Supporting Information

Ligand-free copper-catalyzed efficient one-pot access of benzo[*b*]pyrido[3,2-*f*][1,4]oxazepinones through *O*-heteroarylation-Smiles rearrangement-cyclization cascade

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2. General information: 2-Chloronicotinic acid, Cs_2CO_3, Cu_2O, DMF, *o*-bromophenols/naphthols and 2-bromo-3-hydroxypyridine were procured from Sigma-Aldrich Chemie GmbH, Germany, Spectrochem and SRL, India. IR spectra were recorded on Perkin-Elmer FTIR L120-000A. NMR spectra were measured on Bruker AM-300L (300 MHz) and Bruker DPX-400 (400 MHz) instruments. Applied Biosystems MDS Sciex API 3200 and QTOF micro^{TM} were used for recording mass spectra of the compounds. CHN elemental analyses were recorded on Perkin Elmer 2400 series II CHN analyzer. Silica gel (60-120 mesh, Spectrochem, India) was used for column chromatography. X-ray diffraction patterns were recorded on a Bruker Smart APEX II CCD detector. The structures were solved by SHELXS-97 (G. M. Sheldrick, *Acta Crystallogr. Sect. A*., 2008, **64**, 112-122) and refined by full matrix least squares based on $|Fobs|^2$ using SHELXL-97 programme. Chemical shifts of common trace impurities ($CDCl_3$, ppm) in some samples: H_2O, δ 1.56, $CHCl_3$, 7.26 and that of (DMSO-d_6, ppm): H_2O, δ 2.50; solvent residual peaks ~3.35.[1] In addition to this solvent impurities appeared at δ 1.26, 0.86 in some cases. Melting points were measured by open capillary method in metal bath, and are uncorrected. Light petrol used for chromatographic experiments refers to the fraction boiling at 60-80 ^oC. Crystallographic data for the structure reported here have been deposited with the Cambridge Crystallographic Data Centre.

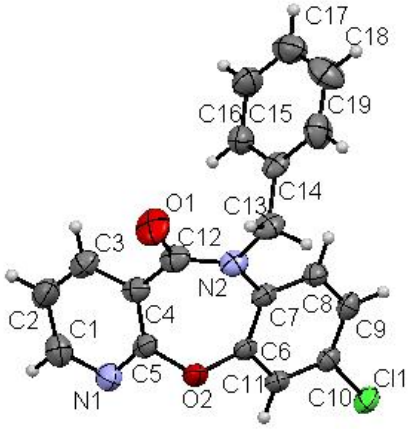
3. Crystallographic information Table for 3c (CCDC 994880) and 3i (CCDC 994881):

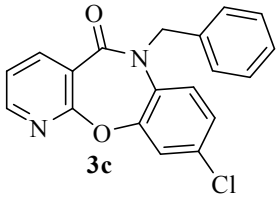
	3c	3i
Empirical formula	$C_{19}H_{13}ClN_2O_2$	$C_{19}H_{14}N_2O_2$
Formula weight	336.76	302.32
Crystal system	Monoclinic	Triclinic
Space group	P-21/c	P-1
a, Å	8.808 (4)	7.983 (2)
b, Å	19.723 (8)	8.944 (3)
c, Å	9.339 (4)	10.904 (3)
α, deg	90.00	101.512 (5)
β, deg	102.983 (10)	95.264 (6)
γ, deg	90.00	101.942 (5)
Volume	1580.8 (11)	739.1 (4)
Z	4	2
Density (calculated)	1.415 mg/m^3	1.358 mg/m^3
Wavelength	0.71073 Å	0.71073 Å
Temperature	293 (2) K	150 (2) K
F(000)	696	316
Absorption coefficient	0.255 mm^{-1}	0.090 mm^{-1}
θ range for data collection	2.37^o-25.00^o	1.92^o-25.00^o
Reflections collected	2646	2483
Independent reflections	1962	2259
R(*F* obsd data) [I > 2σ(I)]	0.1094	0.0698
wR(F^2 all data)	0.2726	0.2062
Goodness-of-fit on F^2	1.245	0.924
Largest diff. peak and hole	0.706 e/Å^3 to -1.147 e/Å^3	0.539 e/Å^3 to -0.445 e/Å^3

