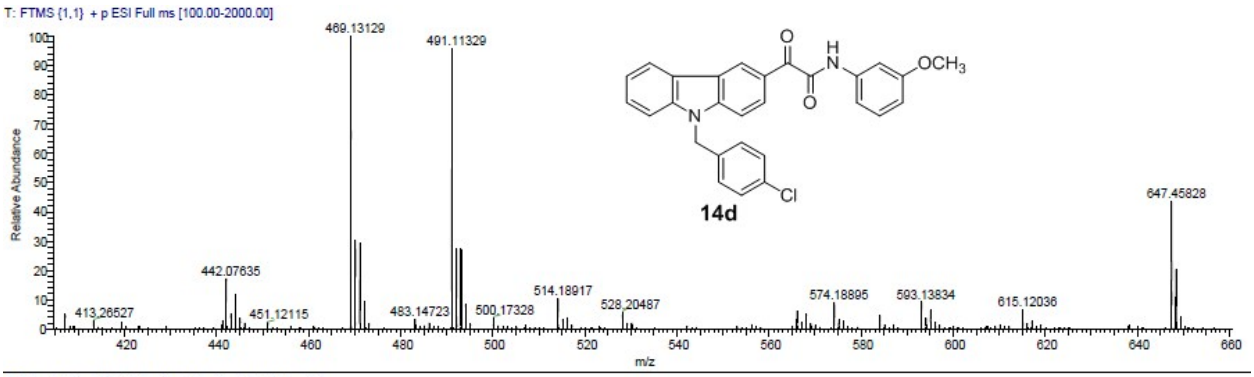
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	4.368	92435	98.67	15782
2	PDA 350.0 nm	6.510	1245	1.33	199

14d


9.43
9.11
8.57
8.56
8.55
8.54
8.24
8.22
7.51
7.49
7.40
7.38
7.37
7.35
7.31
7.29
7.24
7.07
7.05
5.52
OCH3
Cl
14d
0.98
0.99
1.15
1.00
2.11
3.08
2.35
2.34
2.19
1.06
1.98
3.13
f1 (ppm)

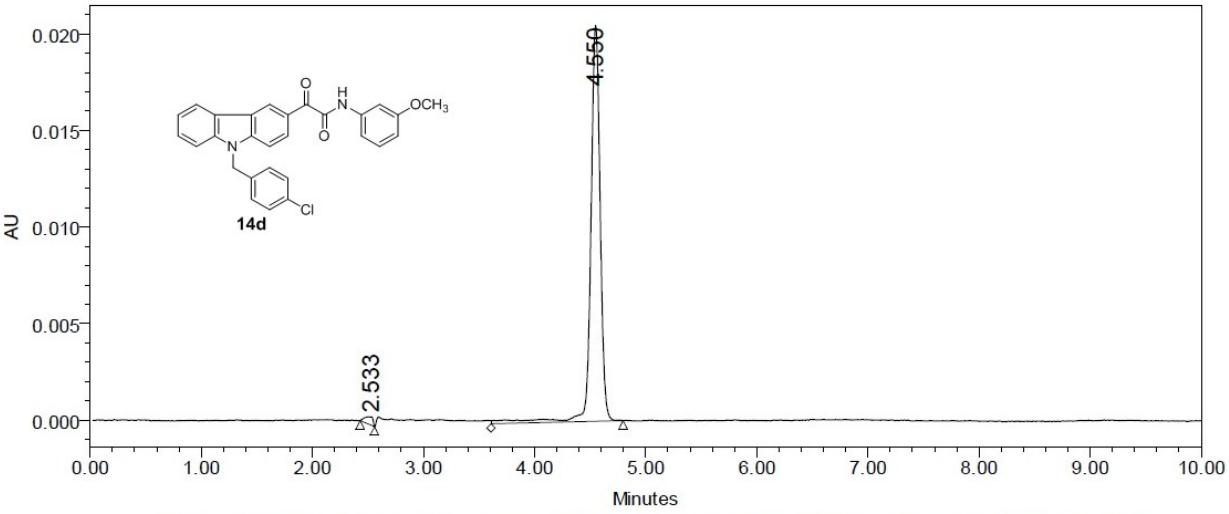
14d


185.80
160.30
159.98
141.14
138.09
129.93
129.75
129.16
127.74
126.98
126.10
121.10
121.03
112.24
111.15
109.47
108.74
105.55
55.42
46.20
OCH3
Cl
14d
f1 (ppm)



ARP-4#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 450.13-478.25

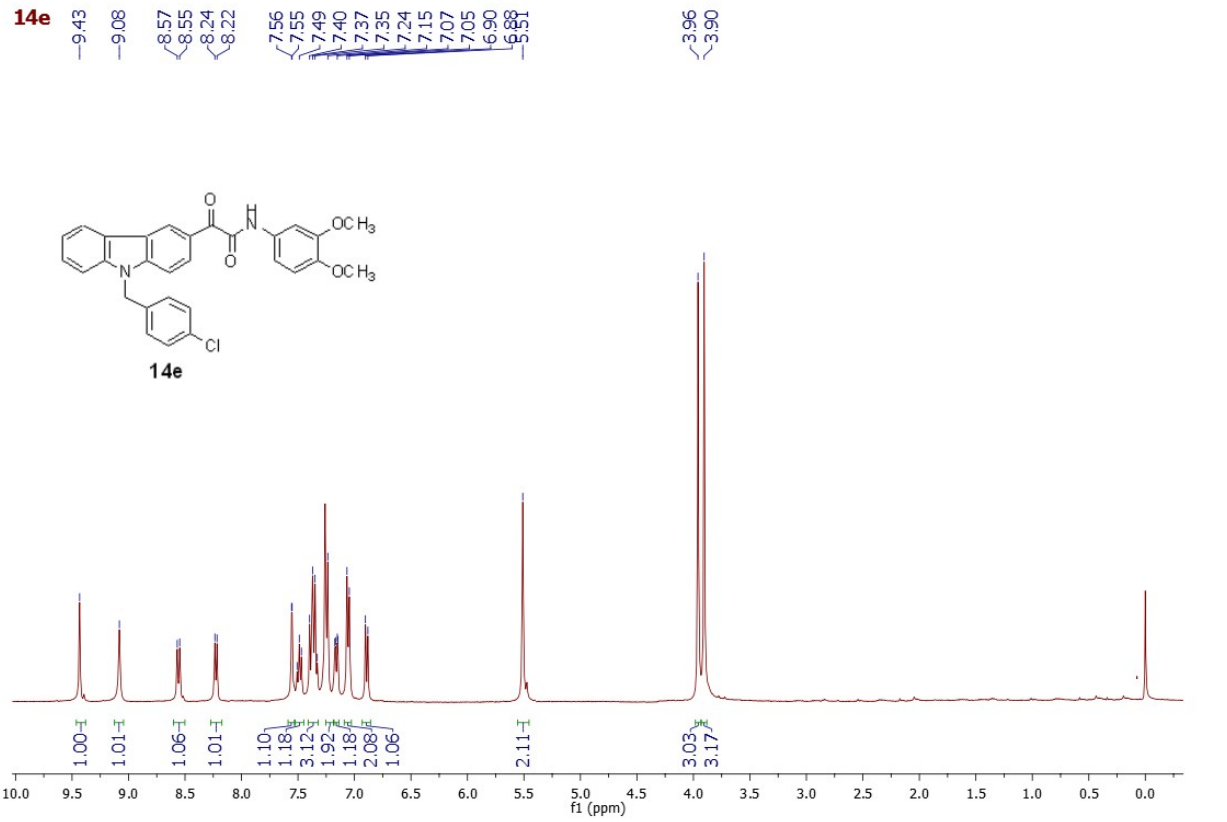
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
469.13160	698277.9	100.00	469.13135	0.54	18.5	$C_{28}H_{22}O_3N_2Cl$

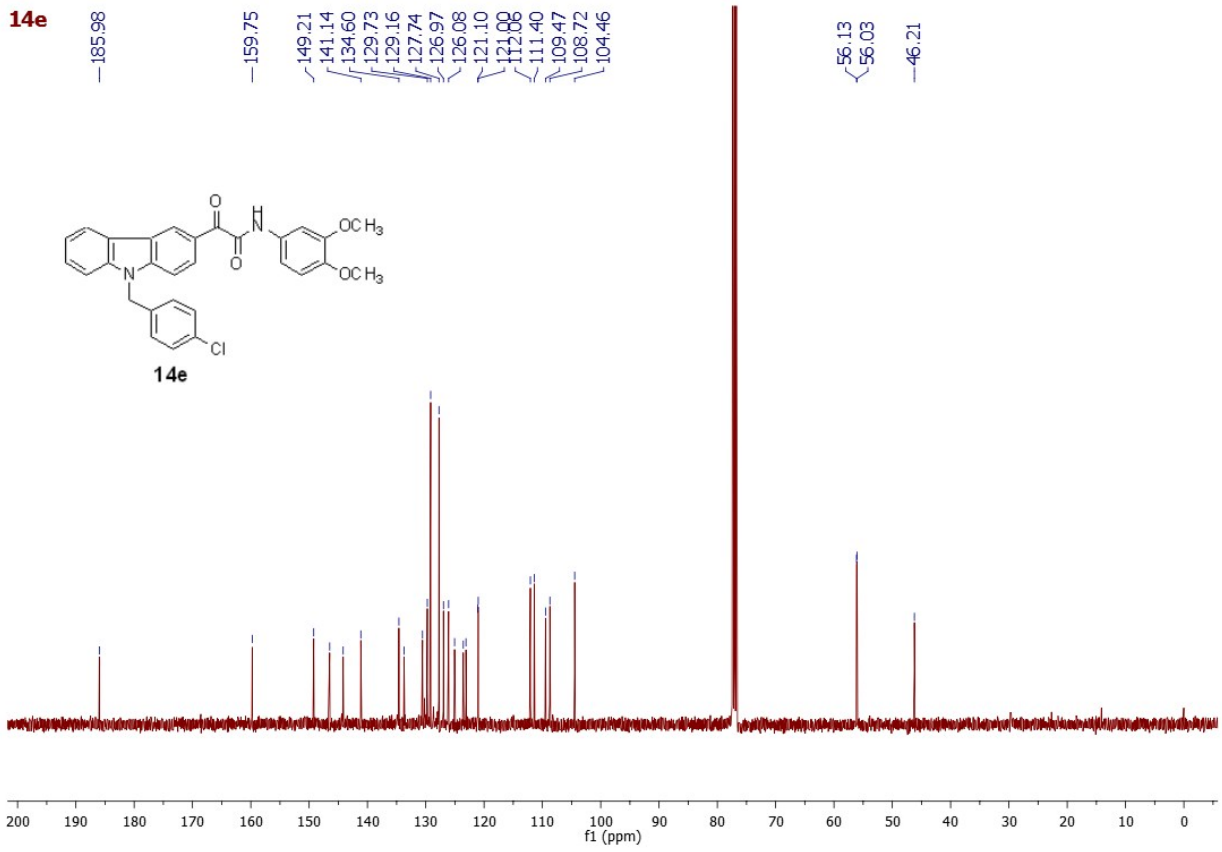


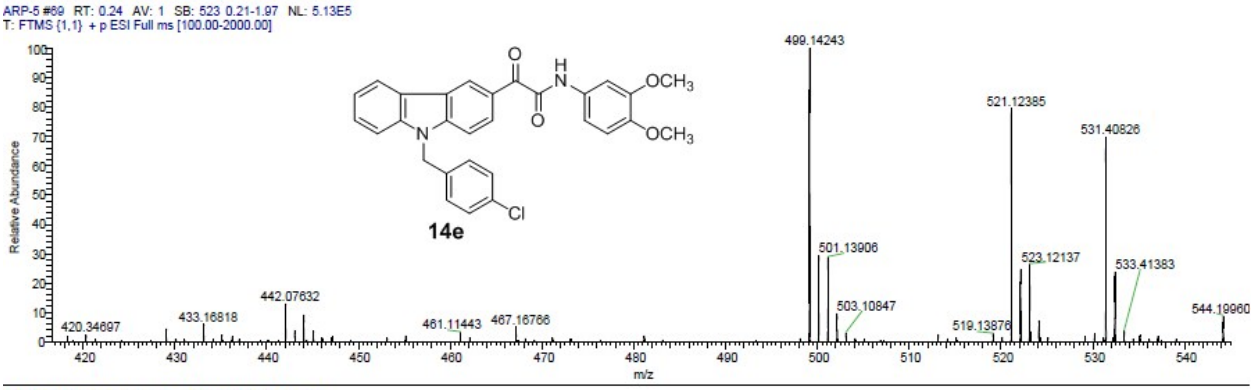
Channel: 2998; Processed Channel: PDA 302.5 nm; Result Id: 4011; Processing Method: cga4

Processed Channel Descr.: PDA 302.5 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 302.5 nm	2.533	2033	1.64	443
2	PDA 302.5 nm	4.550	122099	98.36	20475

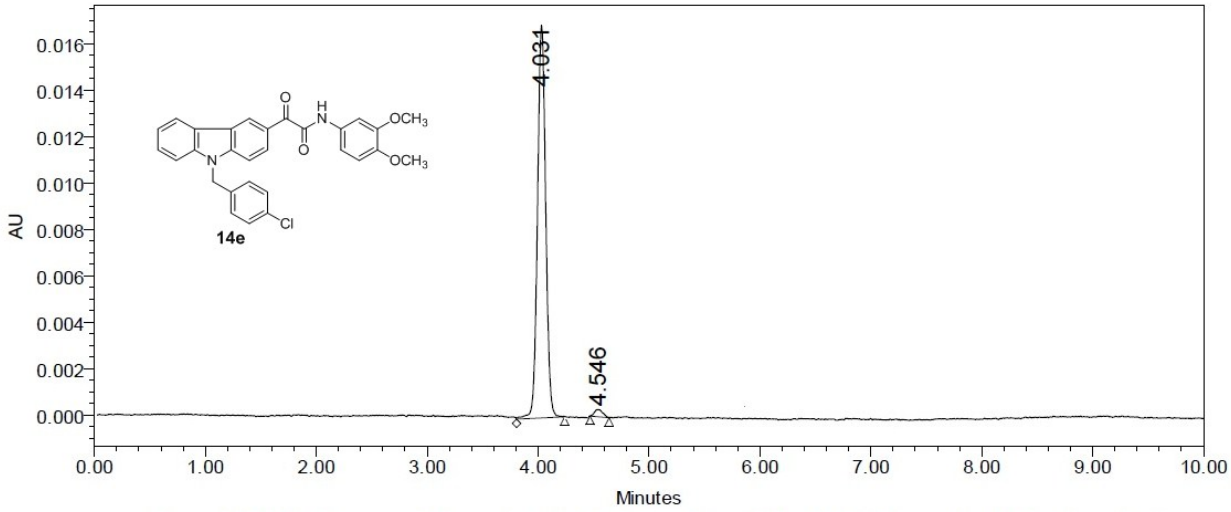

14e
9.43
9.08
8.57
8.55
8.24
8.22
7.56
7.55
7.49
7.40
7.37
7.35
7.24
7.15
7.07
7.05
6.90
6.88
6.51
3.96
3.90
OCH3
OCH3
Cl
14e
1.00
1.01
1.06
1.01
1.10
1.18
3.12
1.92
1.18
2.08
1.06
2.11
3.03
3.17
f1 (ppm)


14e
185.98
159.75
149.21
141.14
134.60
129.73
129.16
127.74
126.97
126.08
121.10
121.00
112.08
111.40
109.47
108.72
104.46
56.13
56.03
46.21
OCH3
OCH3
Cl
14e
f1 (ppm)



ARP-5#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 495.88-502.80

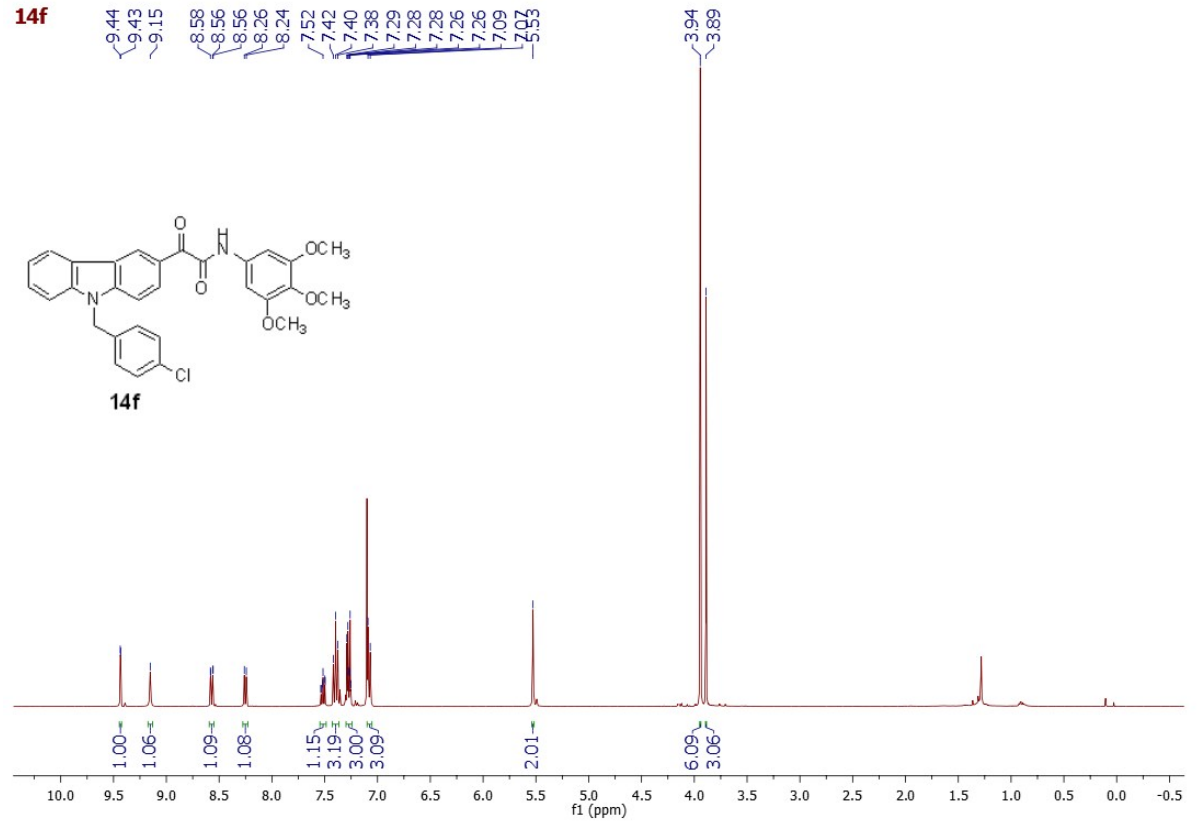
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
499.14208	919160.6	100.00	499.14191	0.35	18.5	$C_{29}H_{24}O_4N_2Cl$

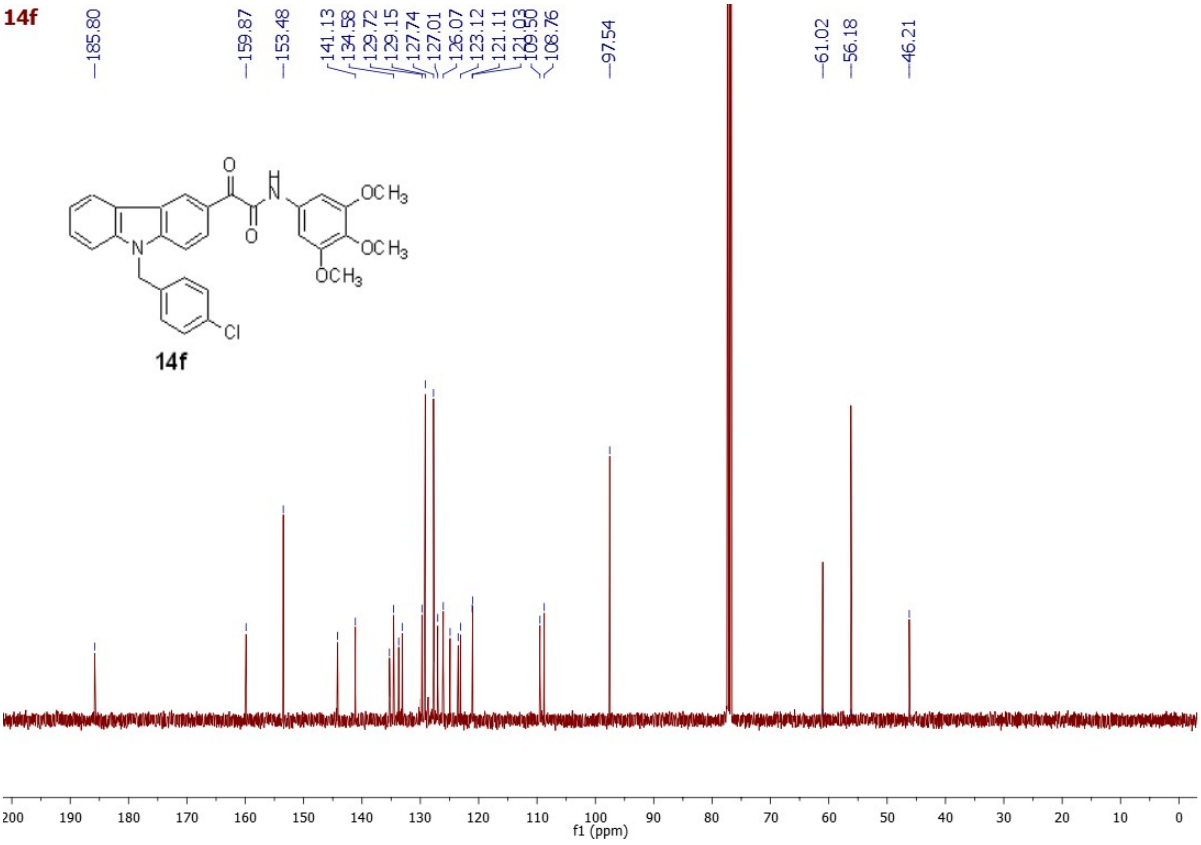


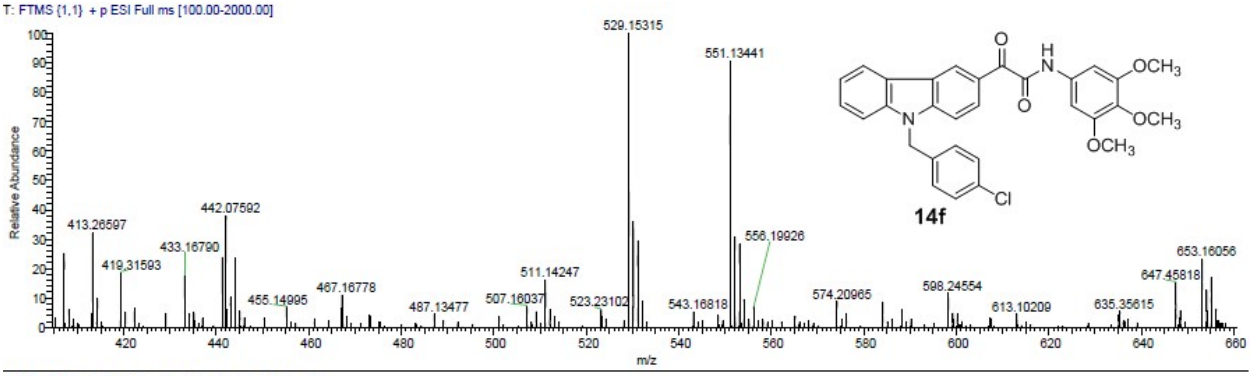
Channel: 2998; Processed Channel: PDA 328.7 nm; Result Id: 4083; Processing Method: cga5ab

Processed Channel Descr.: PDA 328.7 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 328.7 nm	4.031	86820	98.17	16917
2	PDA 328.7 nm	4.546	1620	1.83	305

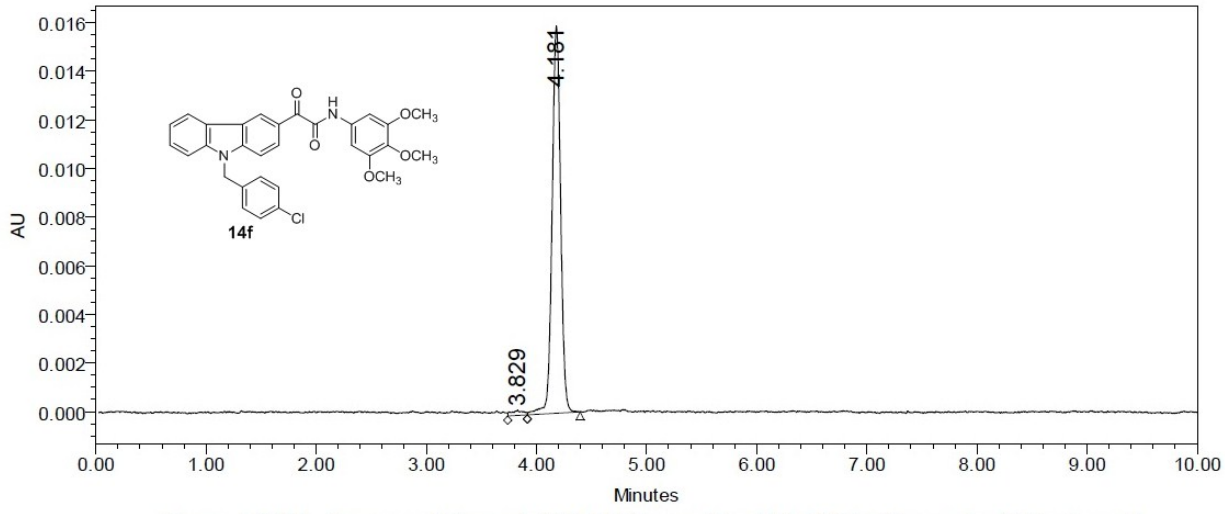

14f
9.44
9.43
9.15
8.58
8.56
8.56
8.26
8.24
7.52
7.42
7.40
7.38
7.29
7.28
7.28
7.26
7.26
7.09
7.02
5.53
3.94
3.89
OCH3
OCH3
OCH3
Cl
14f
1.00
1.06
1.09
1.08
1.15
3.19
3.00
3.09
2.01
6.09
3.06
f1 (ppm)