$wR2 = \{\Sigma [w(F_o^2 - F_c^2)^2] / \Sigma [w(F_o^2)^2]\}^{1/2}$

$R1 = \Sigma ||F_o| - |F_c|| / \Sigma |F_o|$

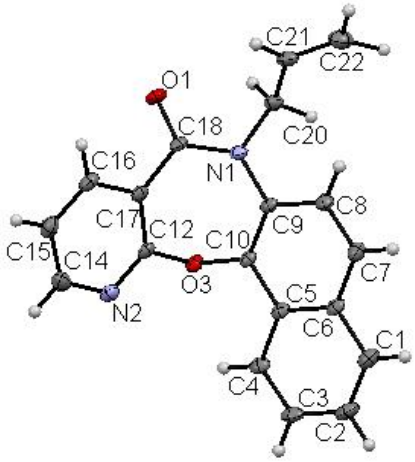
4. ORTEP diagrams of 3c and 3i. Ellipsoids are drawn at the 50% probability level.

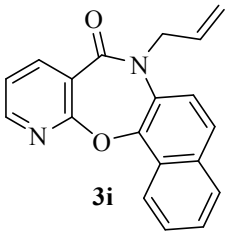




3c

3c





3i

3i

5. General procedure for the preparation of *N*-substituted-*o*-chloronicotinamides (1a-1d):

To a suspension of 2-chloronicotinic acid (5.00 mmol) in CH_2Cl_2 (15 mL) was added DMF (2 drops) followed by oxalyl chloride (0.5 mL, 6 mmol). The reaction mixture was stirred at room temperature for 4 hours, and then concentrated under reduced pressure. The acid chloride thus prepared was dissolved in CH_2Cl_2 (15 mL) at 0 °C and triethylamine (2.10 mL, 15.0 mmol) was added to it followed by benzylamine/allylamine/ethylamine/methylamine (7.50 mmol), as the case may be. The reaction mixture was allowed to warm to room temperature and stirred for further 15 hours. Water (30 mL) was added to quench the reaction and the mixture was then extracted with CH_2Cl_2 (3x25 mL). The combined organic extracts were washed with saturated Na_2CO_3 (2x10 mL), dried over $MgSO_4$, and concentrated in

vacuo. The crude product was purified by flash chromatography on silica gel, eluting with EtOAc/*n*-hexane/CH_2Cl_2, to afford *N*-substituted-*o*-chloronicotinamides (**1a-1d**).

Characterization data of *N*-substituted-2-chloronicotinamides

***N*-benzyl-2-chloronicotinamide (1a):** Off-white solid. m.p. 116-118 ^oC (Lit.[2] 120 ^oC); ^1H NMR (400 MHz, $CDCl_3$): δ 8.46 (dd, J = 4.8, 2 Hz, 1H), 8.14 (dd, J = 7.6, 2 Hz, 1H), 7.39-7.31 (m, 6H), 6.80 (br s, 1H), 4.68 (d, J = 5.6 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.7, 150.9, 147.2, 139.6, 137.3, 131.3, 128.8, 127.9, 127.8, 122.7, 44.3; IR (KBr): 3263, 3067, 3029, 2875, 1645, 1584, 1549, 1455, 1406, 1171, 1083, 1074, 971, 813 cm^{-1}.

***N*-allyl-2-chloronicotinamide (1b):** Pink solid. m.p. 68-70 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ 8.47 (dd, J = 4.8, 2 Hz, 1H), 8.13 (dd, J = 7.6, 1.6 Hz, 1H), 7.36 (dd, J = 7.6, 4.8 Hz, 1H), 6.62 (br s, 1H), 6.00-5.90 (m, 1H), 5.33 (d, J =17.2 Hz, 1H), 5.23 (d, J = 10 Hz, 1H), 4.14-4.11 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.7, 150.7, 147.1, 139.3, 133.2, 131.4, 122.7, 117.0, 42.5; IR (KBr): 3272, 3047, 3029, 2812, 1643, 1580, 1536, 1406, 1304, 1168, 1083, 991, 939, 821, 741 cm^{-1}.

2-Chloro-*N*-ethylnicotinamide (1c)[3]: Colourless oil; ^1H NMR (400 MHz, $CDCl_3$): δ 8.72 (dd, J = 4.8, 2 Hz, 1H), 8.34 (dd, J = 7.6, 2 Hz, 1H), 7.61 (dd, J = 7.6, 4.8 Hz, 1H), 6.83 (br s, 1H), 3.83-3.76 (m, 2H), 1.59-1.54 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.8, 150.5, 147.1, 139.0, 131.8, 122.6, 35.1, 14.5; IR (KBr): 3272, 3077, 3029, 2979, 2937, 1646, 1583, 1556, 1400, 1313, 1175, 1077, 873, 752 cm^{-1}.