14f
185.80
159.87
153.48
141.13
134.58
129.72
129.15
127.74
127.01
126.07
123.12
121.11
121.03
109.50
108.76
97.54
61.02
56.18
46.21
OCH3
OCH3
OCH3
Cl
14f
f1 (ppm)



ARP-6#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 526.06-532.80

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
529.15558	284860.3	100.00	529.15248	5.87	18.5	$C_{30}H_{26}O_5N_2Cl$

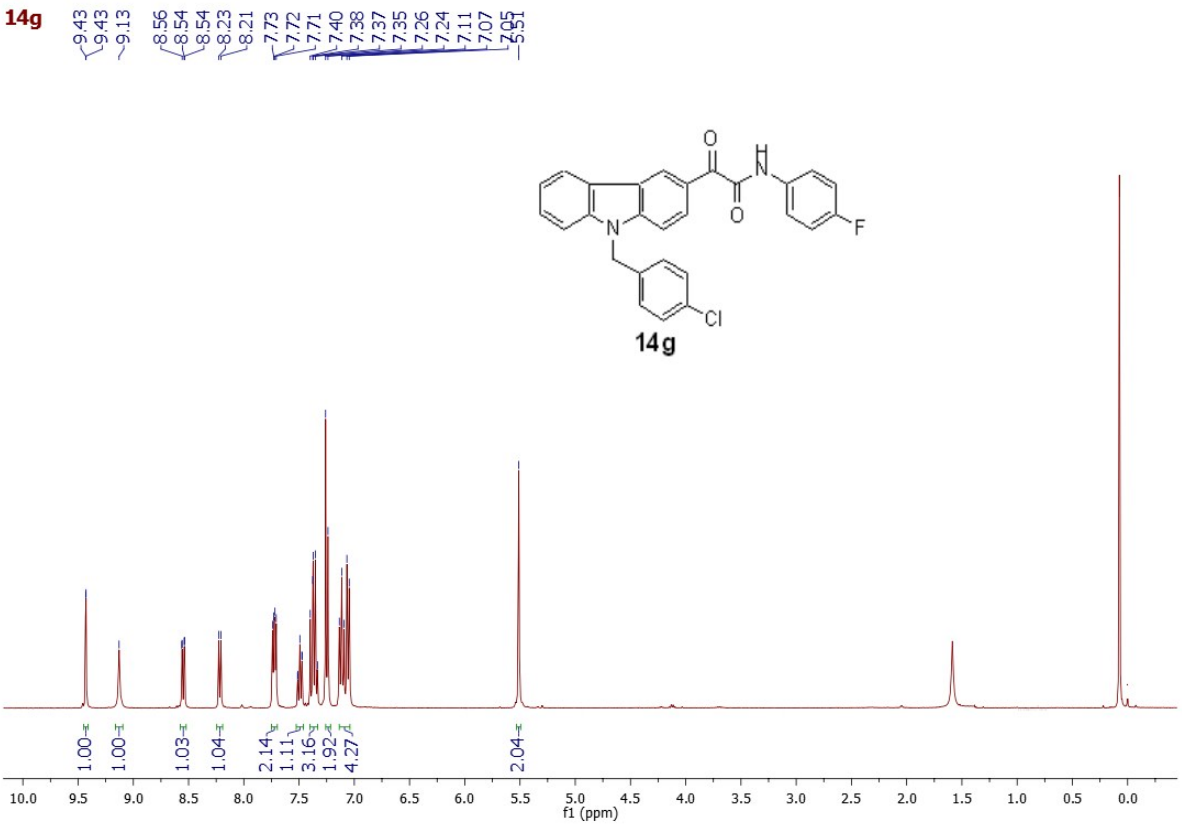


Channel: 2998; Processed Channel: PDA 350.9 nm; Result Id: 4079; Processing Method: cga6

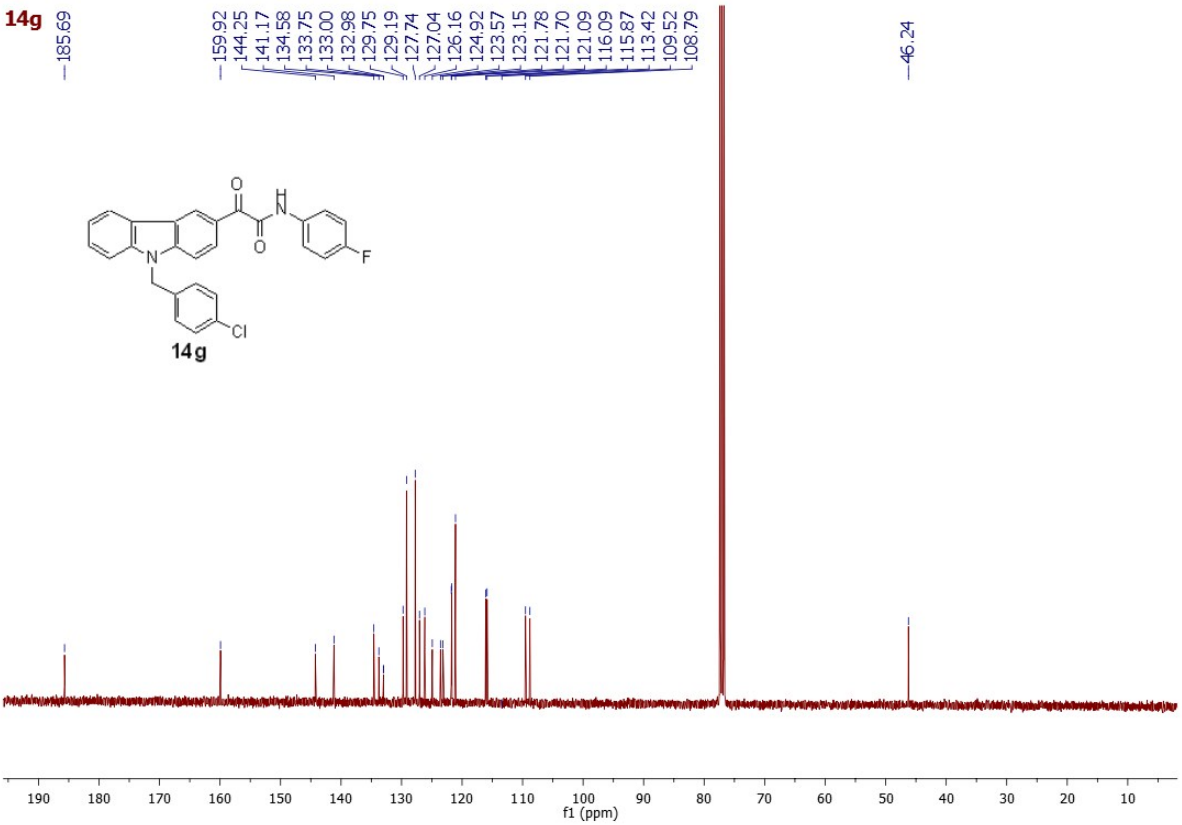
Processed Channel Descr.: PDA 350.9 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.9 nm	3.829	1598	1.83	209
2	PDA 350.9 nm	4.181	85757	98.17	15917

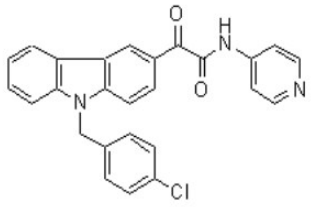
14g


9.43
9.43
9.13
8.56
8.54
8.54
8.23
8.21
7.73
7.72
7.71
7.40
7.38
7.37
7.35
7.26
7.24
7.11
7.07
5.51
O
N
H
O
F
N
Cl
14g
1.00
1.00
1.03
1.04
2.14
1.11
3.16
1.92
4.27
2.04
f1 (ppm)

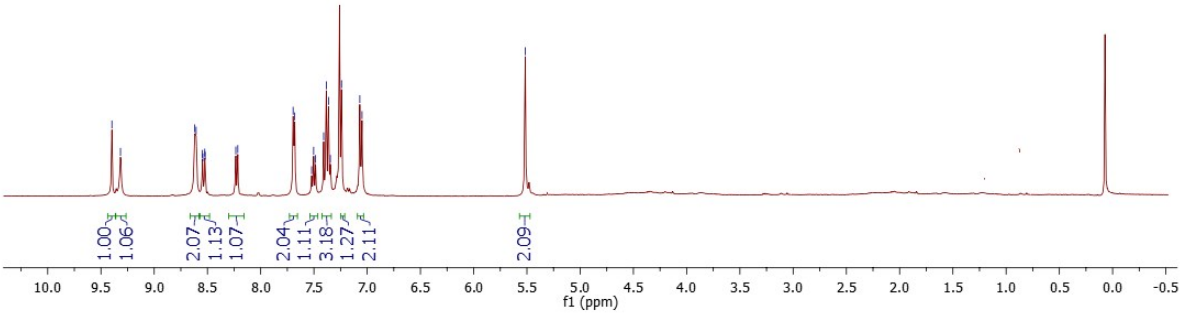
14g


185.69
159.92
144.25
141.17
134.58
133.75
133.00
132.98
129.75
129.19
127.74
127.04
126.16
124.92
123.57
123.15
121.78
121.70
121.09
116.09
115.87
113.42
109.52
108.79
46.24
O
N
H
O
F
N
Cl
14g
f1 (ppm)

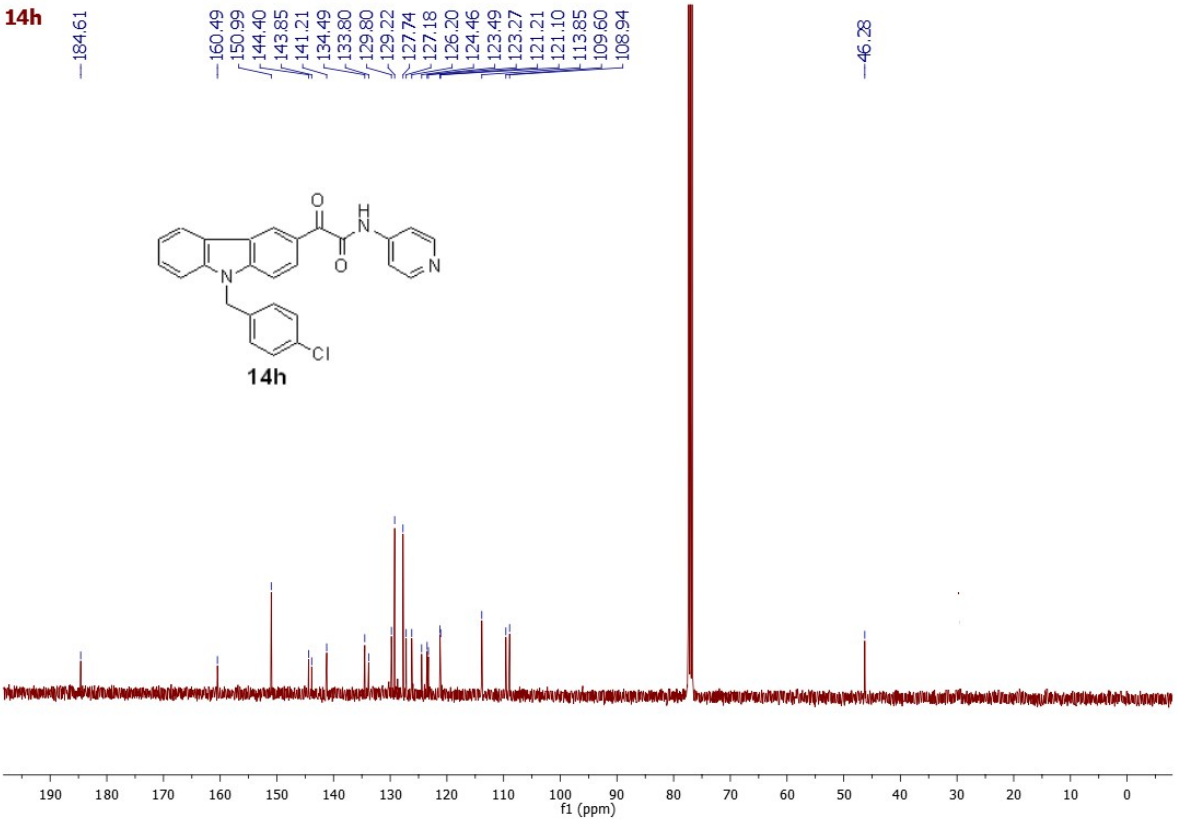
14h



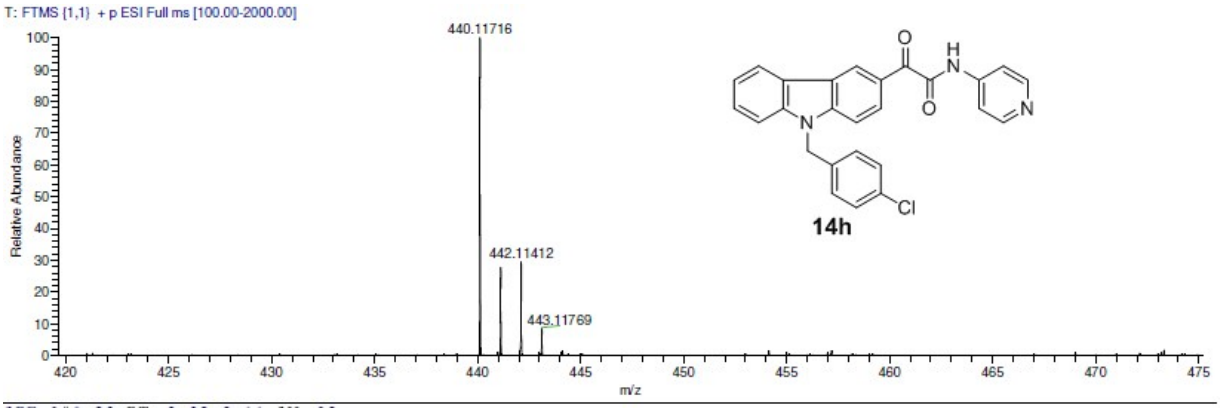
14h



14h

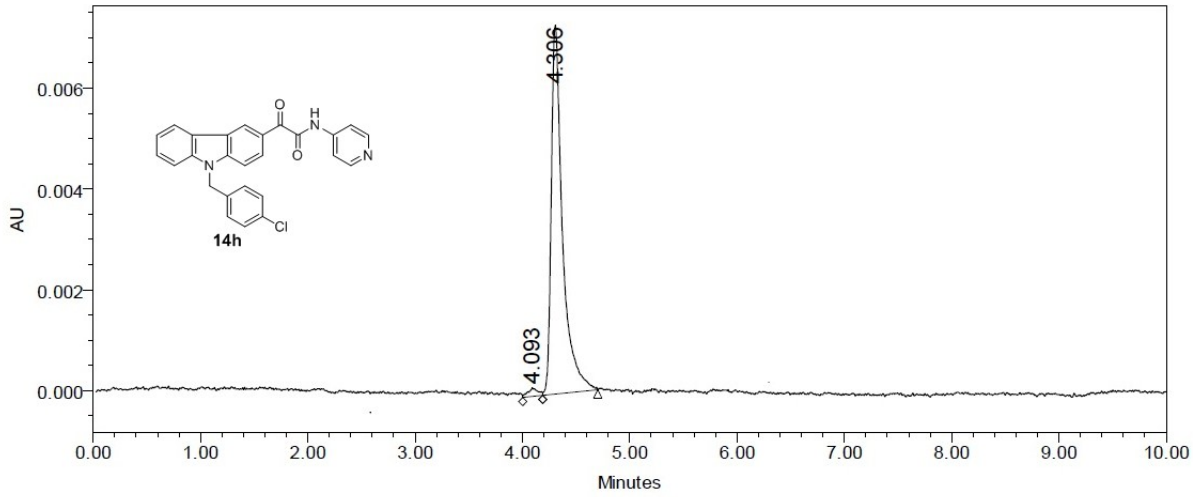


14h



ARP-9#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 435.97-445.39

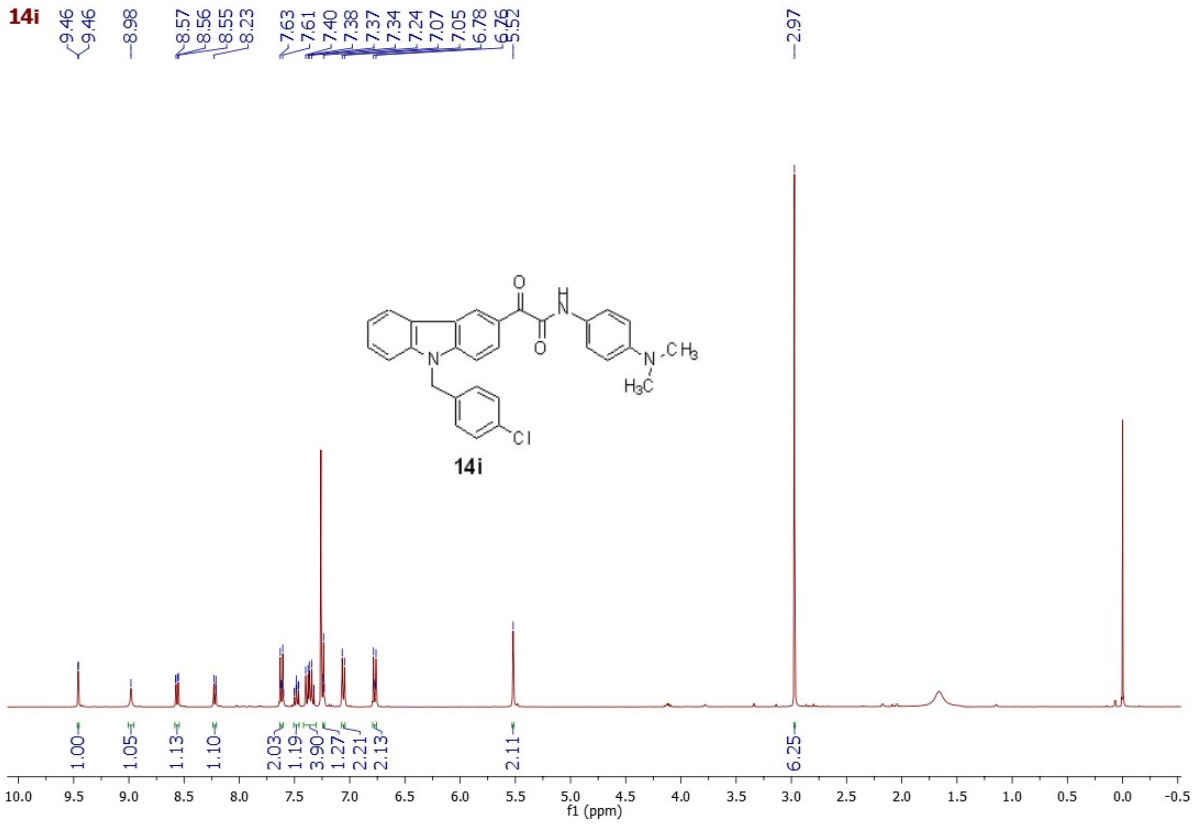
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
440.11712	7499132.5	100.00	440.11603	1.09	18.5	$C_{26}H_{19}O_2N_3Cl$

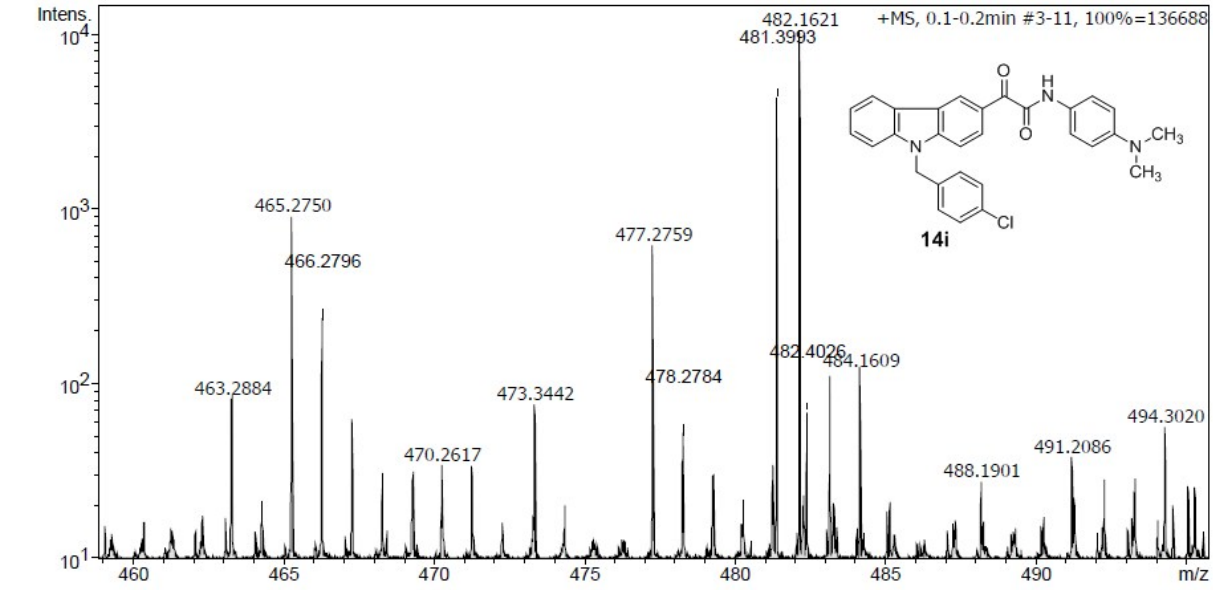


Channel: 2998; Processed Channel: PDA 345.2 nm; Result Id: 4076; Processing Method: cga9

Processed Channel Descr.: PDA 345.2 nm

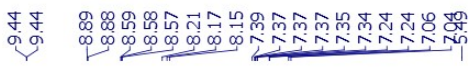
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 345.2 nm	4.093	1073	1.98	169
2	PDA 345.2 nm	4.306	53192	98.02	7315

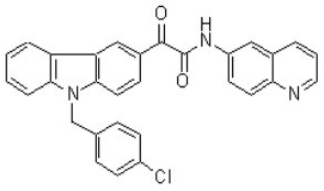




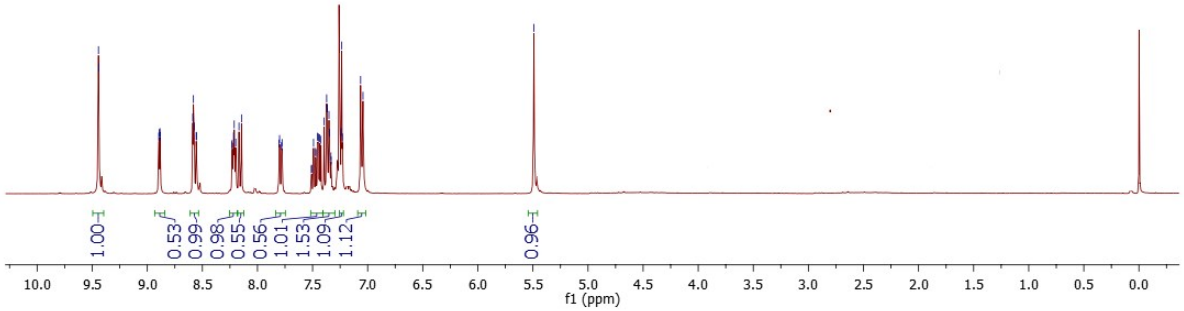
Meas. m/z	#	Ion Formula	m/z	err [ppm]	mSigma	# Sigma	Score	rdb	e⁻ Conf	N-Rule
482.1621	1	C29H25ClN3O2	482.1630	1.9	12.5	1	100.00	18.5	even	ok

14j

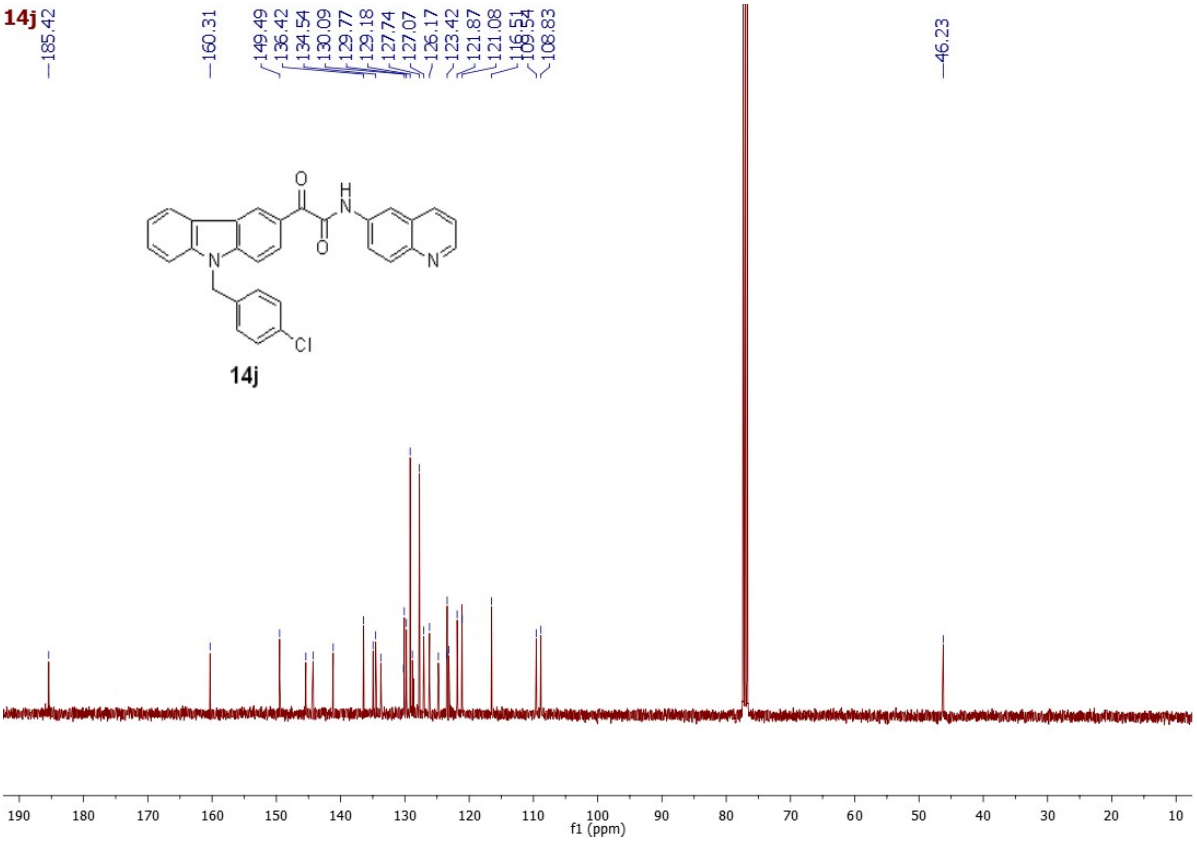




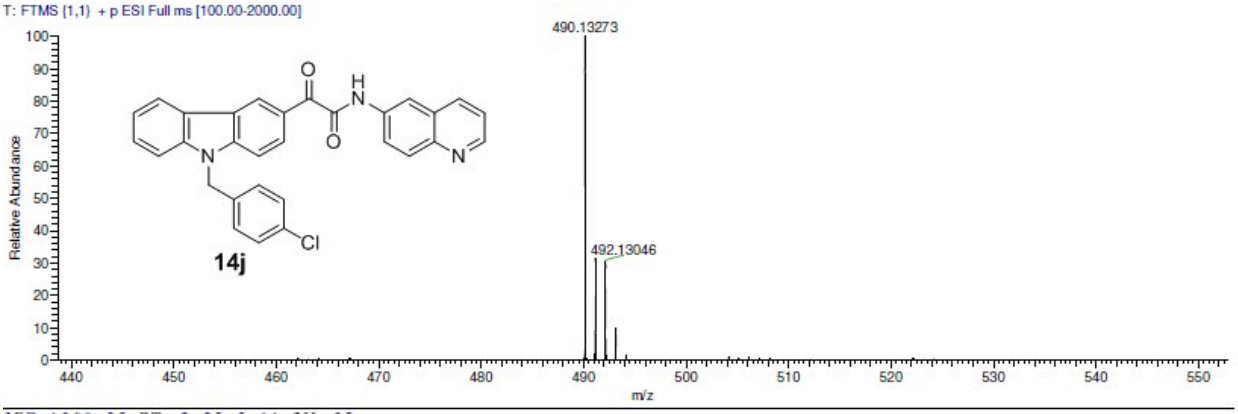
14j



14j

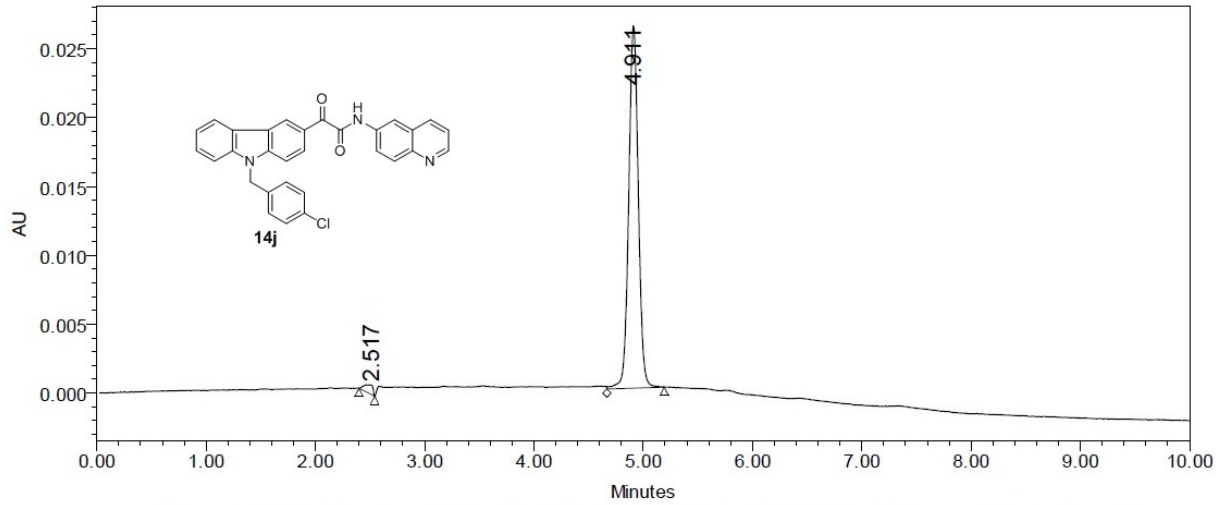


14j



ARP-12#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 488.48-493.94

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
490.13258	14303507.0	100.00	490.13168	0.90	21.5	$C_{30}H_{21}O_2N_3Cl$

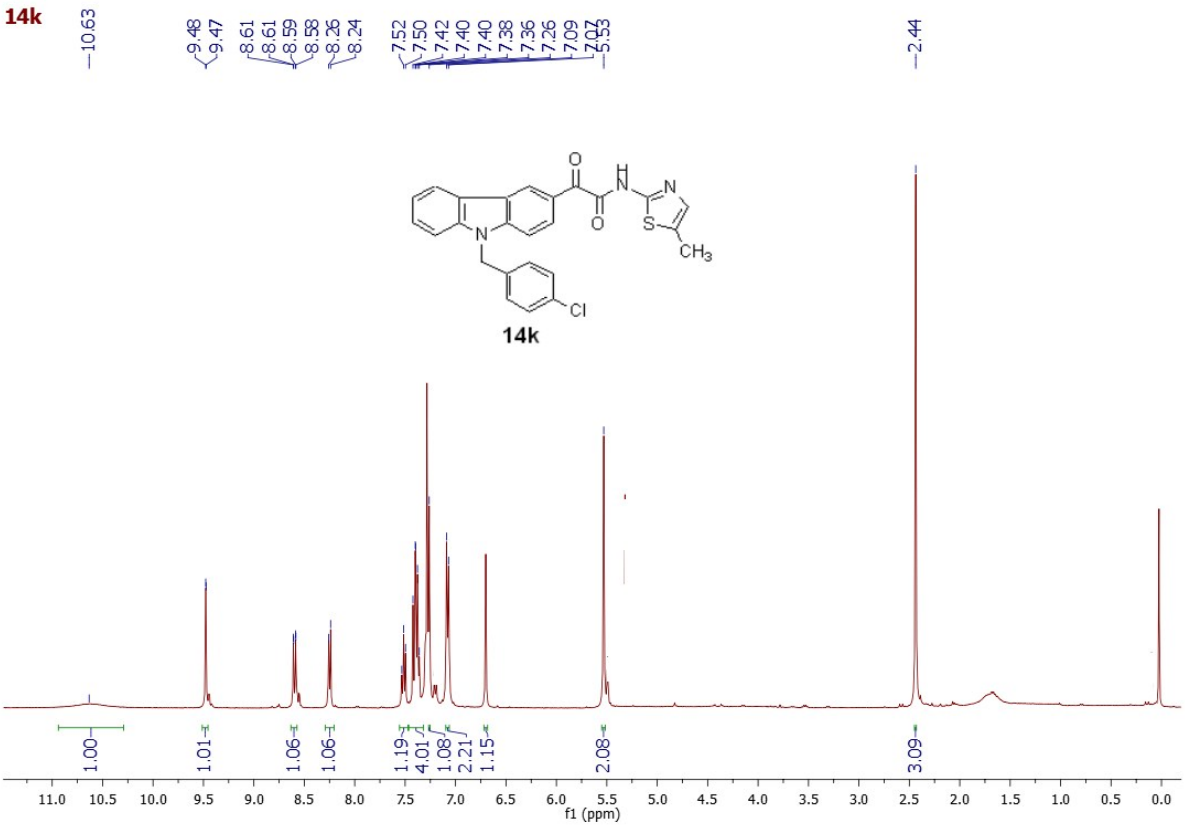


Channel: 2998; Processed Channel: PDA 304.0 nm; Result Id: 4182; Processing Method: cga12

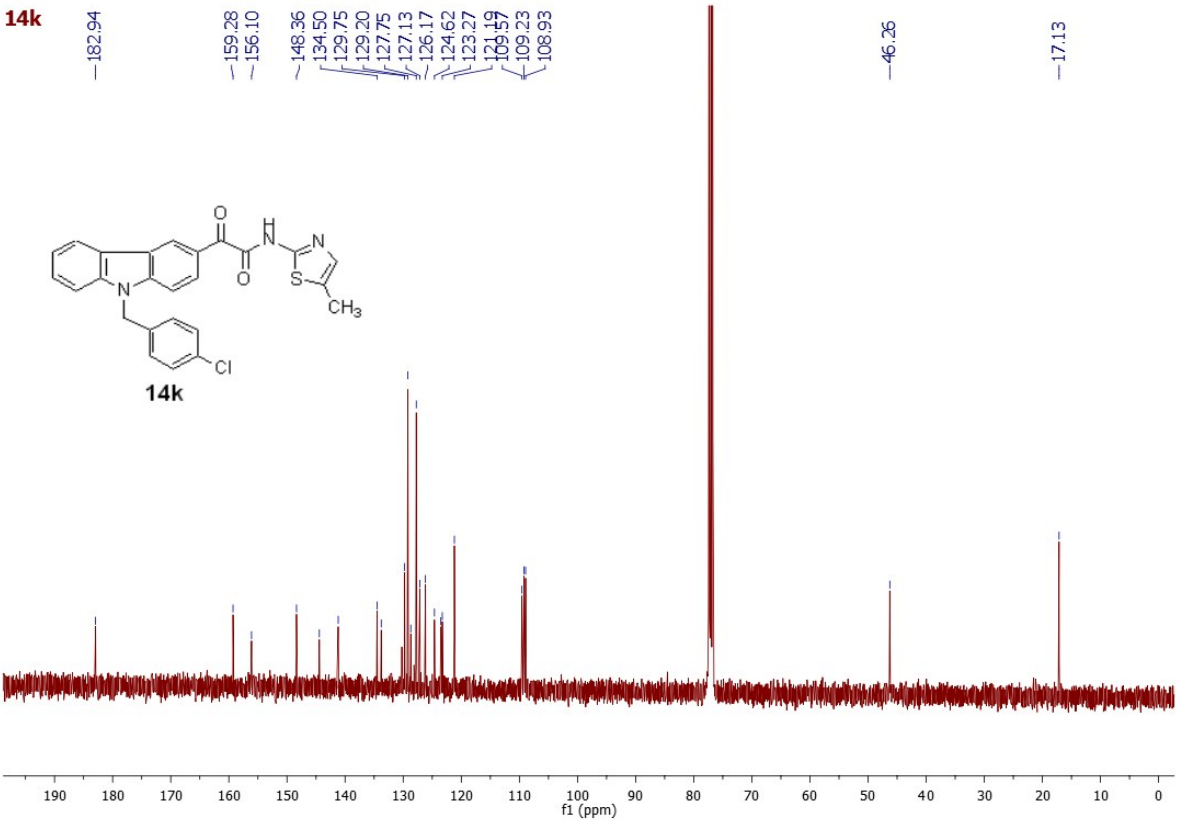
Processed Channel Descr.: PDA 304.0 nm

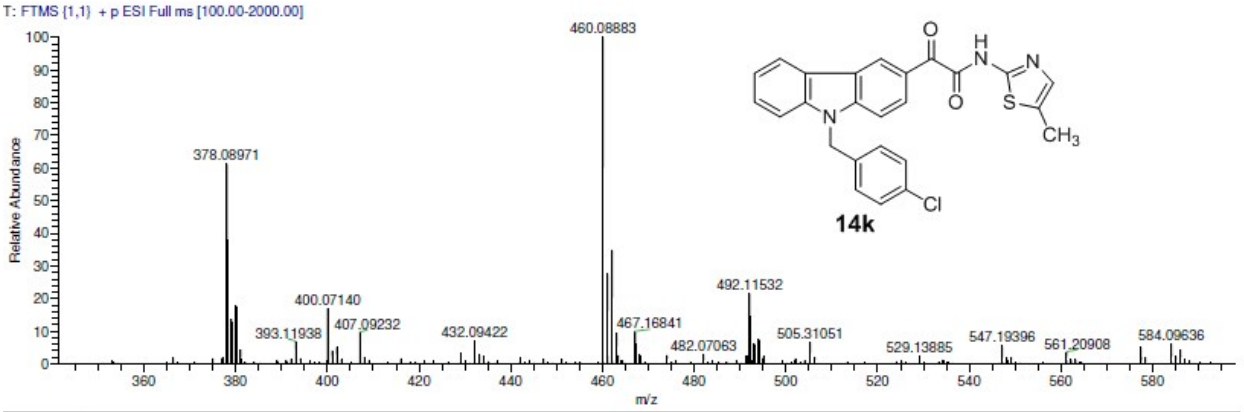
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 304.0 nm	2.517	3462	2.11	673
2	PDA 304.0 nm	4.911	160726	97.89	26290

14k


10.63
9.48
9.47
8.61
8.61
8.59
8.58
8.26
8.24
7.52
7.50
7.42
7.40
7.40
7.38
7.36
7.26
7.09
7.07
5.53
2.44
O
H
N
N
S
O
O
CH3
Cl
14k
1.00
1.01
1.06
1.06
1.19
4.01
1.08
2.21
1.15
2.08
3.09
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

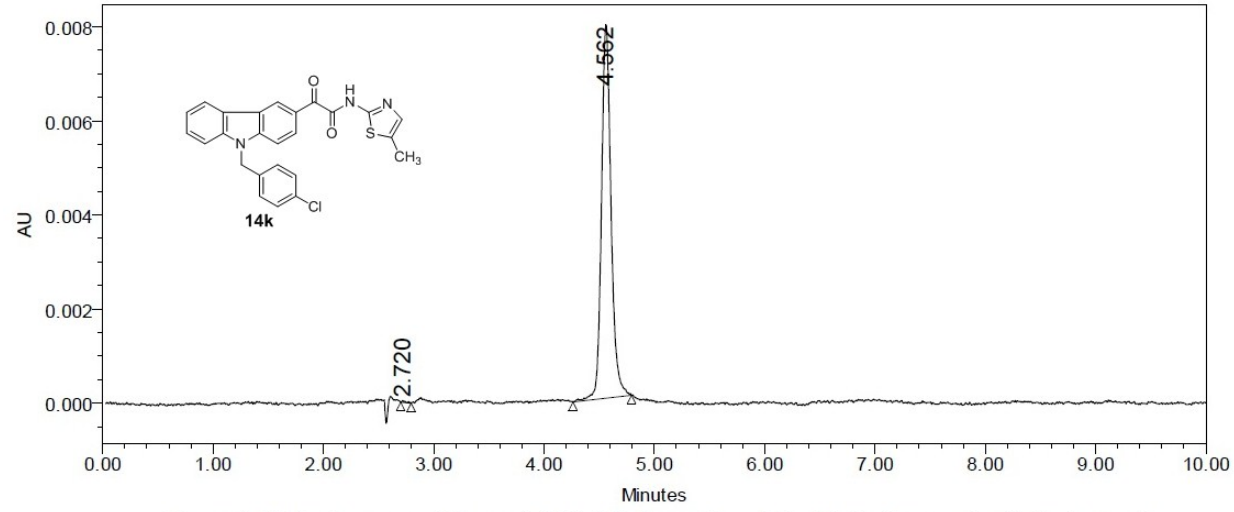
14k


182.94
159.28
156.10
148.36
134.50
129.75
129.20
127.75
127.13
126.17
124.62
123.27
109.57
109.23
108.93
46.26
17.13
O
H
N
N
S
O
O
CH3
Cl
14k
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



ARP-13#8-30 RT: 0.03-0.10 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 451.84-463.31

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
460.08878	1213339.8	100.00	460.08810	0.68	17.5	$C_{25}H_{19}O_2N_3ClS$

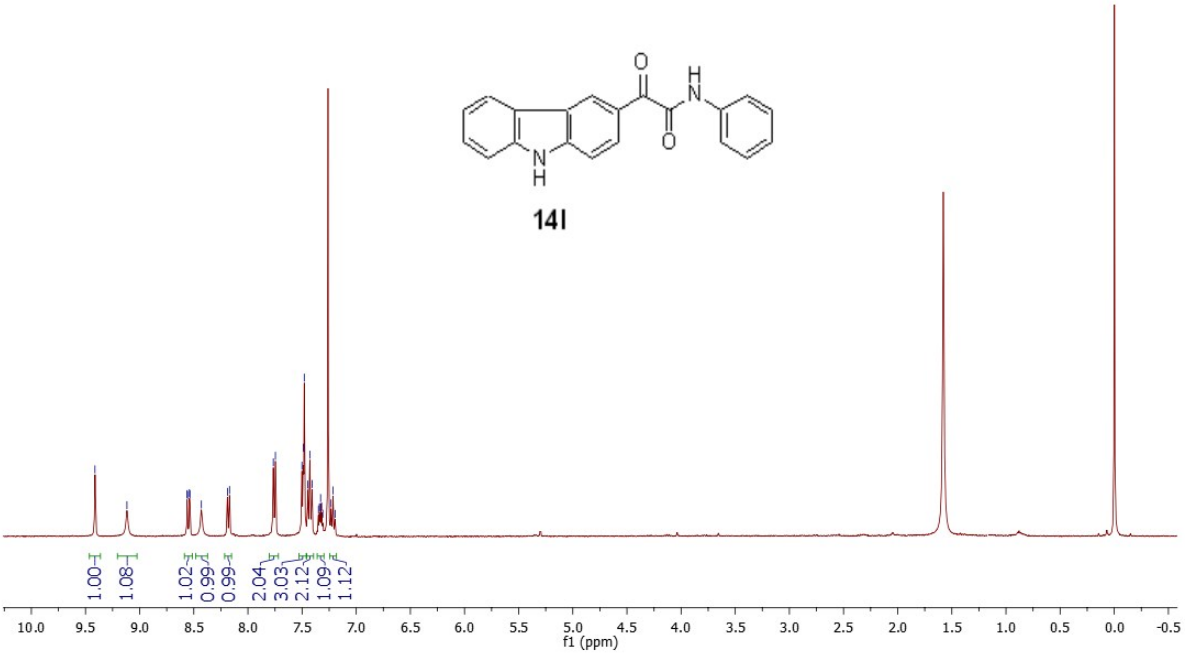


Processed Channel Descr.: PDA 350.0 nm

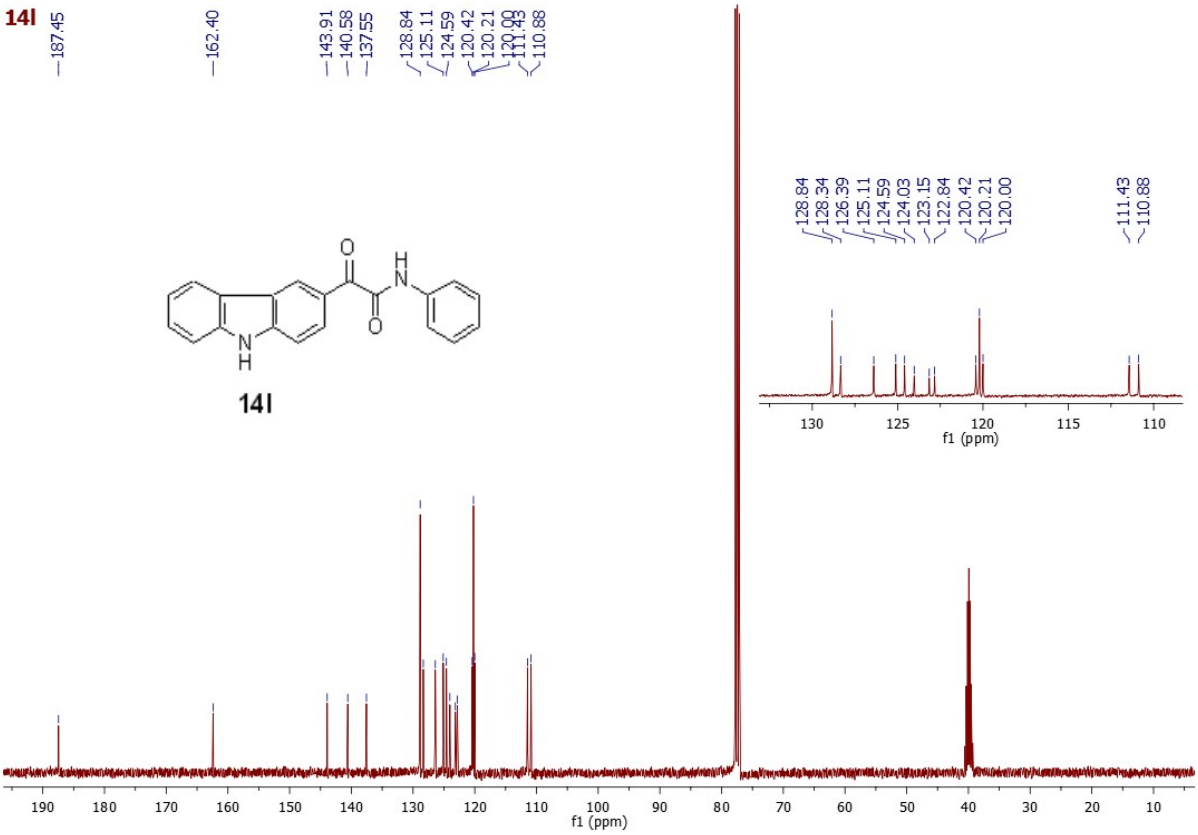
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	2.720	87	0.18	39
2	PDA 350.0 nm	4.562	48013	99.82	7939

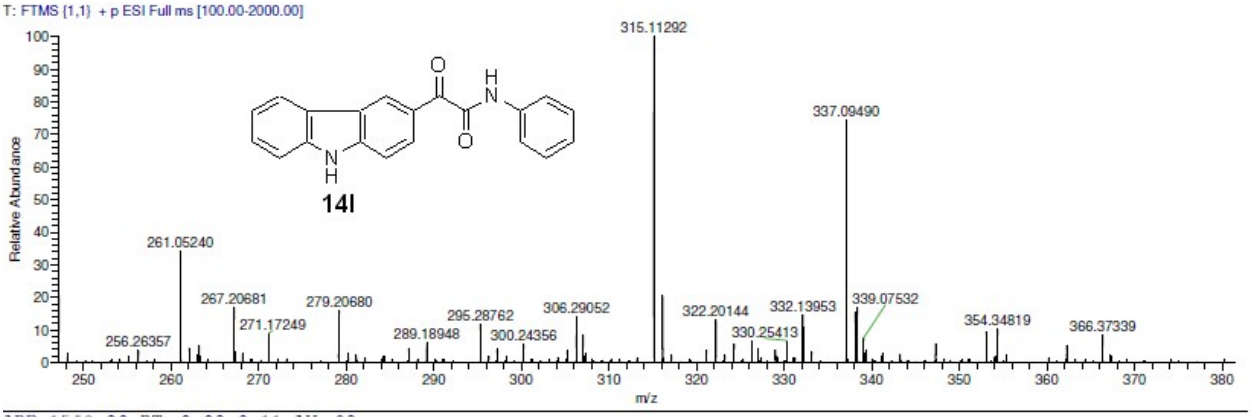
14l


9.41
9.12
8.56
8.54
8.54
8.19
8.17
7.77
7.75
7.50
7.49
7.48
7.45
7.43
7.41
7.35
7.34
7.33
7.32
7.31
7.23
7.21
7.20


14l
1.00
1.08
1.02
0.99
0.99
2.04
3.03
2.12
1.09
1.12
f1 (ppm)

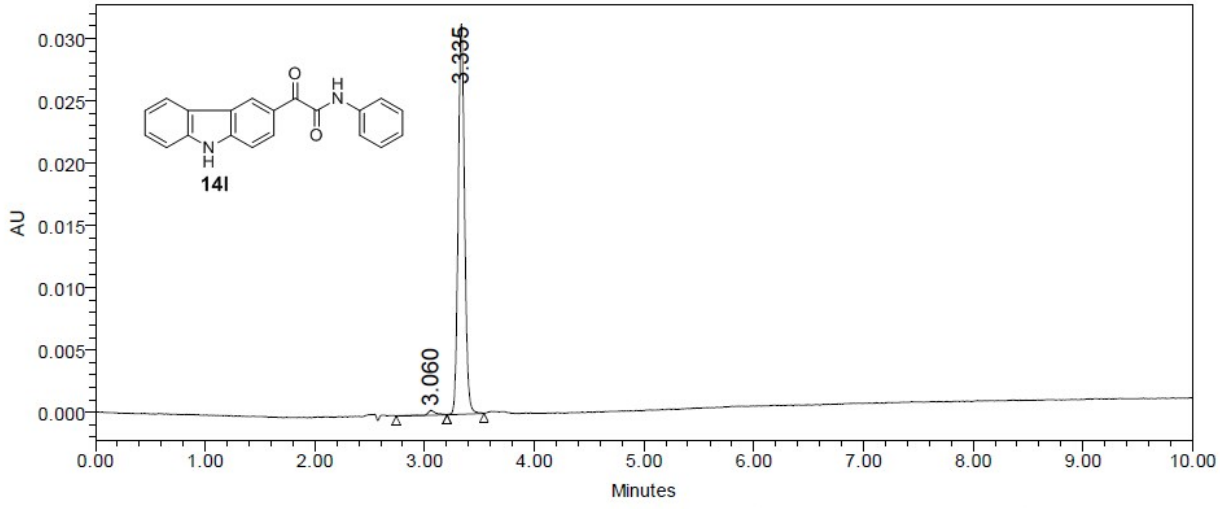
14l


187.45
162.40
143.91
140.58
137.55
128.84
125.11
124.59
120.42
120.21
120.00
111.43
110.88
14l
128.84
128.34
126.39
125.11
124.59
124.03
123.15
122.84
120.42
120.21
120.00
111.43
110.88
f1 (ppm)



ARP-15#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 312.21-320.32

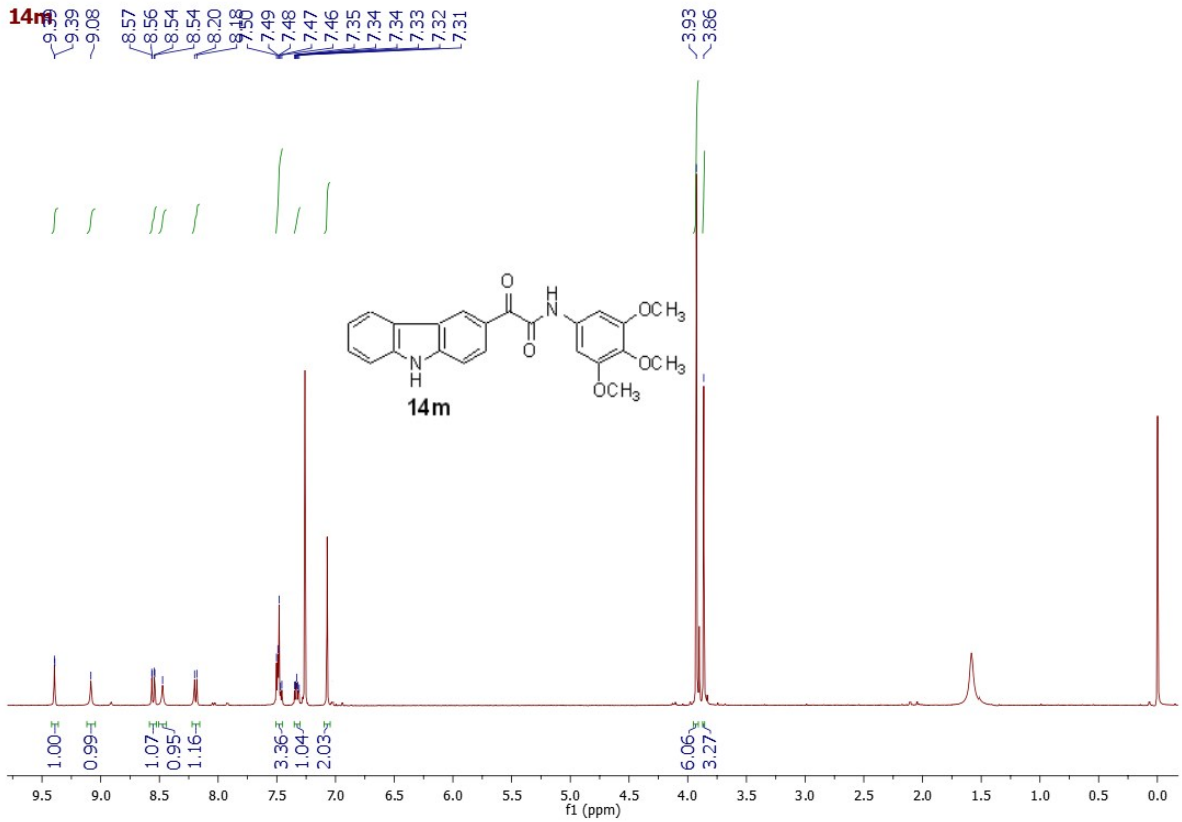
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
315.11295	1149074.5	100.00	315.11280	0.15	14.5	$C_{20}H_{15}O_2N_2$

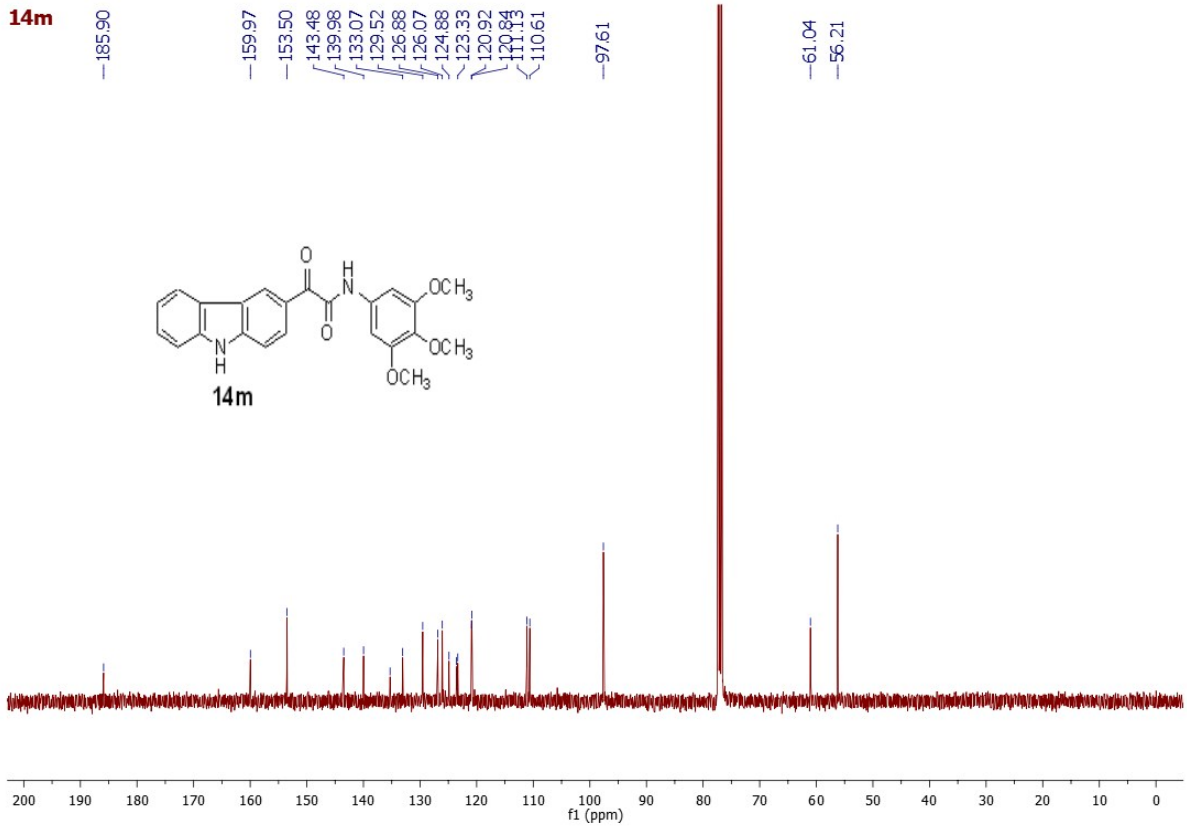


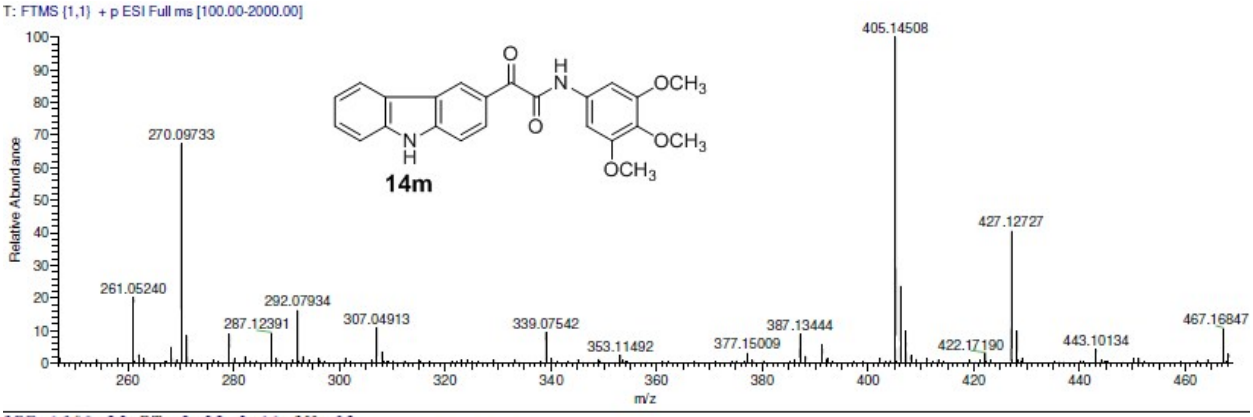
Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 4185; Processing Method: cga15

Processed Channel Descr.: PDA 350.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	3.060	2263	1.75	397
2	PDA 350.0 nm	3.335	127190	98.25	31325

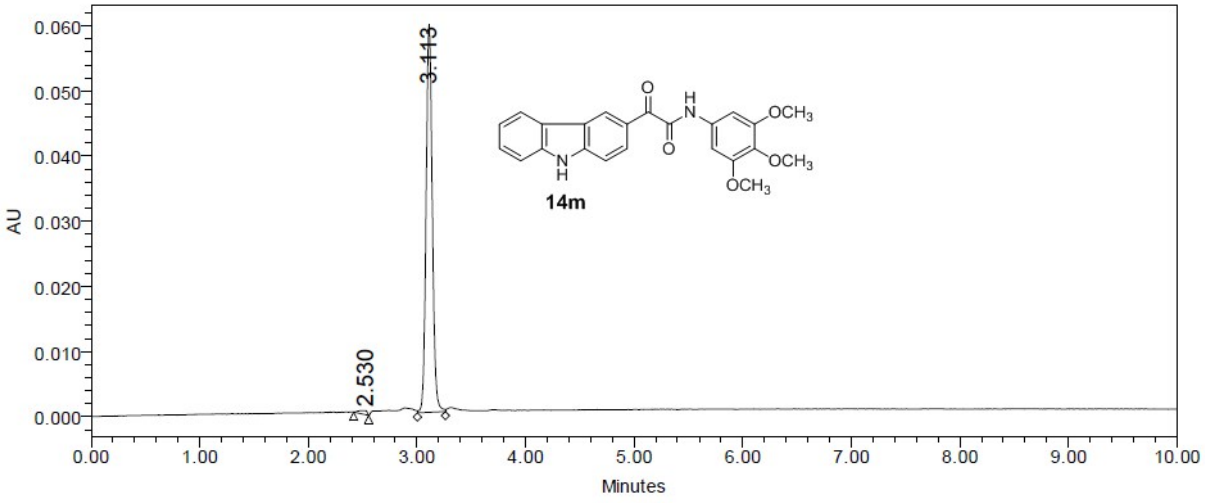

14m
9.39
9.08
8.57
8.56
8.54
8.54
8.20
7.49
7.48
7.47
7.46
7.35
7.34
7.34
7.33
7.32
7.31
3.93
3.86
OCH3
OCH3
OCH3
14m
1.00
0.99
1.07
0.95
1.16
3.36
1.04
2.03
6.06
3.27
f1 (ppm)


14m
185.90
159.97
153.50
143.48
139.98
133.07
129.52
126.88
126.07
124.88
123.33
120.92
120.84
111.13
110.61
97.61
61.04
56.21
OCH3
OCH3
OCH3
14m
f1 (ppm)



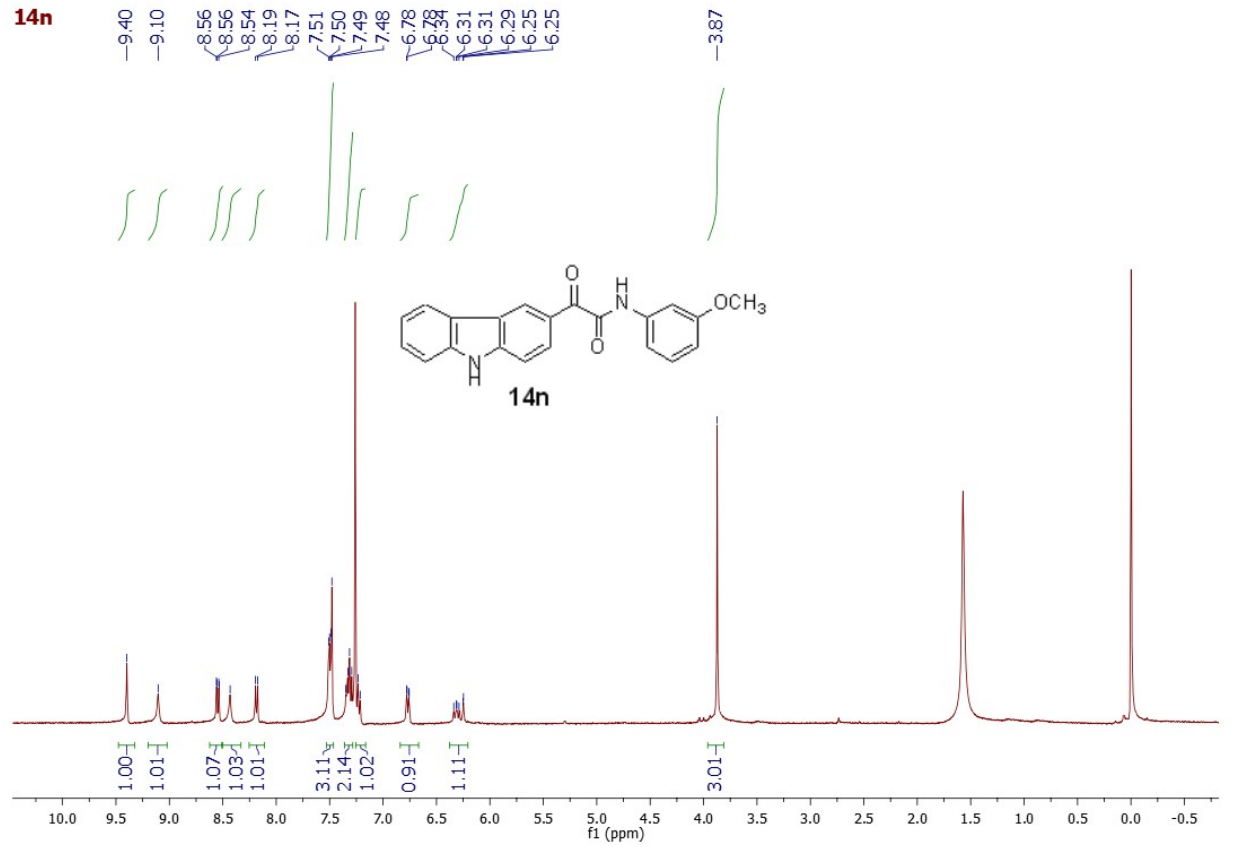
ARP-16#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 391.03-411.89

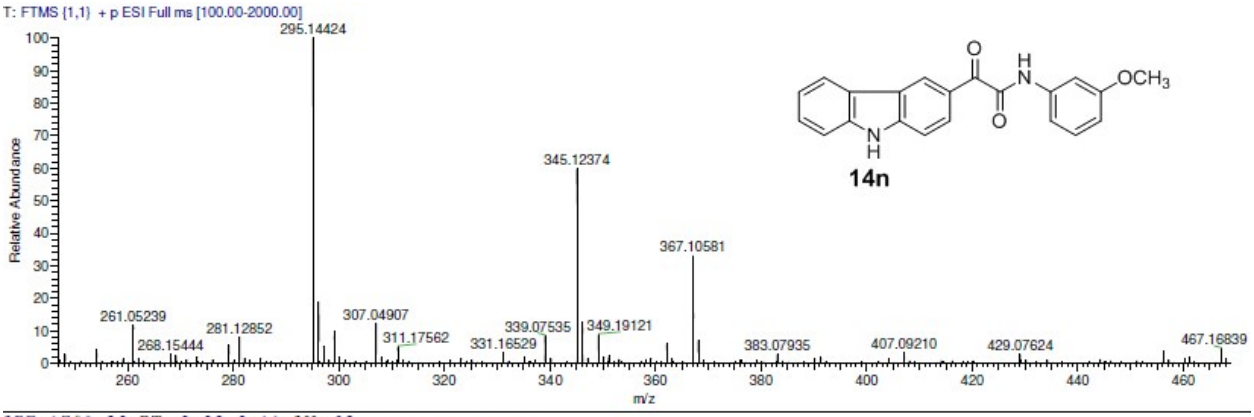
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
405.14506	2470315.0	100.00	405.14450	0.56	14.5	$C_{23}H_{21}O_5N_2$



Processed Channel Descr.: PDA 359.6 nm

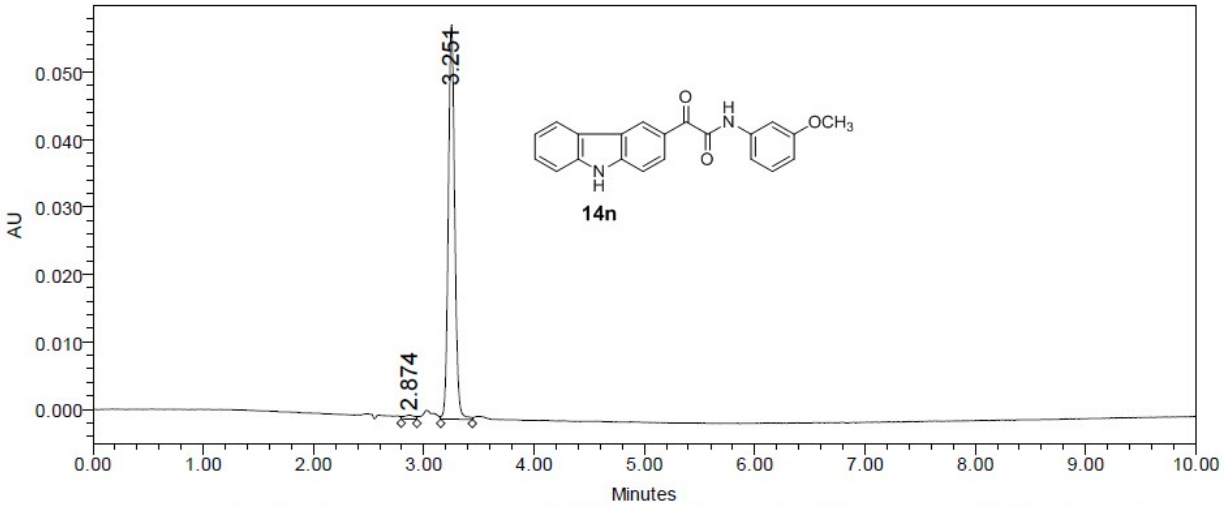
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 359.6 nm	2.530	3056	1.28	643
2	PDA 359.6 nm	3.113	235993	98.72	59517





ARP-17#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 341.43-351.50

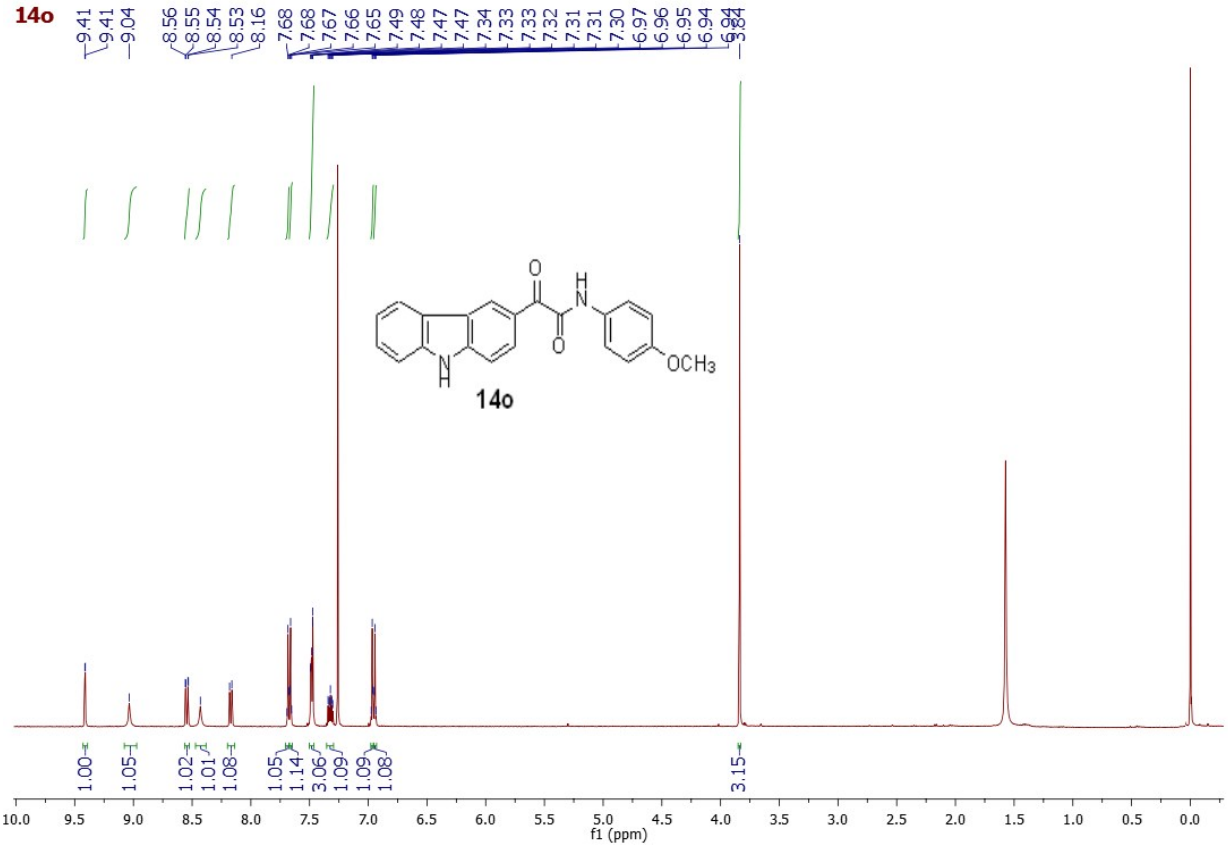
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
345.12369	1074506.3	100.00	345.12337	0.33	14.5	$C_{21}H_{17}O_3N_2$

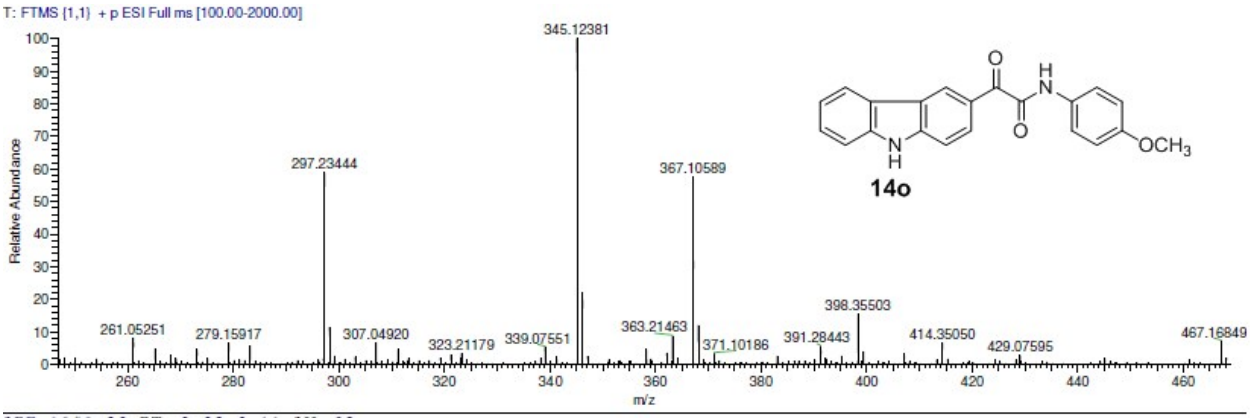


Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 4191; Processing Method: cga17

Processed Channel Descr.: PDA 350.0 nm

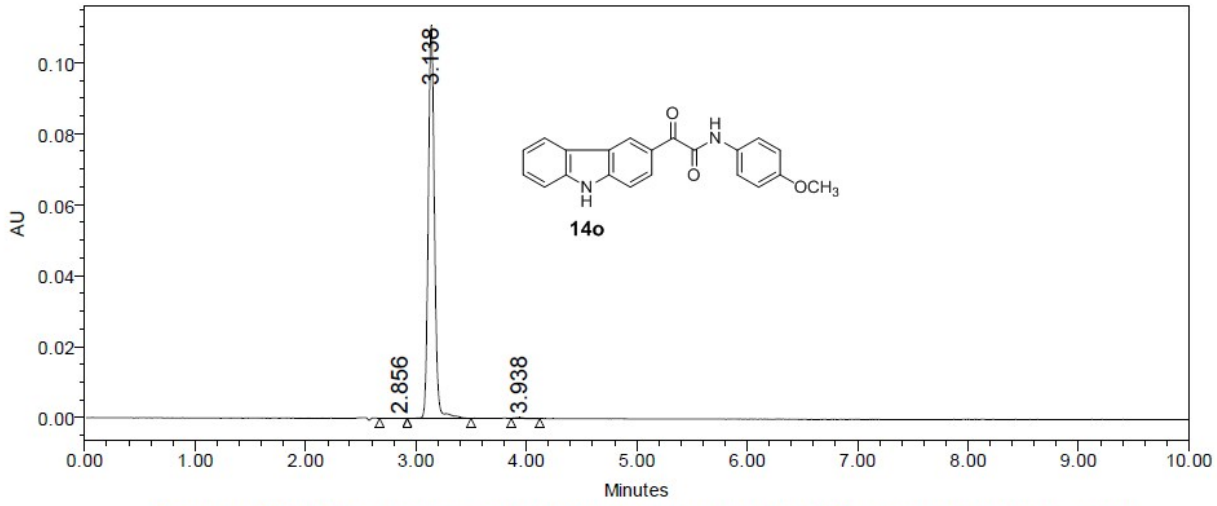
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	2.874	3905	1.63	588
2	PDA 350.0 nm	3.251	235584	98.37	58395





ARP-18#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 339.54-352.81

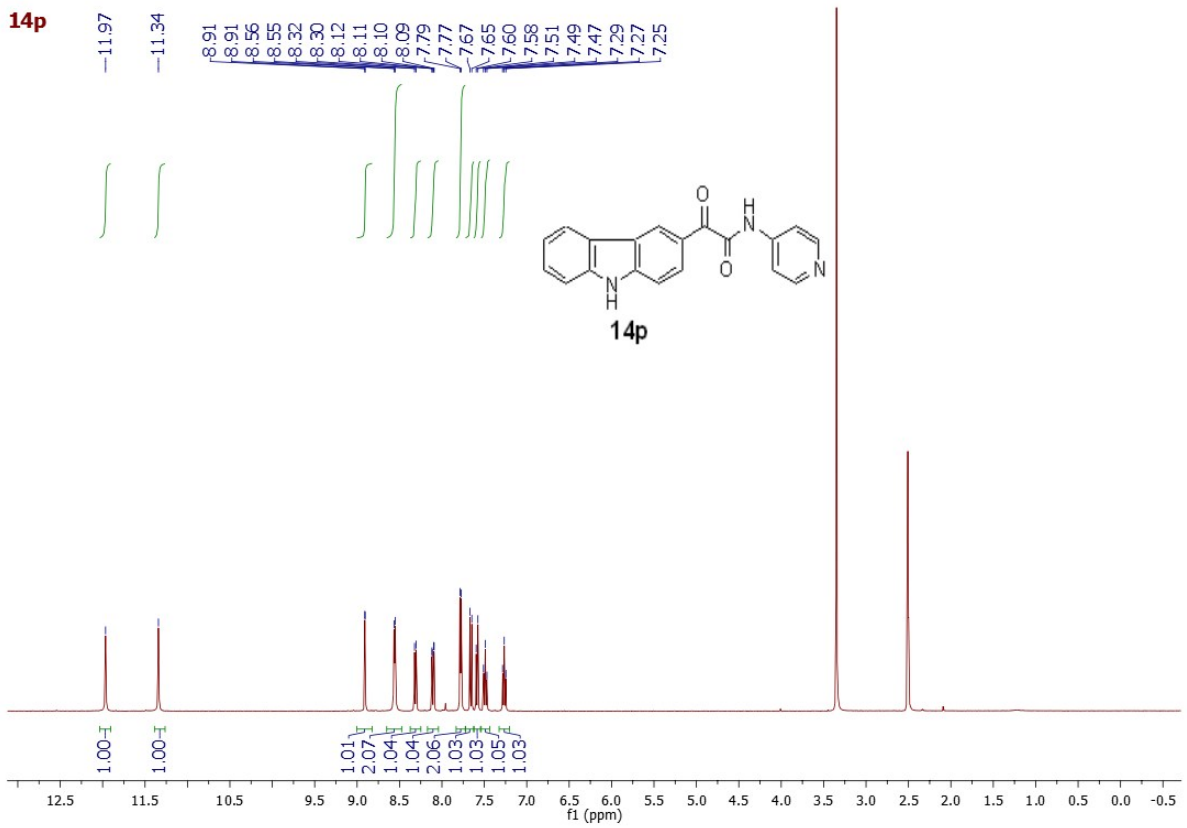
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
345.12382	1776299.6	100.00	345.12337	0.45	14.5	$C_{21}H_{17}O_3N_2$

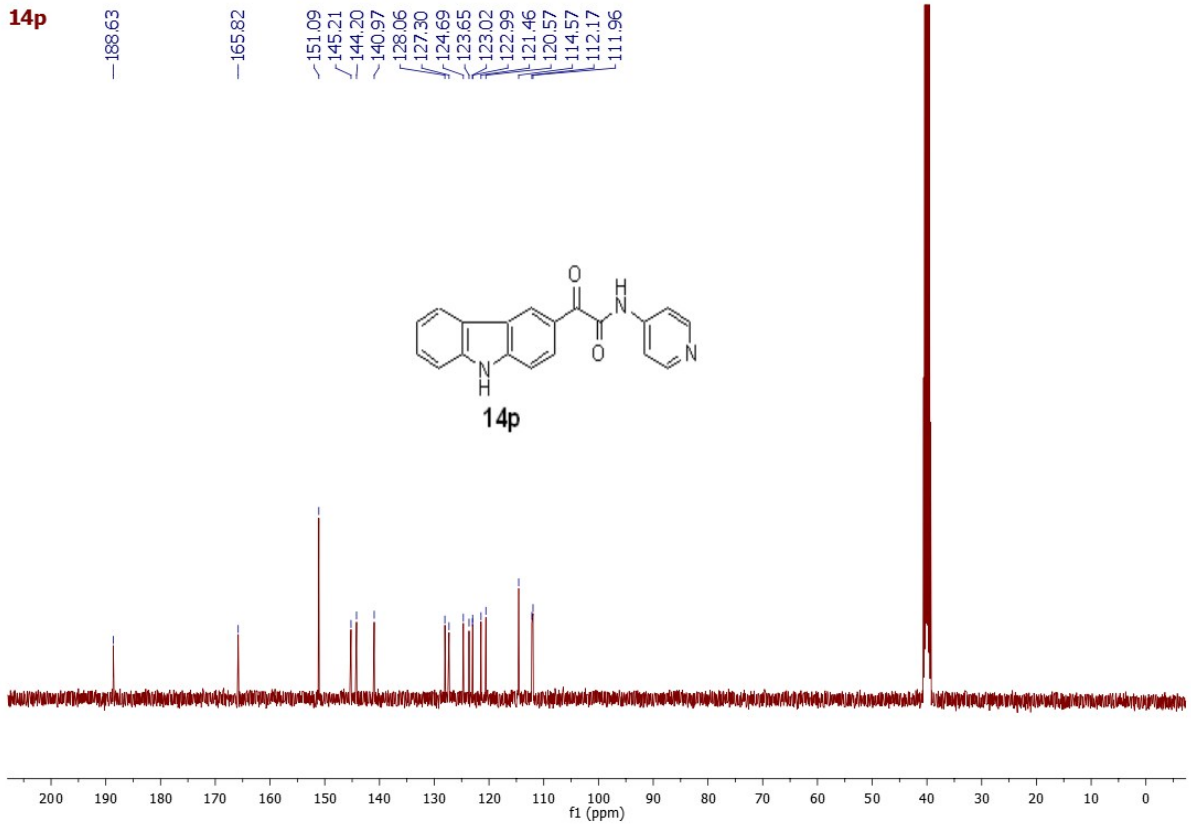


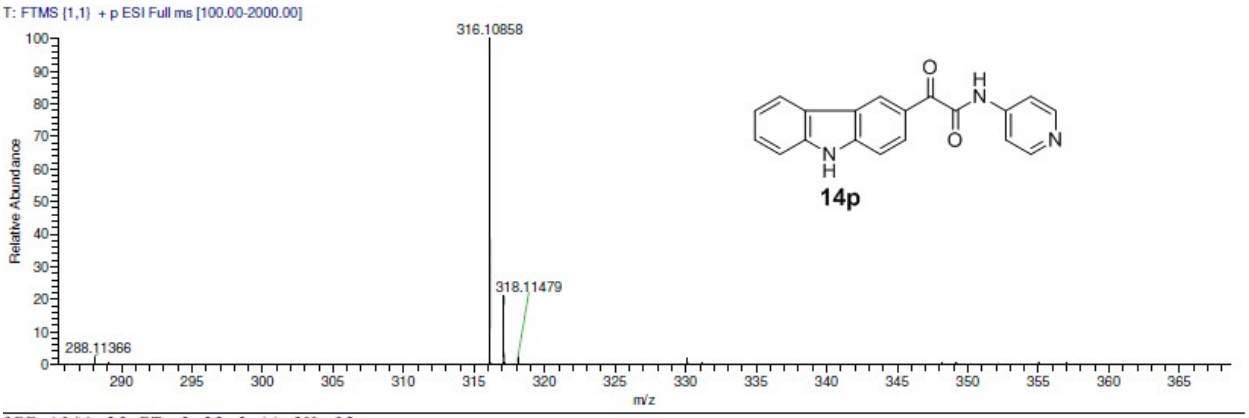
Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 4194; Processing Method: cga18

Processed Channel Descr.: PDA 350.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	2.856	362	0.08	51
2	PDA 350.0 nm	3.138	431141	99.62	110734
3	PDA 350.0 nm	3.938	1283	0.30	235

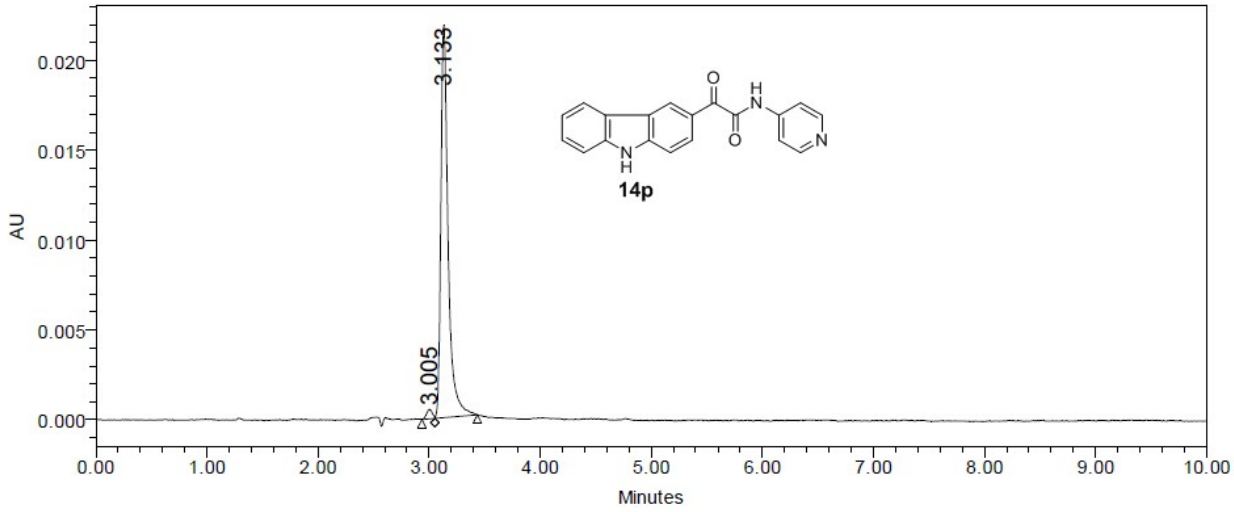

14p
11.97
11.34
8.91
8.91
8.56
8.55
8.32
8.30
8.12
8.11
8.10
8.09
7.79
7.77
7.67
7.65
7.60
7.58
7.51
7.49
7.47
7.29
7.27
7.25
14p
1.00
1.00
1.01
2.07
1.04
1.04
2.06
1.03
1.03
1.05
1.03
f1 (ppm)


14p
188.63
165.82
151.09
145.21
144.20
140.97
128.06
127.30
124.69
123.65
123.02
122.99
121.46
120.57
114.57
112.17
111.96
14p
f1 (ppm)



ARP-19#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 308.48-335.55

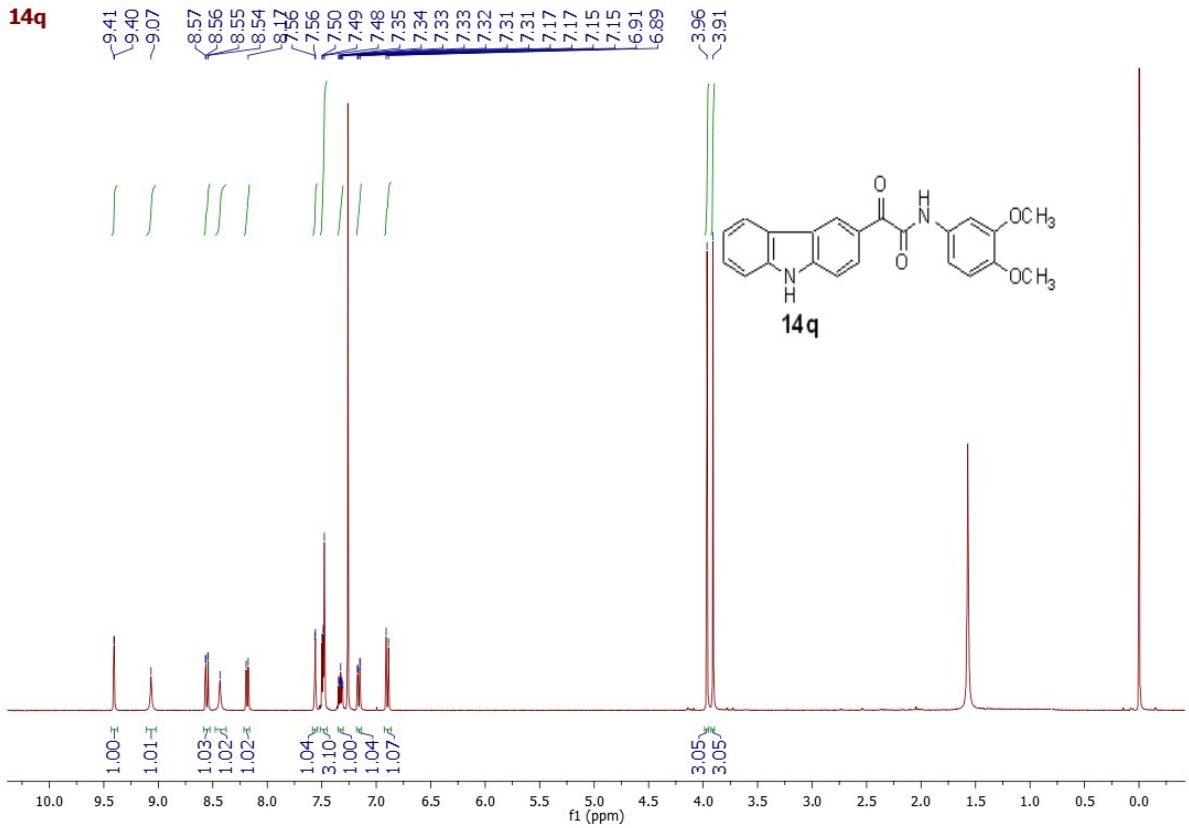
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
316.10857	41230760.0	100.00	316.10805	0.52	14.5	$C_{19}H_{14}O_2N_3$

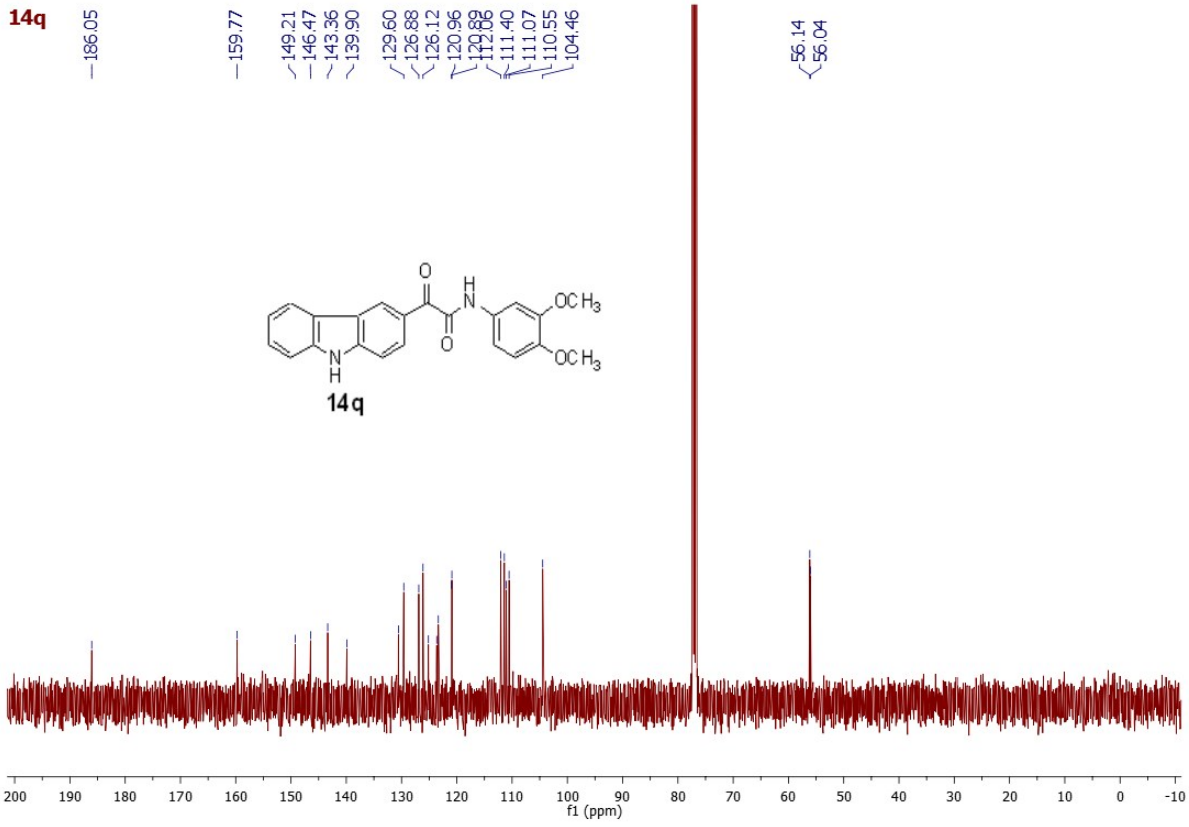


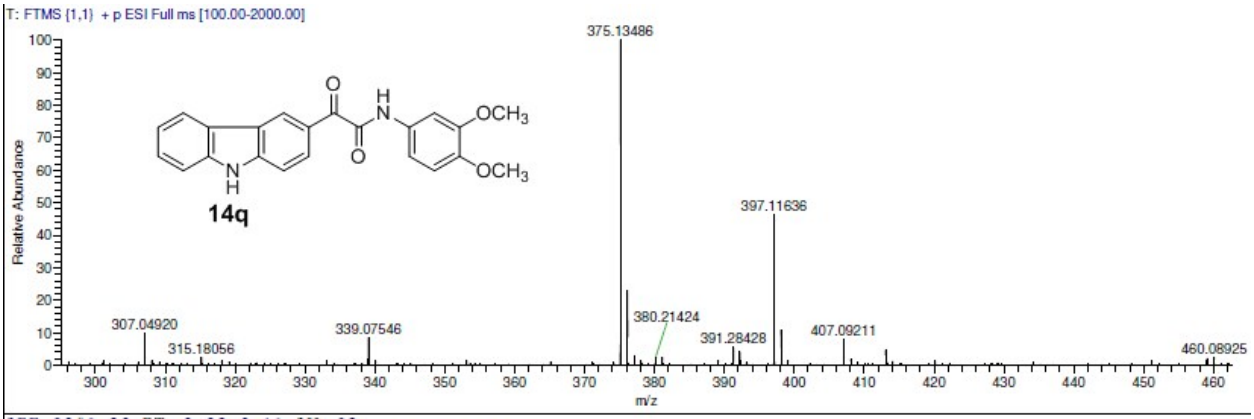
Channel: 2998; Processed Channel: PDA 303.0 nm; Result Id: 4200; Processing Method: cga19

Processed Channel Descr.: PDA 303.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 303.0 nm	3.005	1898	1.88	531
2	PDA 303.0 nm	3.133	99142	98.12	21853

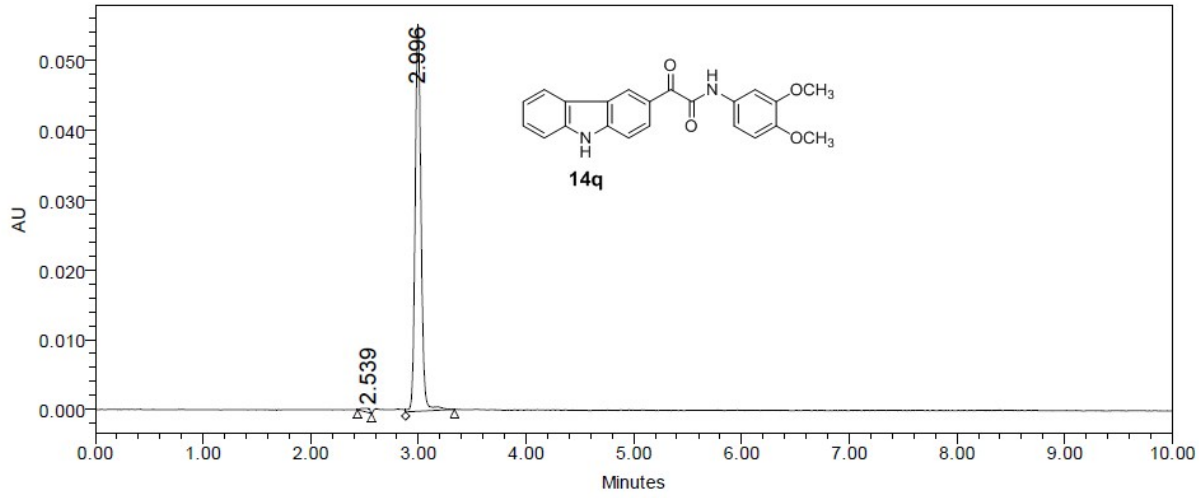

14q
9.41
9.40
9.07
8.57
8.56
8.55
8.54
7.56
7.50
7.49
7.48
7.35
7.34
7.33
7.33
7.32
7.31
7.31
7.17
7.17
7.15
7.15
6.91
6.89
3.96
3.91
1.00
1.01
1.03
1.02
1.02
1.04
3.10
1.00
1.04
1.07
3.05
3.05
f1 (ppm)
14q


14q
186.05
159.77
149.21
146.47
143.36
139.90
129.60
126.88
126.12
120.96
111.40
111.07
110.55
104.46
56.14
56.04
f1 (ppm)
14q



ARP-20#8-30 RT: 0.03-0.11 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 367.47-379.57

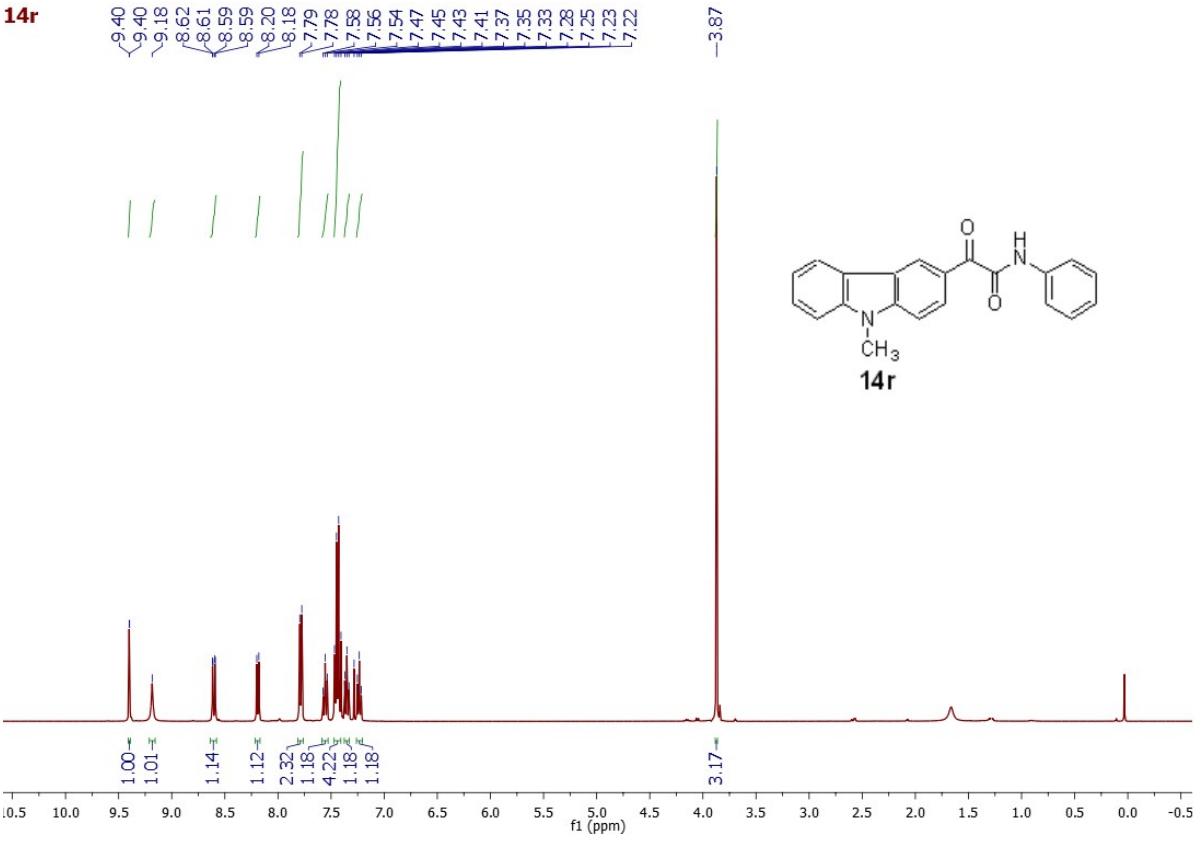
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
375.13482	2546129.5	100.00	375.13393	0.89	14.5	$C_{22}H_{19}O_4N_2$

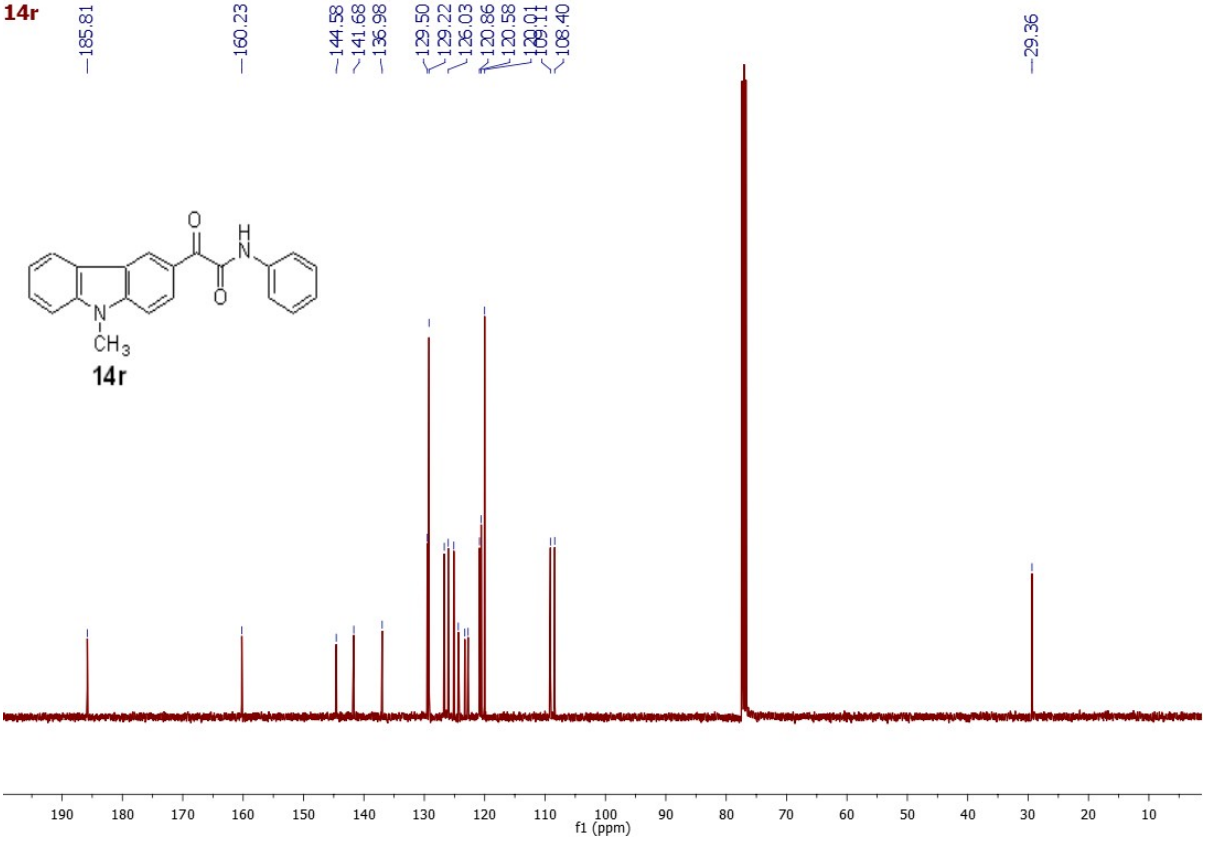


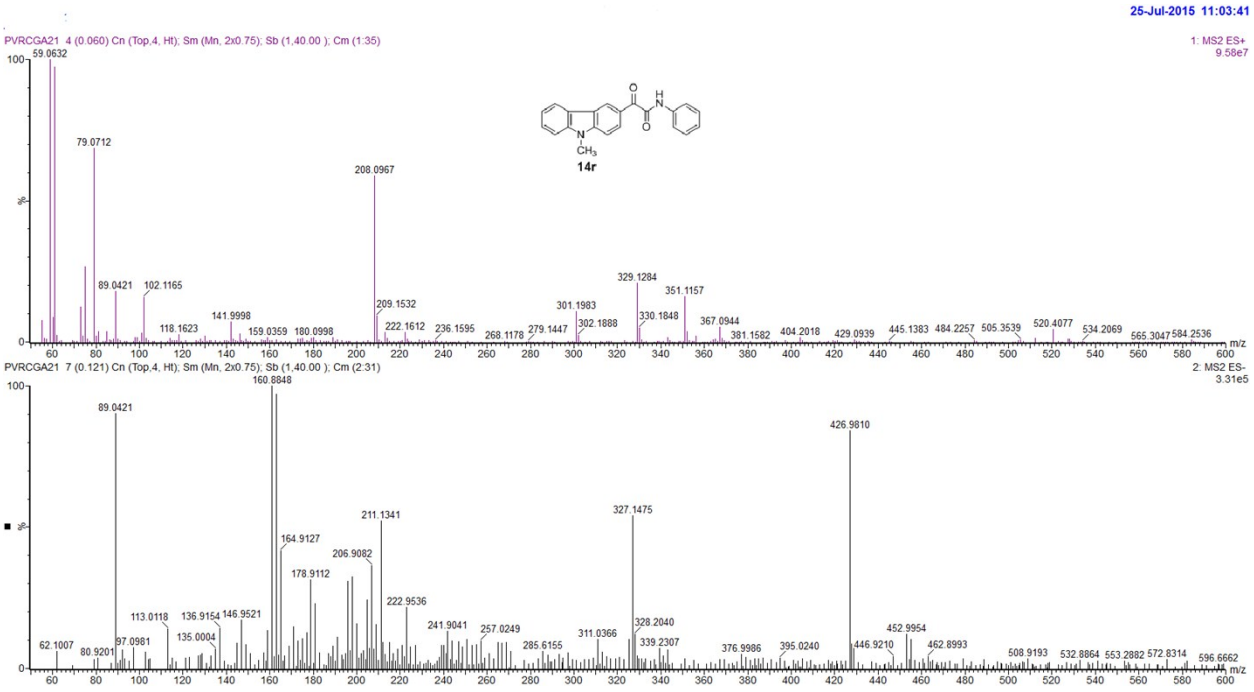
Channel: 2998; Processed Channel: PDA 350.0 nm; Result Id: 4197; Processing Method: cga20

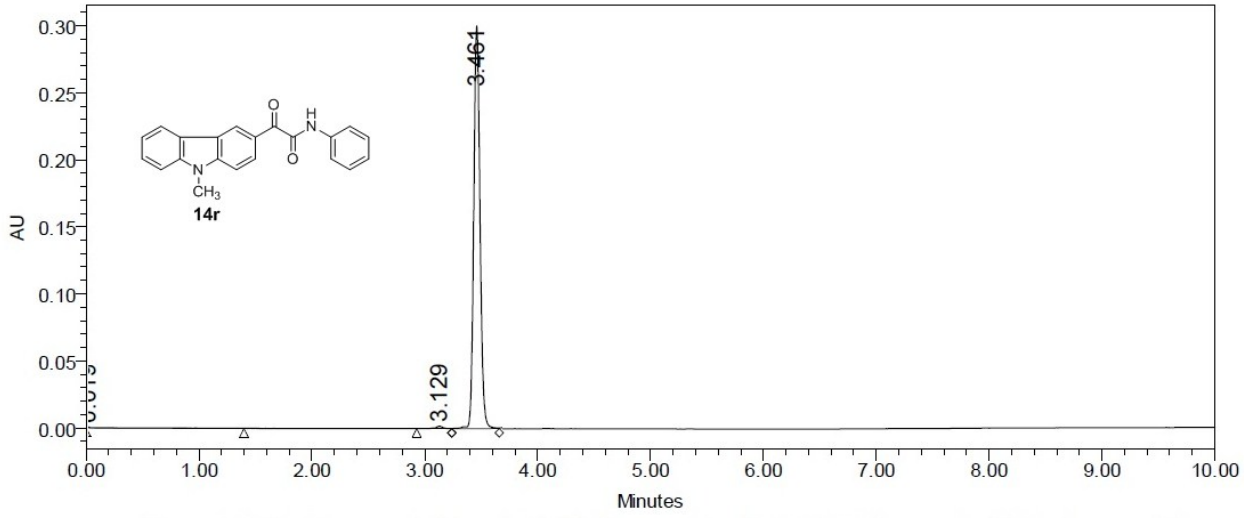
Processed Channel Descr.: PDA 350.0 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 350.0 nm	2.539	2873	1.34	614
2	PDA 350.0 nm	2.996	210926	98.66	55398


14r
9.40
9.40
9.18
8.62
8.61
8.59
8.59
8.20
8.18
7.79
7.78
7.58
7.56
7.54
7.47
7.45
7.43
7.41
7.37
7.35
7.33
7.28
7.25
7.23
7.22
3.87
1.00
1.01
1.14
1.12
2.32
1.18
4.22
1.18
1.18
3.17
f1 (ppm)
14r


14r
185.81
160.23
144.58
141.68
136.98
129.50
129.22
126.03
120.86
120.58
109.11
108.40
29.36
f1 (ppm)
14r



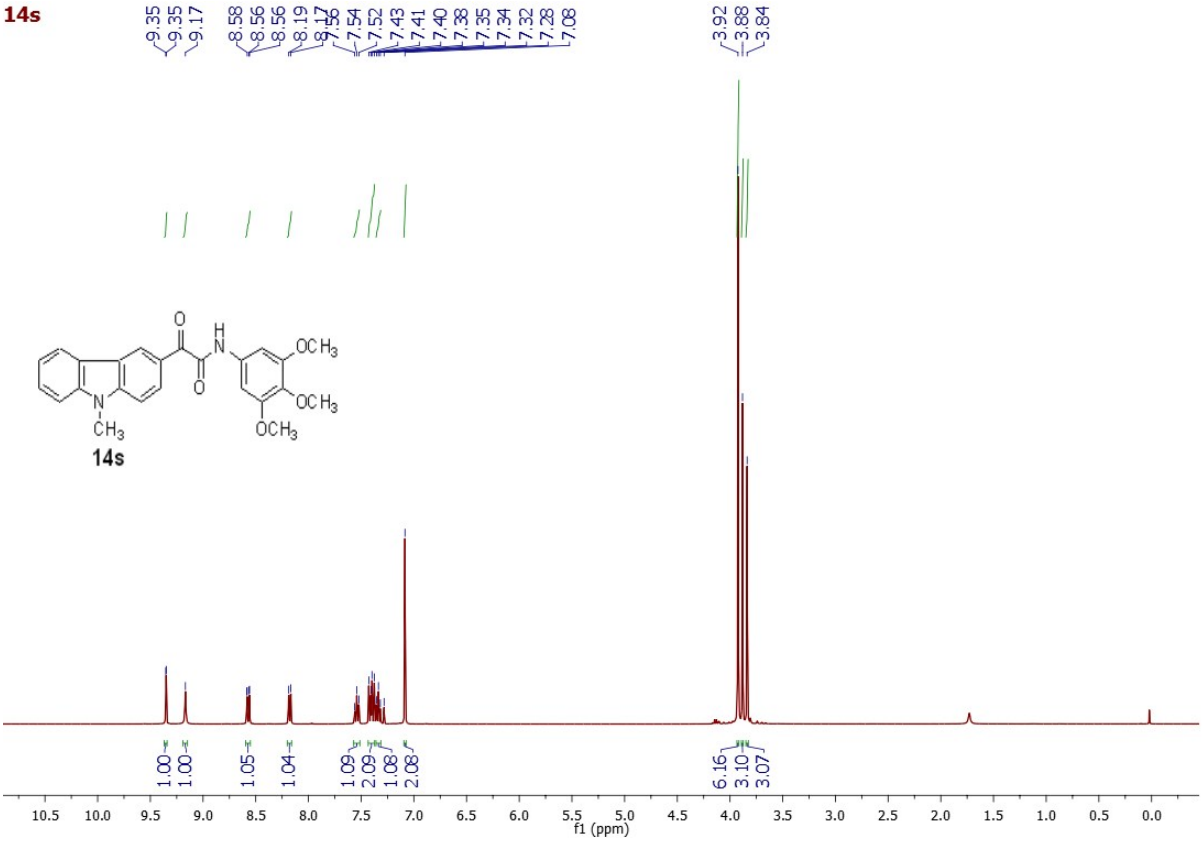


Channel: 2998; Processed Channel: PDA 327.7 nm; Result Id: 1106; Processing Method: pvrcga21

Processed Channel Descr.: PDA 327.7 nm

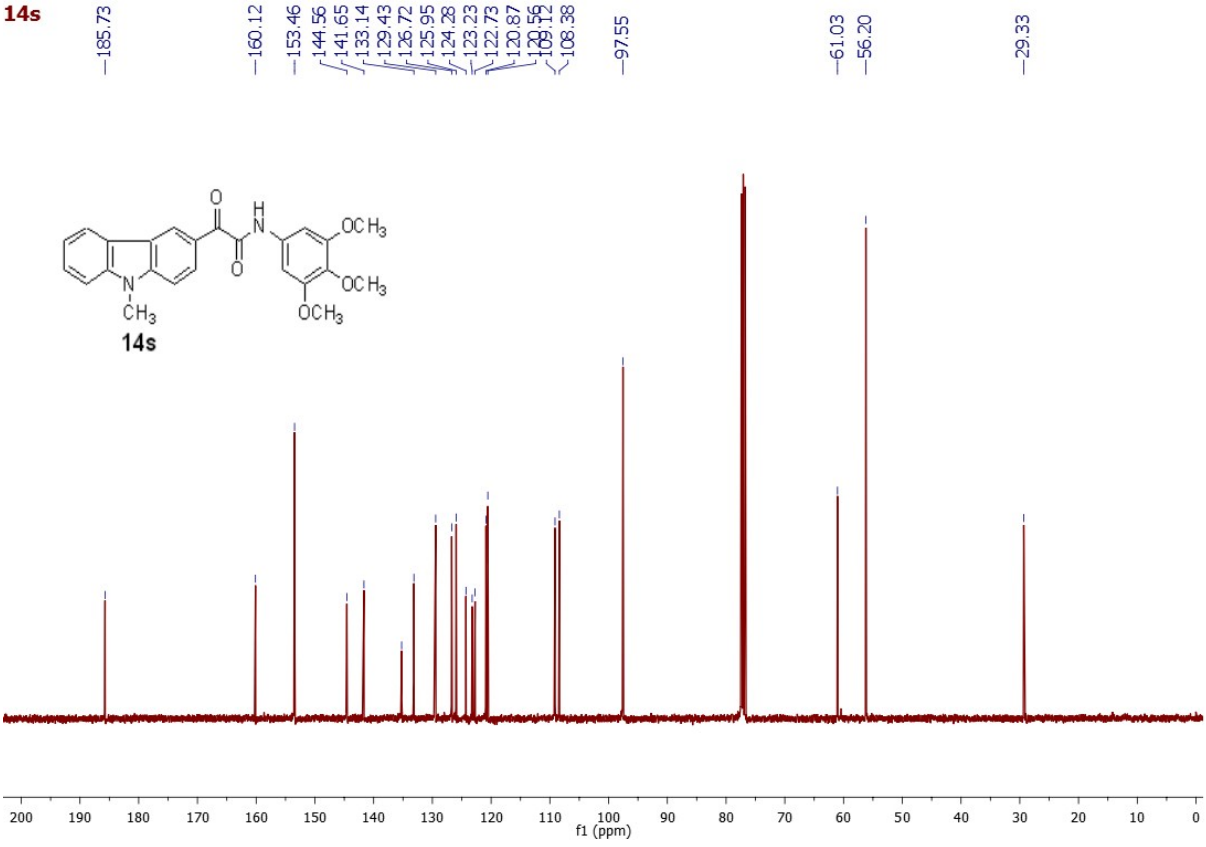
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 327.7 nm	0.019	6873	0.59	829
2	PDA 327.7 nm	3.129	7616	0.65	1804
3	PDA 327.7 nm	3.461	1152191	98.76	300392

14s

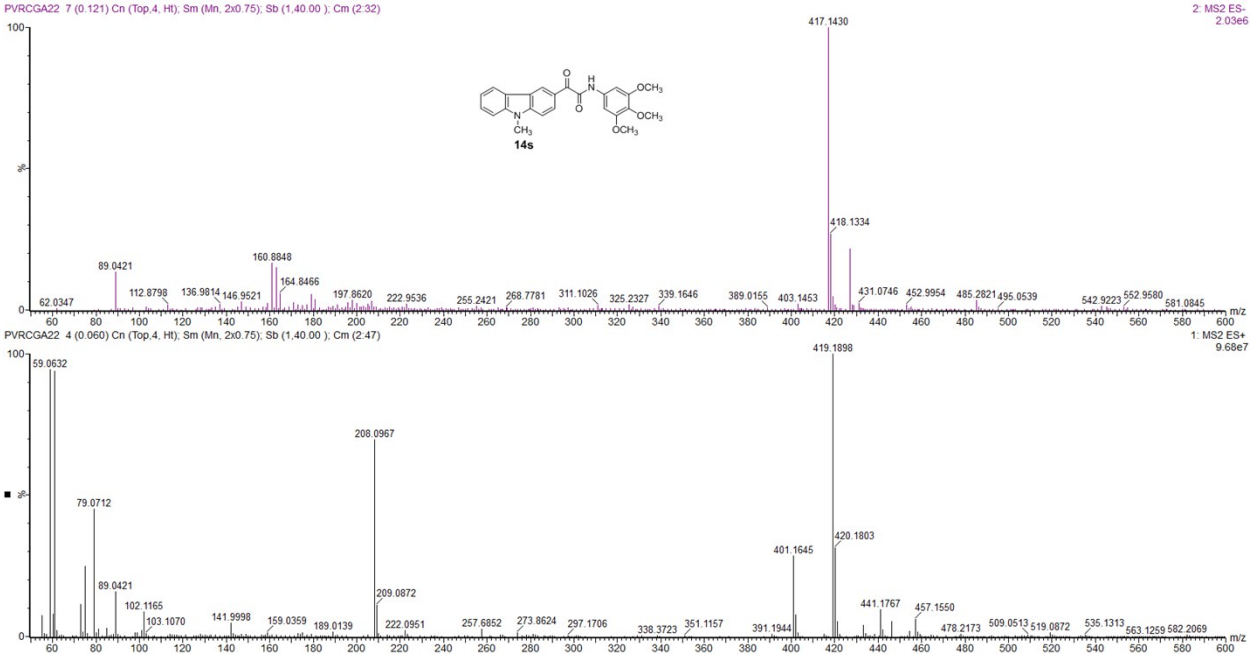


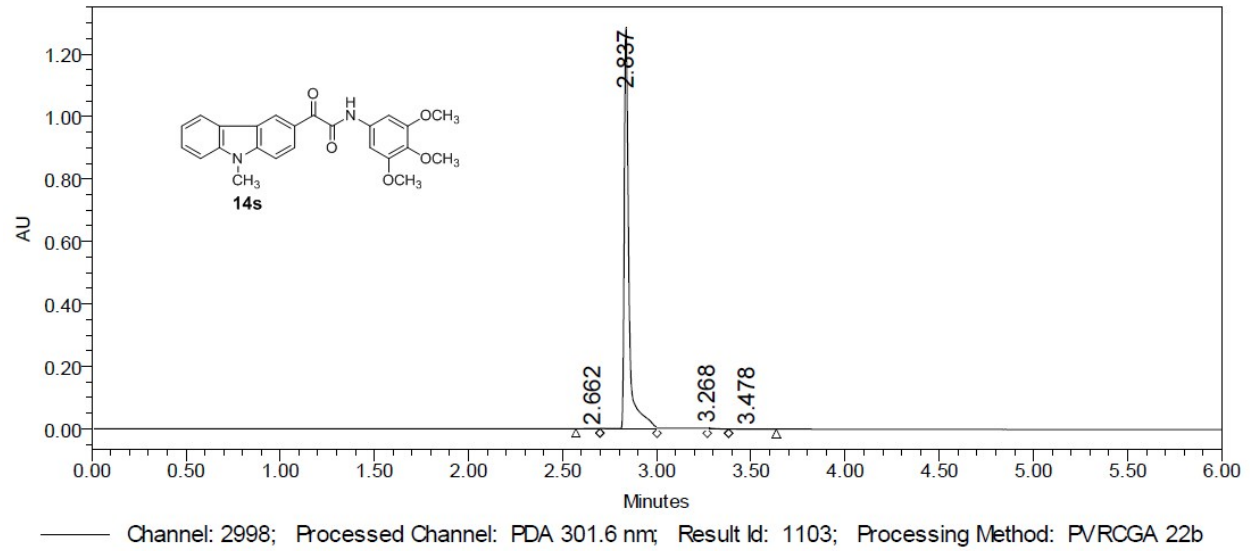
14s

14s



14s



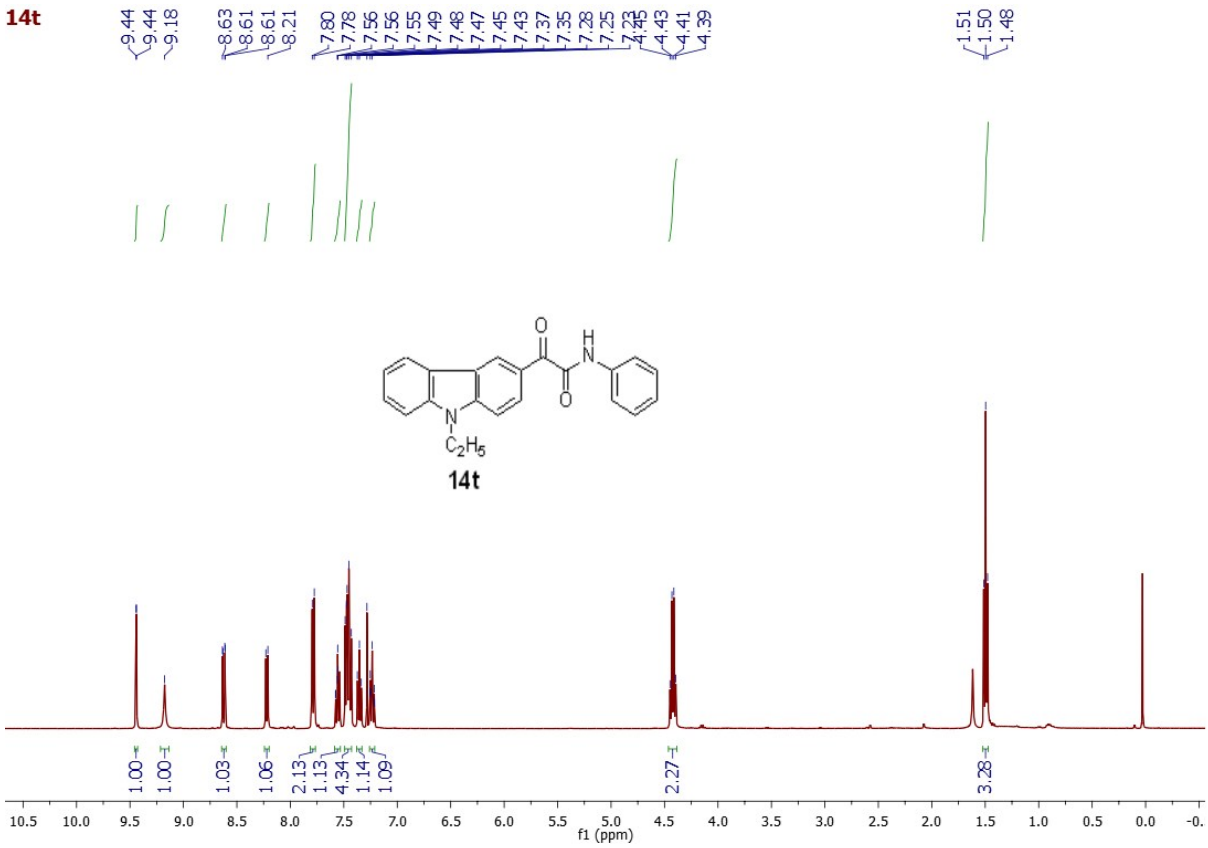


Channel: 2998; Processed Channel: PDA 301.6 nm; Result Id: 1103; Processing Method: PVRCGA 22b

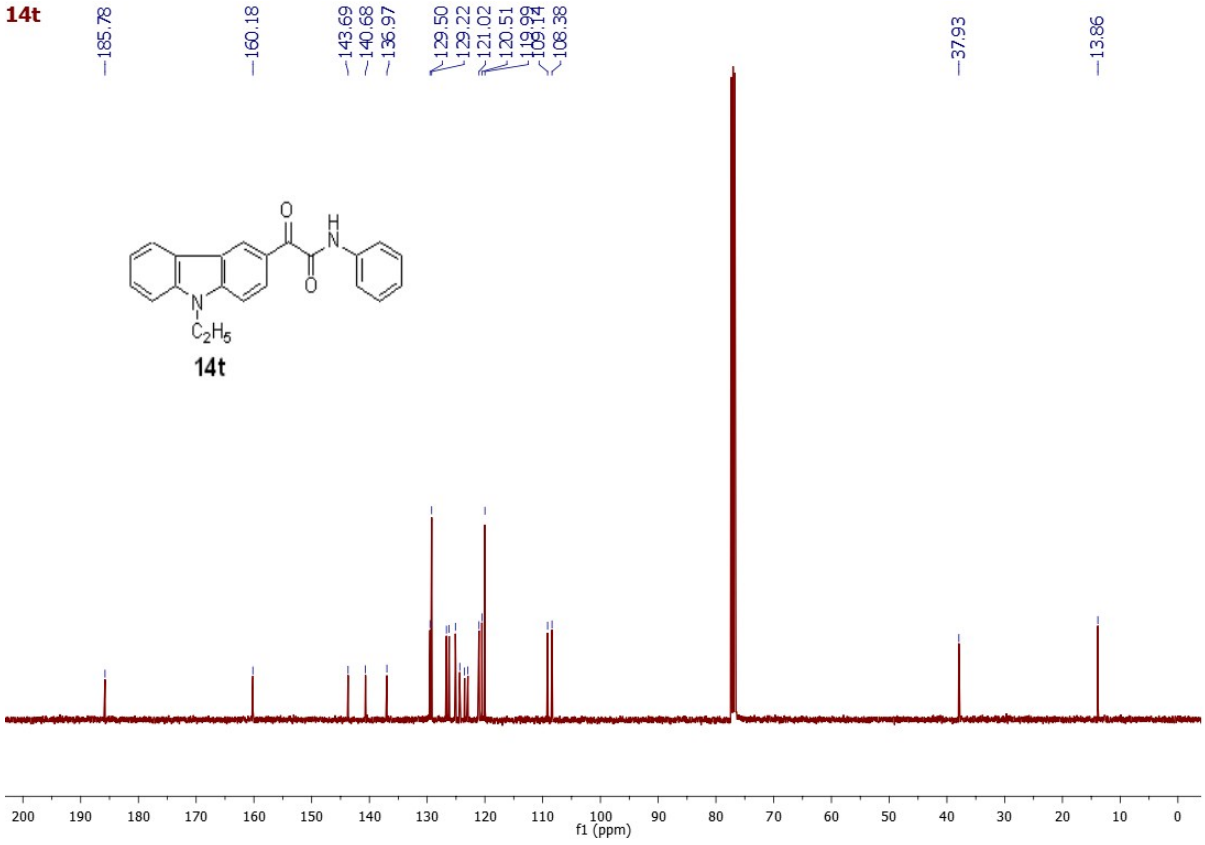
Processed Channel Descr.: PDA 301.6 nm

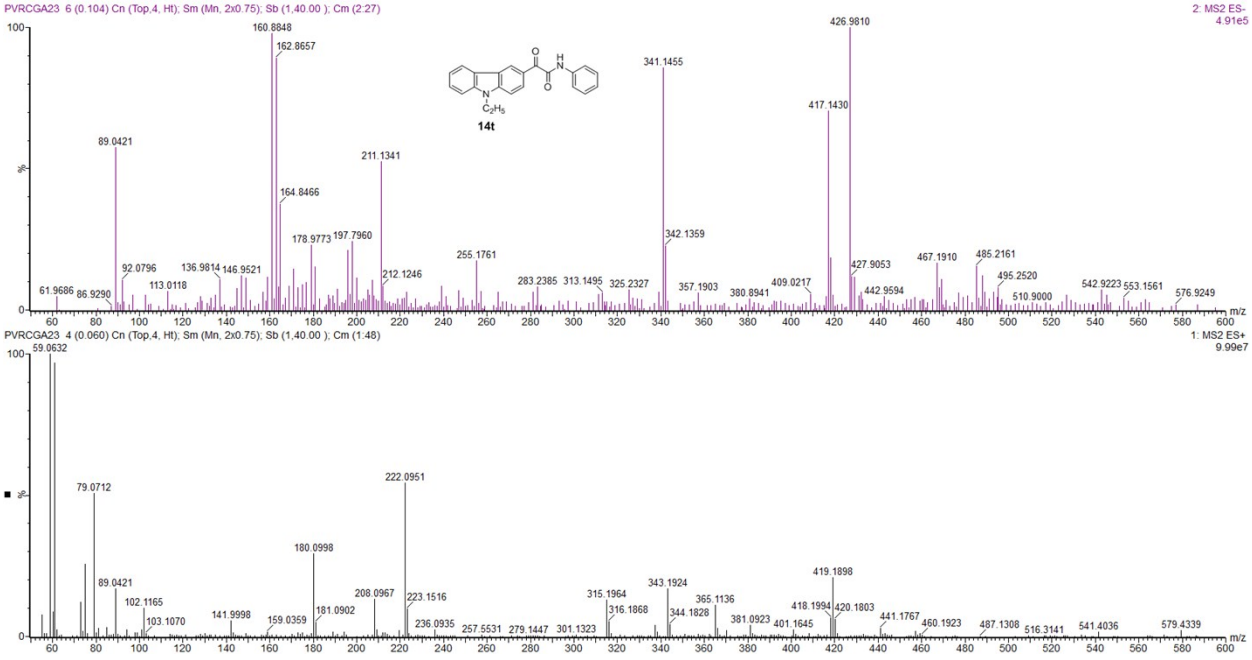
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 301.6 nm	2.662	2652	0.12	743
2	PDA 301.6 nm	2.837	2240394	99.34	1285205
3	PDA 301.6 nm	3.268	8284	0.37	5638
4	PDA 301.6 nm	3.478	3848	0.17	601

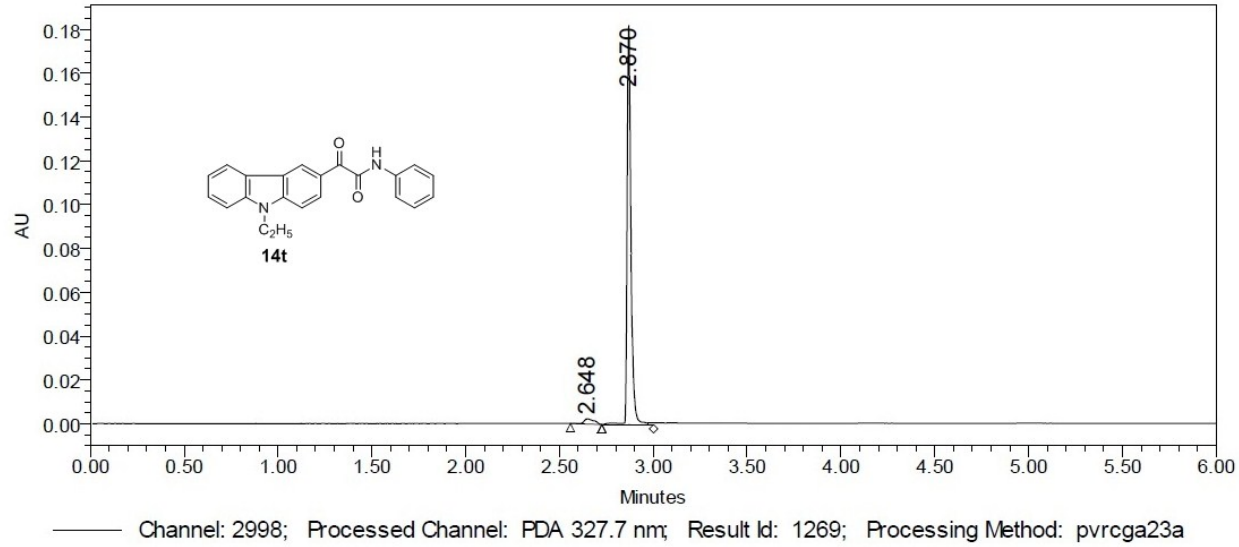
14t


9.44
9.44
9.18
8.63
8.61
8.61
8.21
7.80
7.78
7.56
7.56
7.55
7.49
7.48
7.47
7.45
7.43
7.37
7.35
7.28
7.25
4.43
4.41
4.39
1.51
1.50
1.48
O
H
N
O
N
C2H5
14t
1.00
1.00
1.03
1.06
2.13
1.13
4.34
1.14
1.09
2.27
3.28
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)

14t


185.78
160.18
143.69
140.68
136.97
129.50
129.22
121.02
120.51
119.99
109.14
108.38
37.93
13.86
O
H
N
O
N
C2H5
14t
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

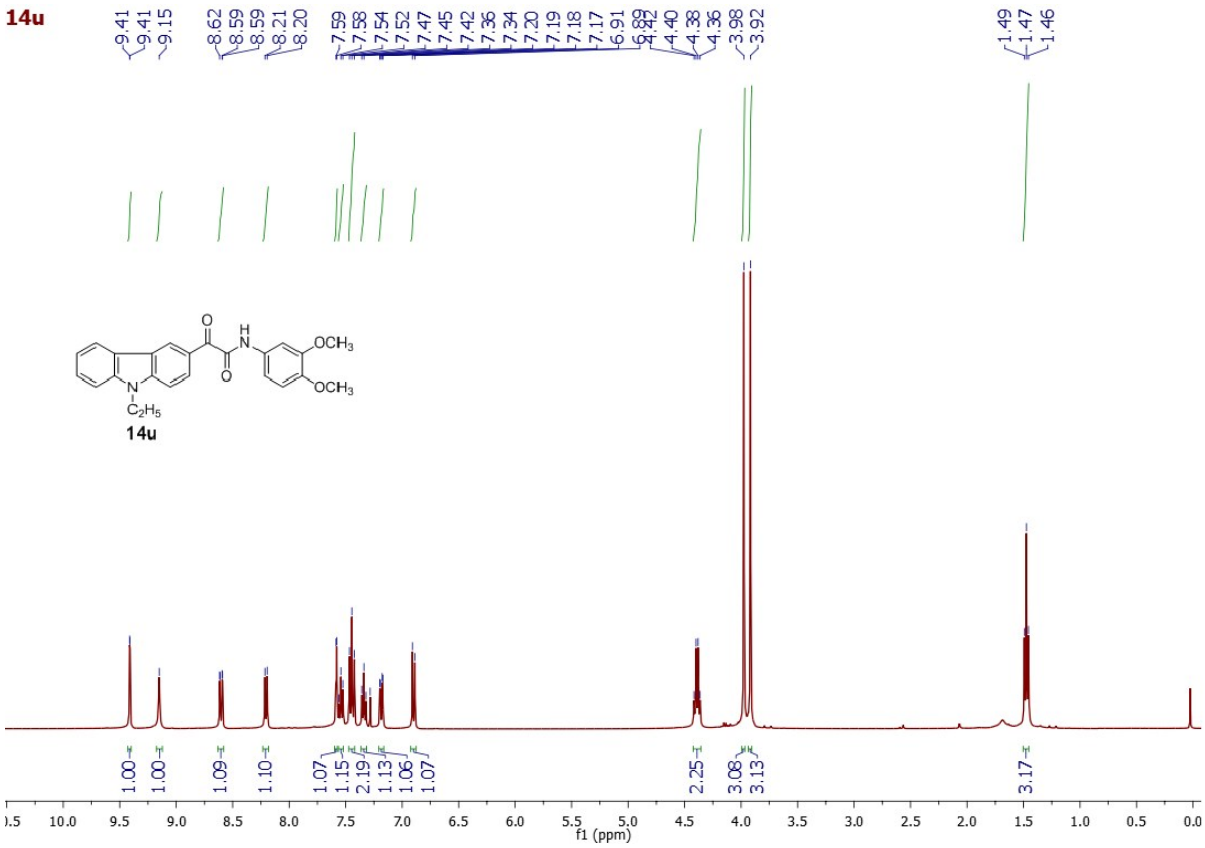


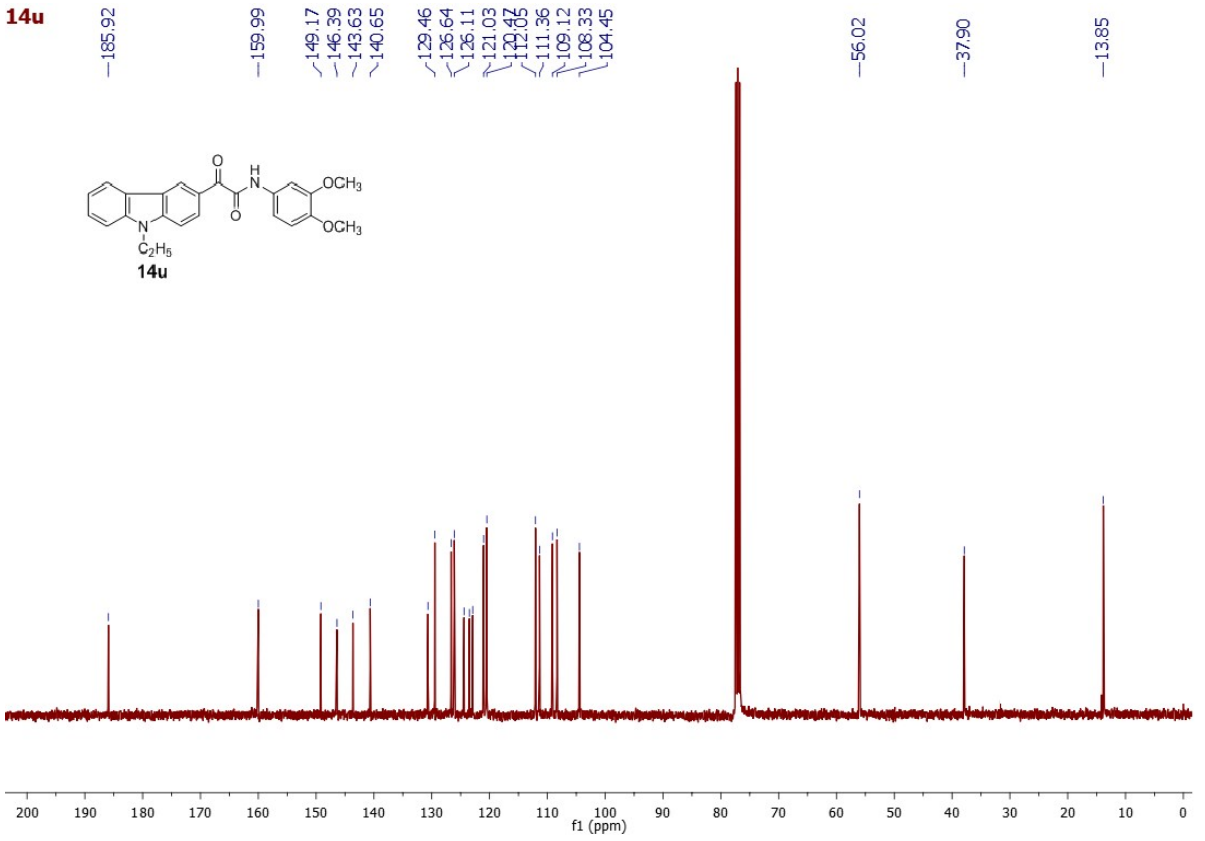


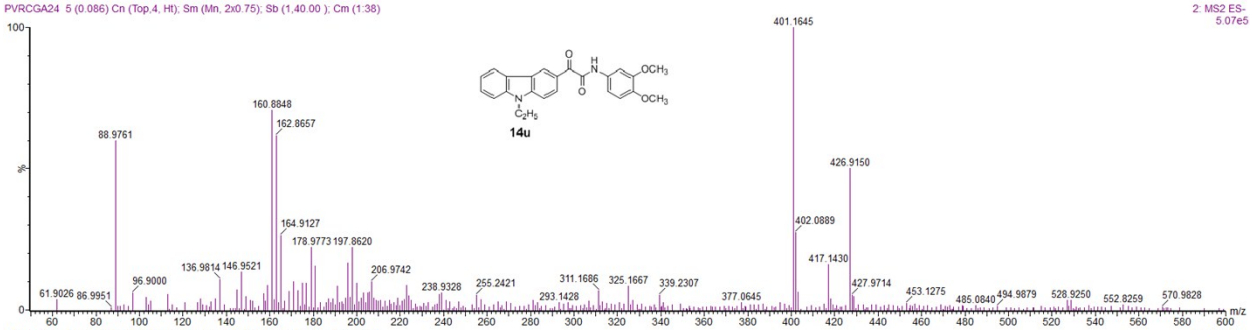
Channel: 2998; Processed Channel: PDA 327.7 nm; Result Id: 1269; Processing Method: pvrcga23a

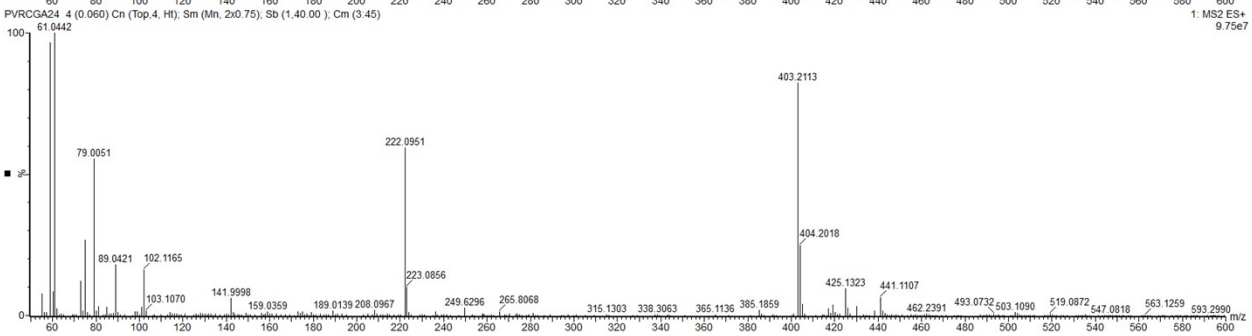
Processed Channel Descr.: PDA 327.7 nm

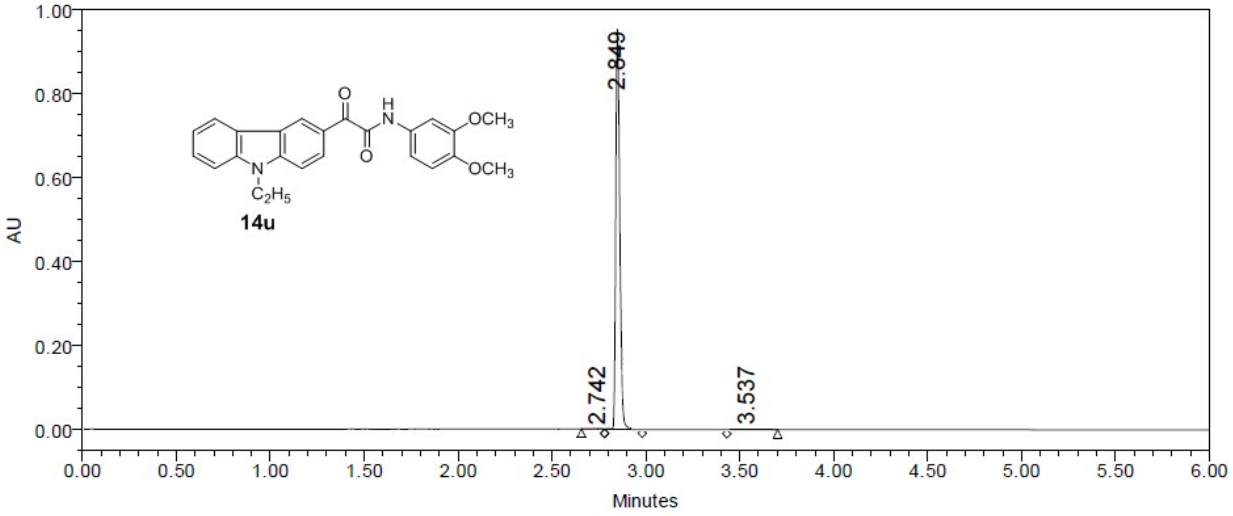
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 327.7 nm	2.648	9252	1.26	2411
2	PDA 327.7 nm	2.870	725065	98.74	182260


14u
9.41
9.41
9.15
8.62
8.59
8.59
8.21
8.20
7.59
7.58
7.54
7.52
7.47
7.45
7.42
7.36
7.34
7.20
7.19
7.18
7.17
6.91
4.40
4.38
4.36
3.98
3.92
1.49
1.47
1.46
OCH3
OCH3
C2H5
14u
1.00
1.00
1.09
1.10
1.07
1.15
2.19
1.13
1.06
1.07
2.25
3.08
3.13
3.17
f1 (ppm)


14u
185.92
159.99
149.17
146.39
143.63
140.65
129.46
126.64
126.11
121.03
120.47
112.05
111.36
109.12
108.33
104.45
56.02
37.90
13.85
OCH3
OCH3
C2H5
14u
f1 (ppm)



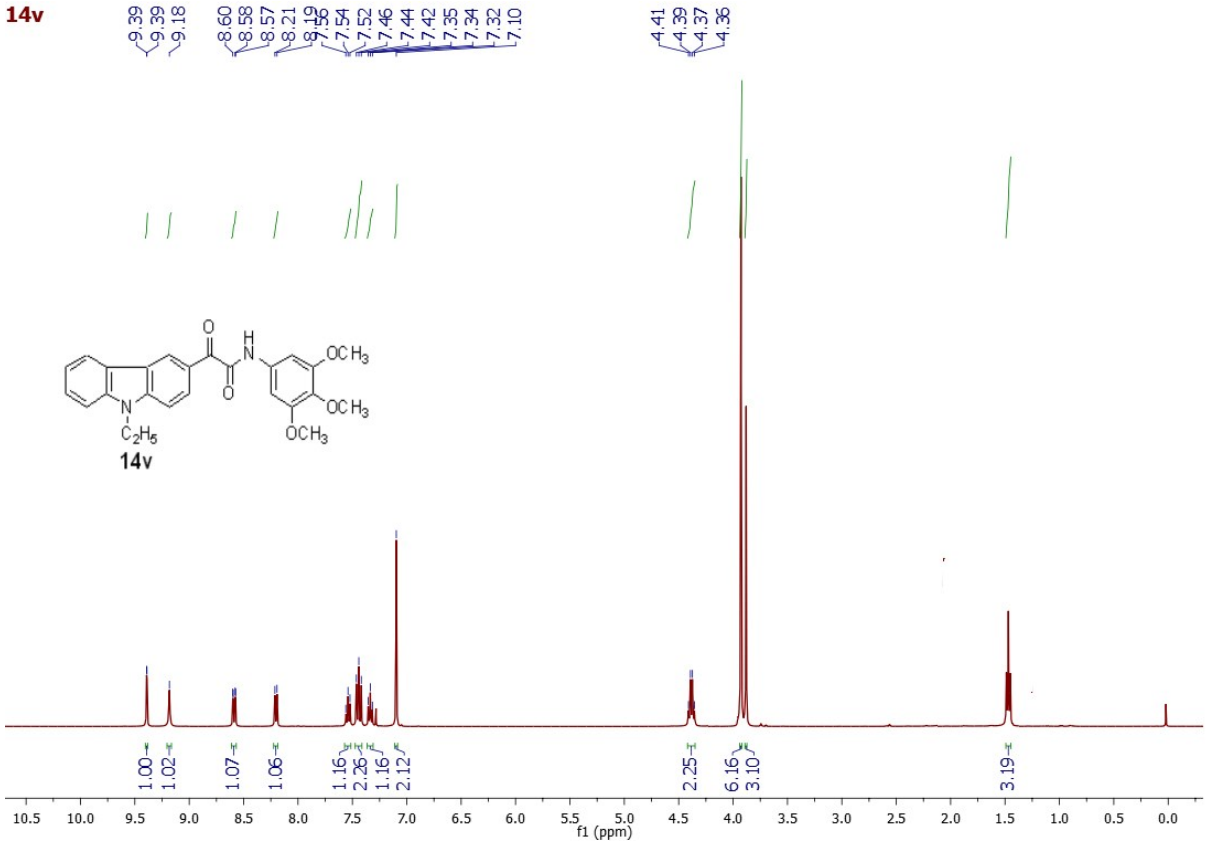


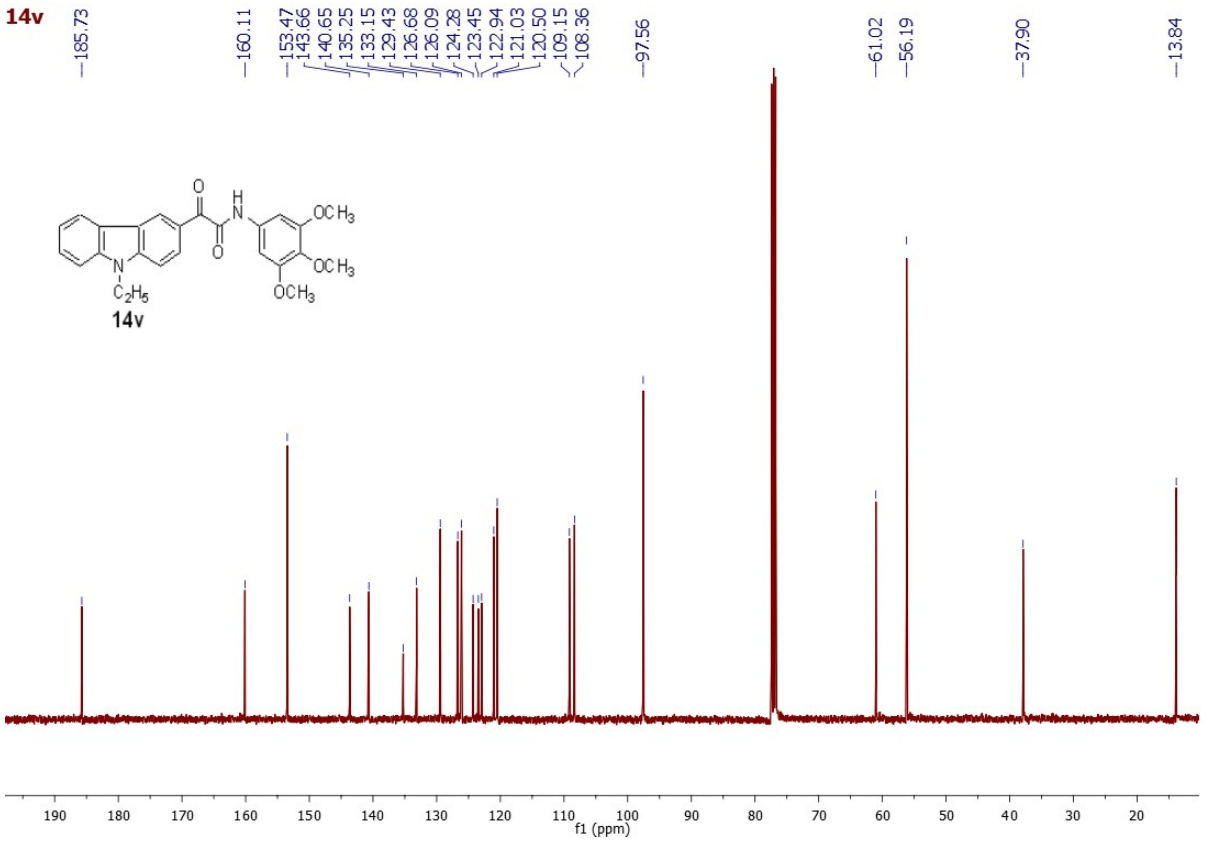


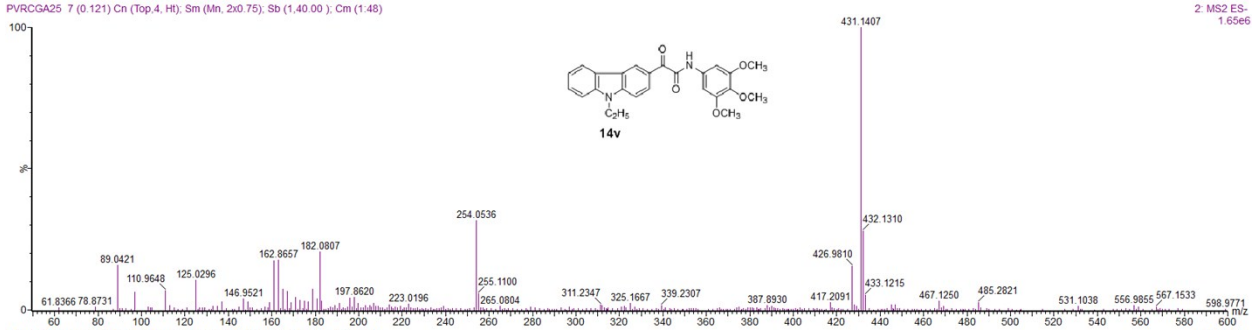
Channel: 2998; Processed Channel: PDA 311.7 nm; Result Id: 1188; Processing Method: pvrcga24

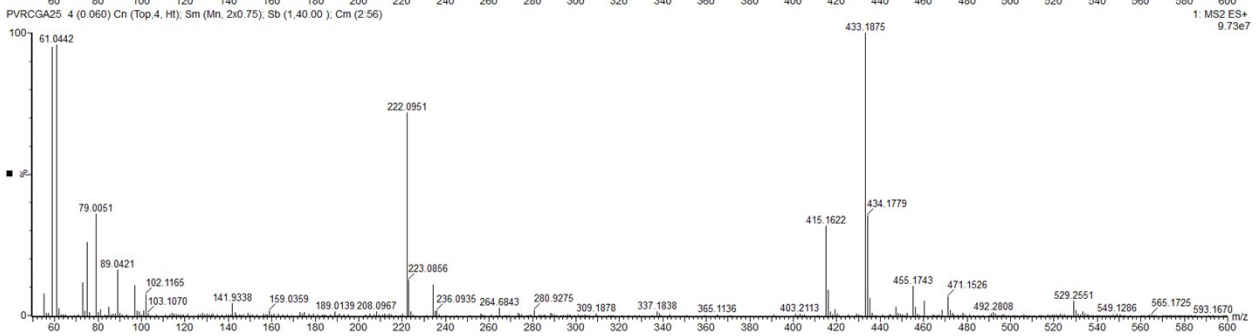
Processed Channel Descr.: PDA 311.7 nm

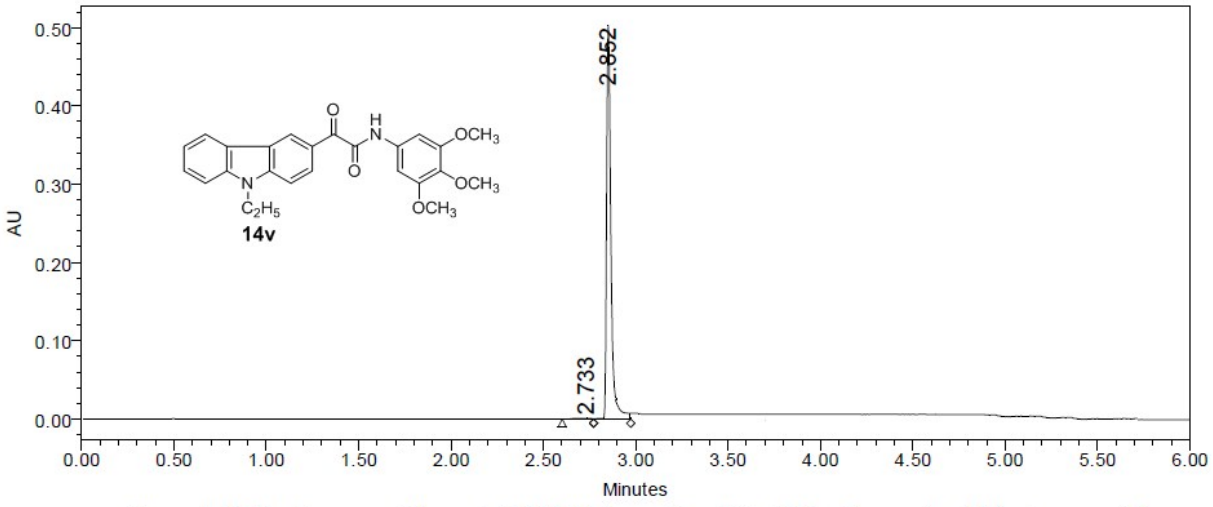
	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 311.7 nm	2.742	2652	0.16	703
2	PDA 311.7 nm	2.849	1630950	99.51	952856
3	PDA 311.7 nm	3.537	5356	0.33	1029


14v
9.39
9.39
9.18
8.60
8.58
8.57
8.21
8.19
7.56
7.54
7.52
7.46
7.44
7.42
7.35
7.34
7.32
7.10
4.41
4.39
4.37
4.36
OCH3
OCH3
OCH3
N
C2H5
14v
1.00
1.02
1.07
1.06
1.16
2.26
1.16
2.12
2.25
6.16
3.10
3.19
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


14v
185.73
160.11
153.47
143.66
140.65
135.25
133.15
129.43
126.68
126.09
124.28
123.45
122.94
121.03
120.50
109.15
108.36
97.56
61.02
56.19
37.90
13.84
OCH3
OCH3
OCH3
N
C2H5
14v
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

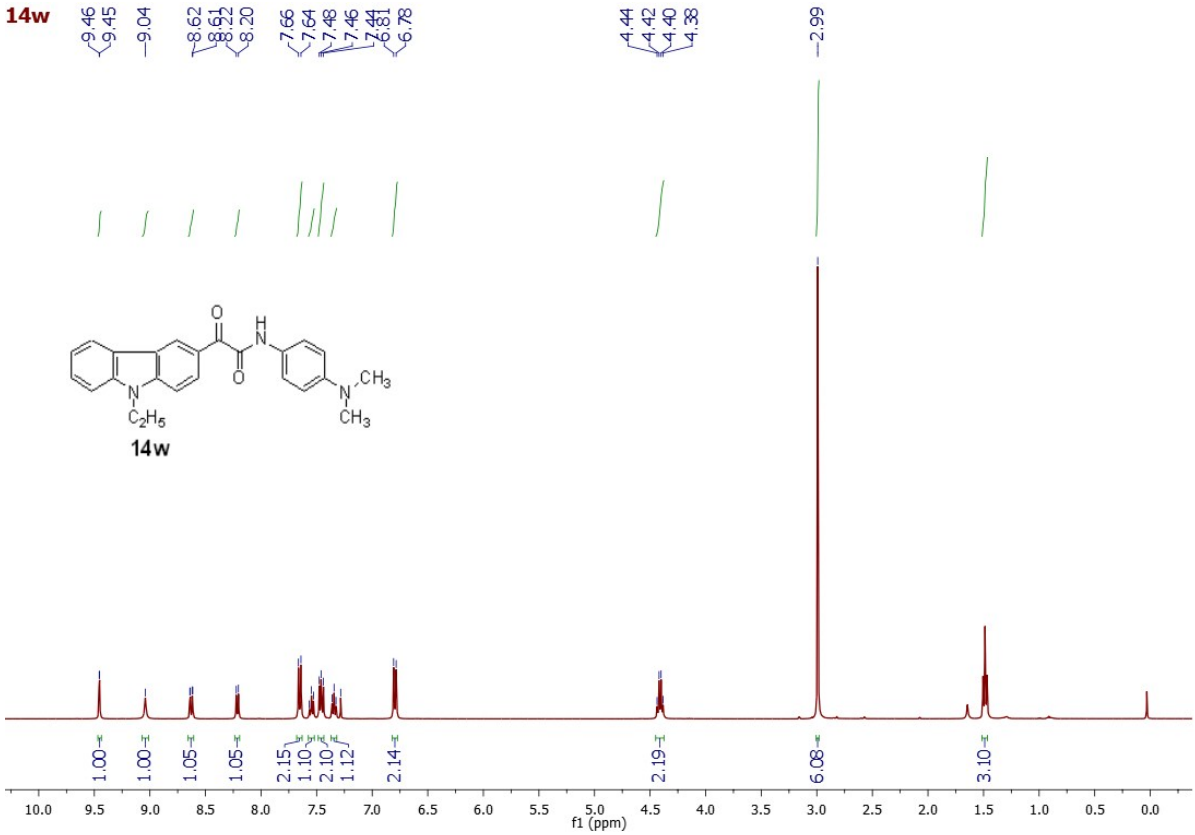


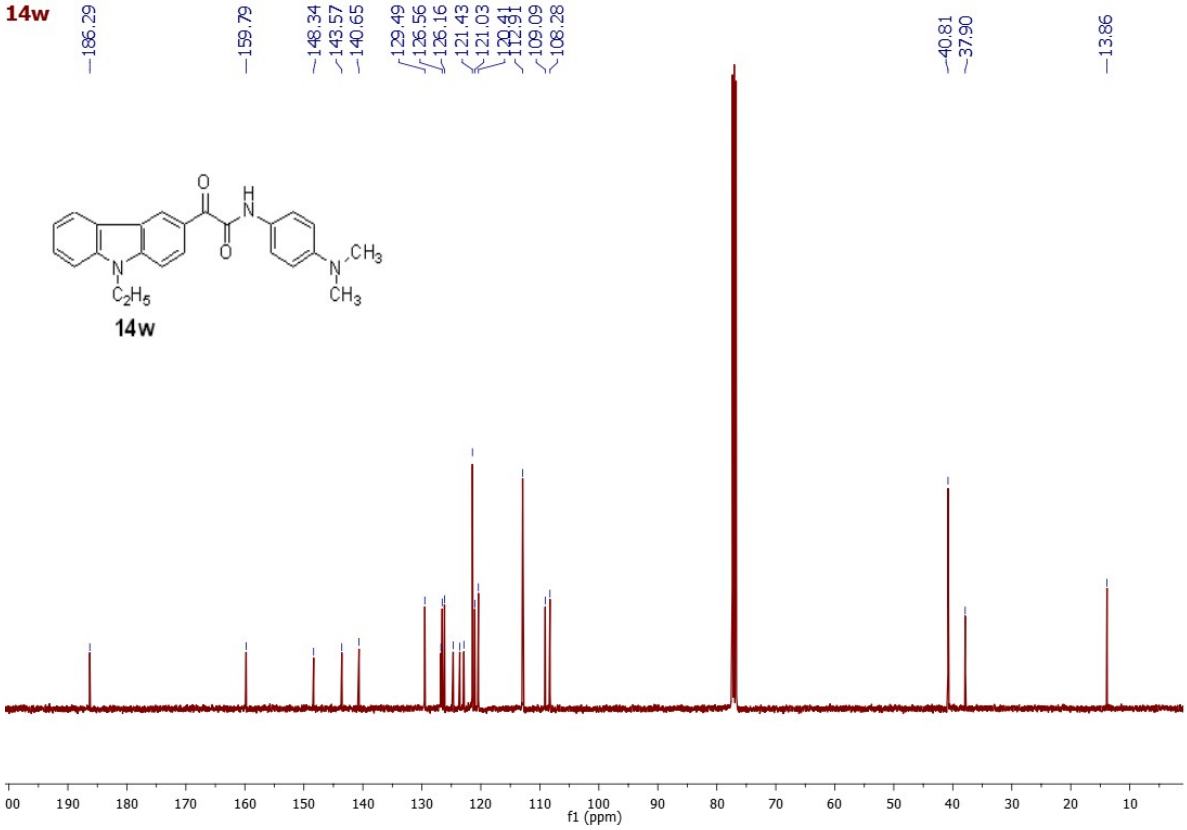


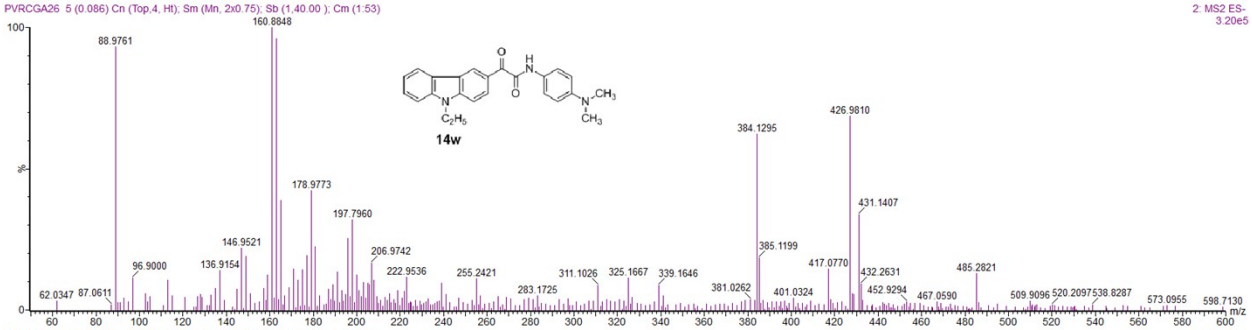


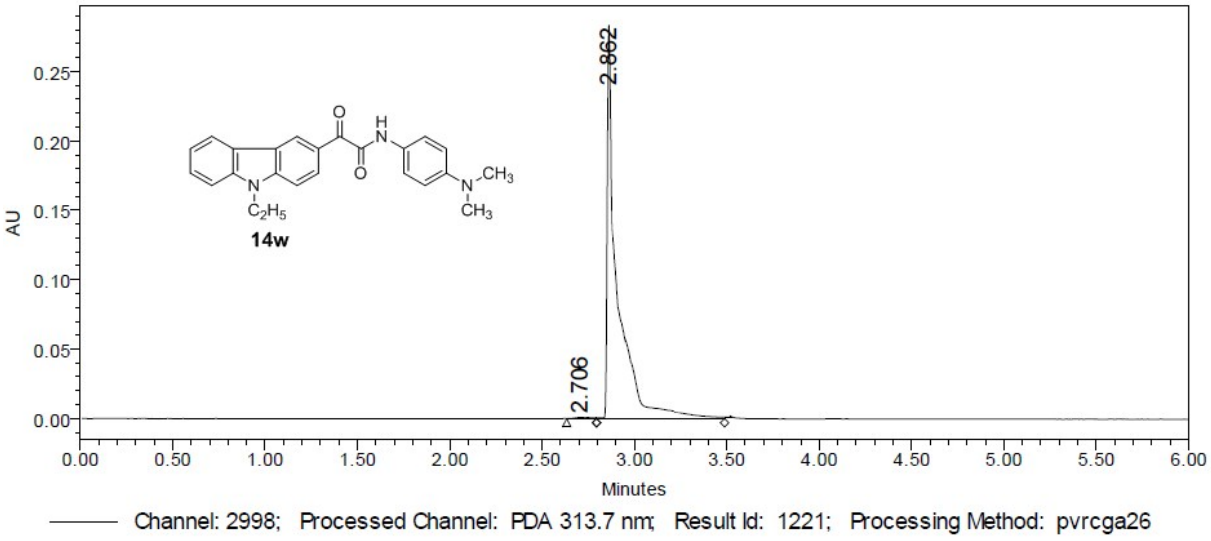
Processed Channel Descr.: PDA 331.8 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 331.8 nm	2.733	3549	0.40	615
2	PDA 331.8 nm	2.852	887485	99.60	502696


14w
9.46
9.45
9.04
8.62
8.61
8.22
8.20
7.66
7.64
7.48
7.46
7.44
6.81
6.78
4.44
4.42
4.40
4.38
2.99
1.00
1.00
1.05
1.05
2.15
1.10
2.10
1.12
2.14
2.19
6.08
3.10
f1 (ppm)
14w

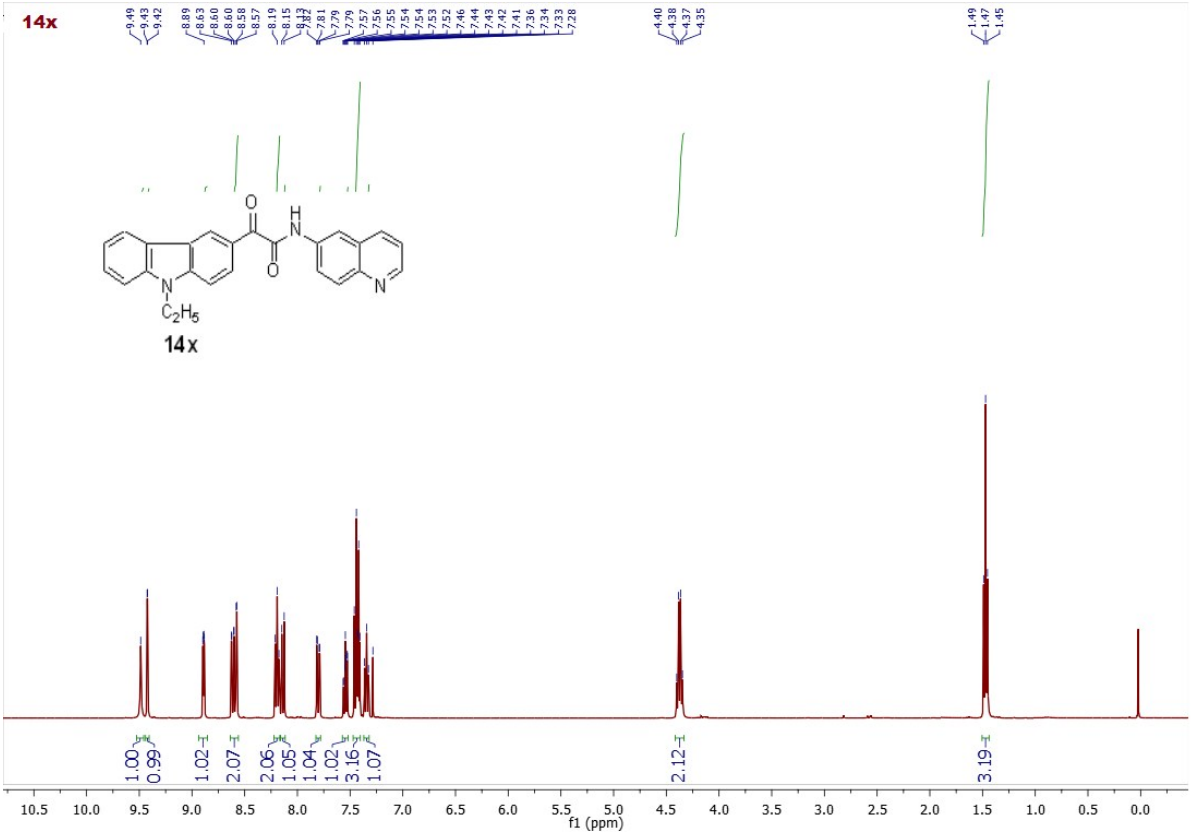

14w
186.29
159.79
148.34
143.57
140.65
129.49
126.56
126.16
121.43
121.03
112.91
109.09
108.28
40.81
37.90
13.86
f1 (ppm)
14w

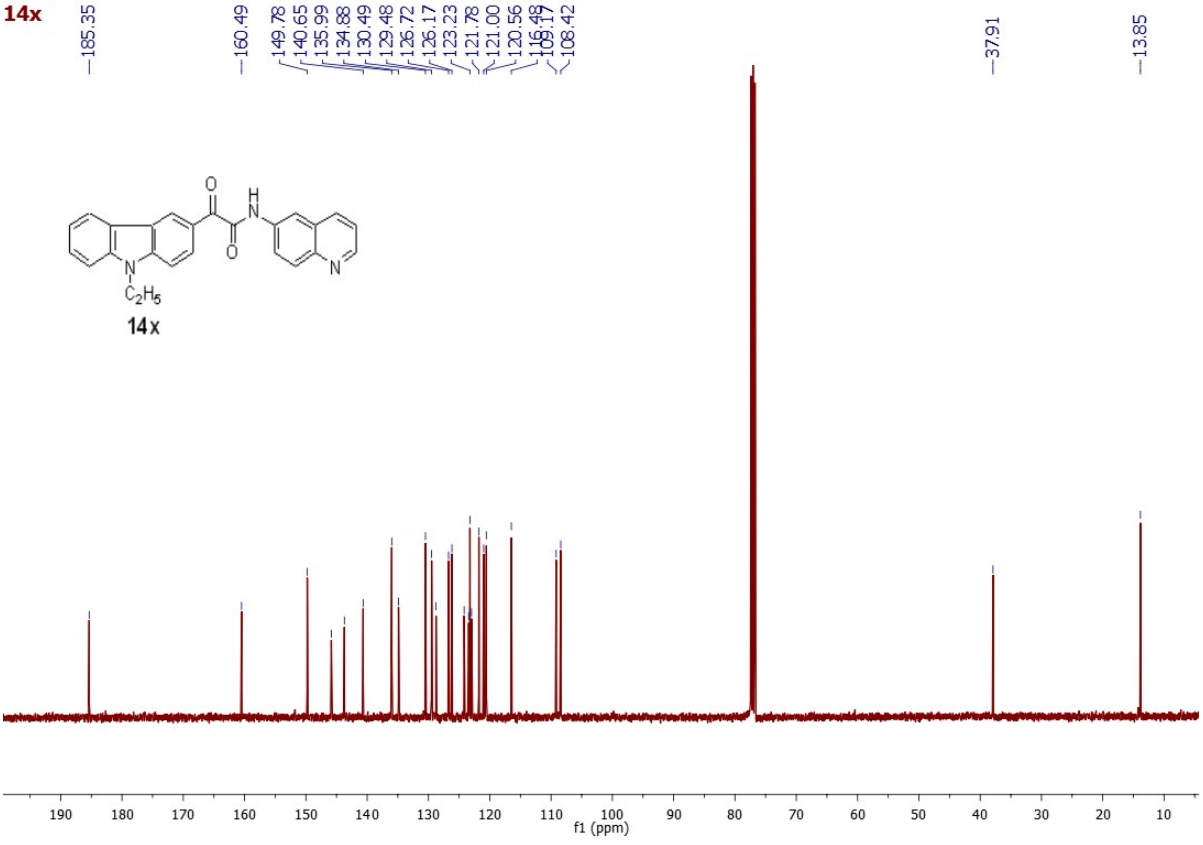


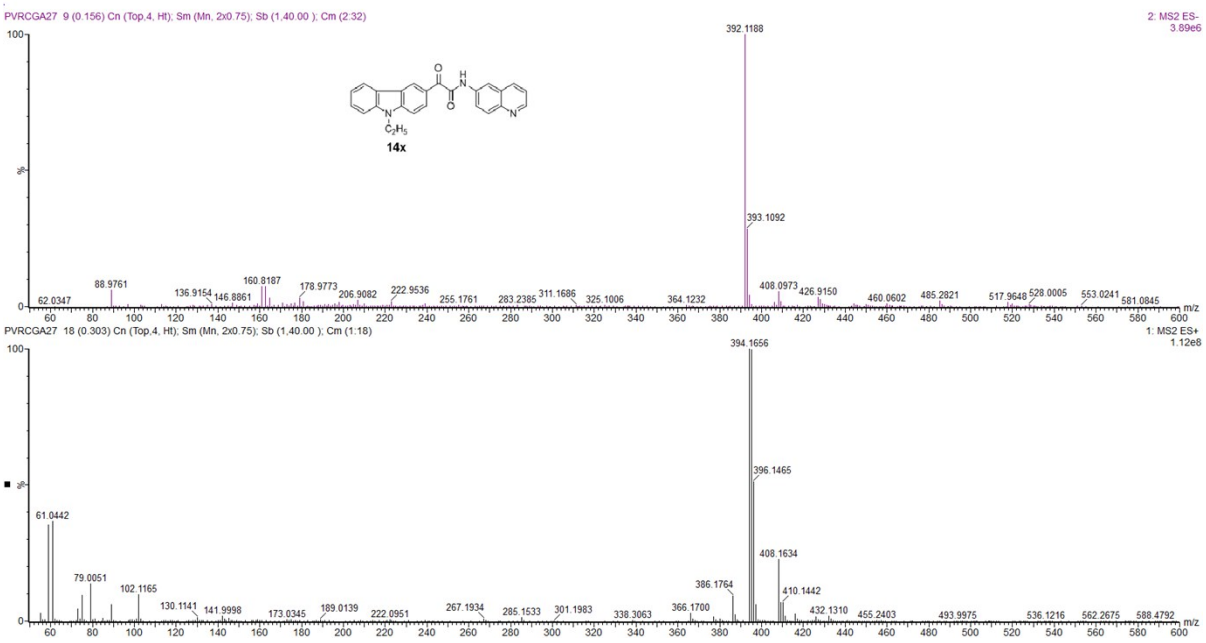


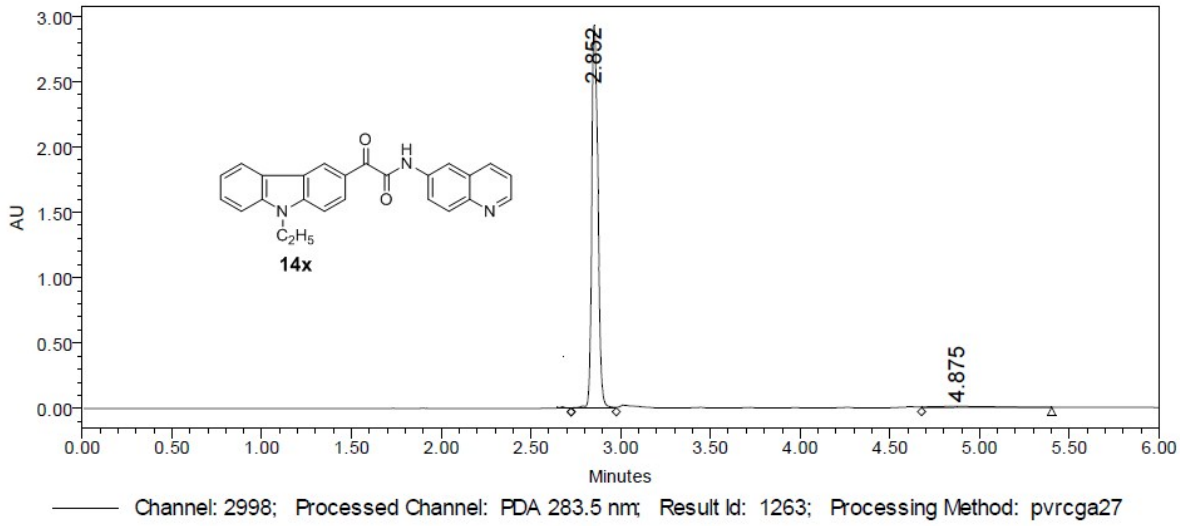
Processed Channel Descr.: PDA 313.7 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 313.7 nm	2.706	4387	0.29	733
2	PDA 313.7 nm	2.862	1492982	99.71	283845


14x
9.49
9.43
9.42
8.89
8.63
8.60
8.60
8.58
8.57
8.19
8.15
7.81
7.79
7.79
7.57
7.56
7.55
7.54
7.54
7.53
7.52
7.46
7.44
7.43
7.42
7.41
7.36
7.34
7.33
7.28
4.40
4.38
4.37
4.35
1.49
1.47
1.45
O
H
N
O
N
C_2H_5
14x
1.00
0.99
1.02
2.07
2.06
1.05
1.04
1.02
3.16
1.07
2.12
3.19
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


14x
185.35
160.49
149.78
140.65
135.99
134.88
130.49
129.48
126.72
126.17
123.23
121.78
121.00
120.56
116.48
108.42
37.91
13.85
O
H
N
O
N
C_2H_5
14x
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)





Channel: 2998; Processed Channel: PDA 283.5 nm; Result Id: 1263; Processing Method: pvrcga27

Processed Channel Descr.: PDA 283.5 nm

	Processed Channel Descr.	RT	Area	% Area	Height
1	PDA 283.5 nm	2.852	10195647	98.11	2930724
2	PDA 283.5 nm	4.875	195974	1.89	8858