2-Chloro-*N*-methylnicotinamide (1d): White solid. m.p. 94-96 ^oC (Lit.[4] 90-92 °C); ^1H NMR (400 MHz, $CDCl_3$): δ 8.58 (dd, J = 4.8, 2 Hz, 1H), 8.25 (dd, J = 7.6, 2 Hz, 1H), 7.47 (dd, J = 7.6, 4.8 Hz, 1H), 6.67 (br s, 1H), 3.18-3.17 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 165.6, 150.7, 147.1, 139.2, 131.6, 122.7, 26.9; IR (KBr): 3281, 3084, 2944, 1652, 1585, 1556, 1402, 1322, 1178, 1082, 1000, 843, 750 cm^{-1}.

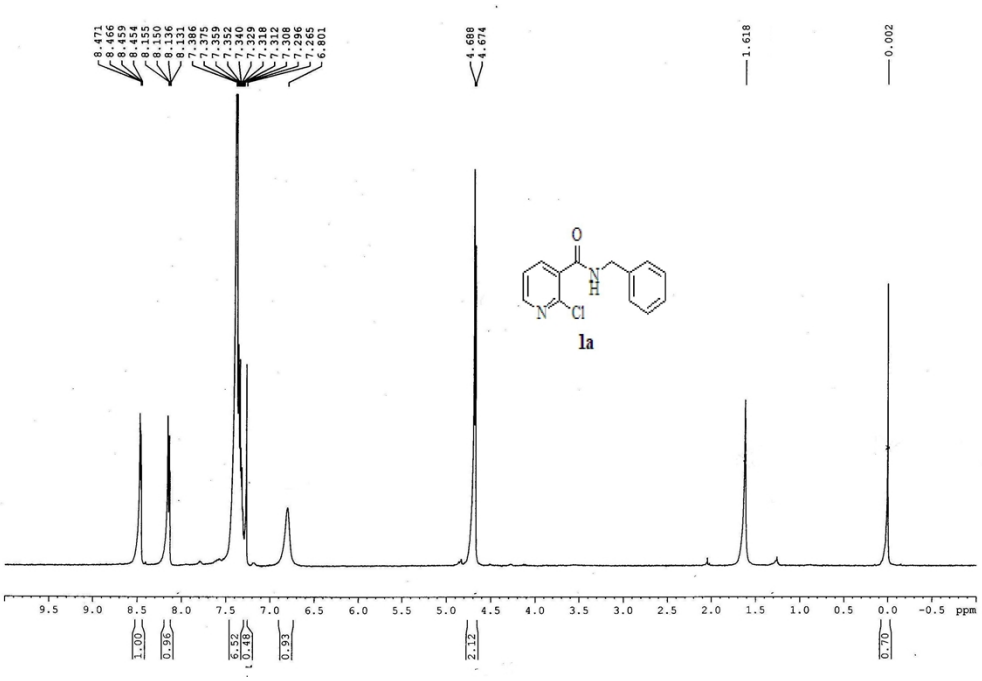
6. Typical procedure for the preparation of 2-nitropyridin-3-ol (2k): 3-Hydroxypyridine (960 mg, 0.01 mole) was added gradually to ice-cooled concentrated sulfuric acid (6.5 mL) with constant stirring. The addition took 20 min and the internal temperature was not allowed to exceed 30 ^oC. A cold mixture of nitric acid (0.5 mL) (sp gr 1.50) and concentrated sulfuric acid (0.9 mL) was poured gradually over 30 min without external cooling maintaining the temperature at 40-45 ^oC. The mixture was allowed to stand overnight. Then poured into a

mixture of ice and water (15 g) and neutralized using $NaHSO_4$ to obtain final pH ca. 4. The mixture was extracted with CH_2Cl_2 (5x20 mL), dried over Na_2SO_4, and the solvent was removed at reduced pressure leaving a yellow crystalline product (1.05 g, 75% yield) mp: 64-66 ^oC (lit.[5] 67-69 ^oC).

IR (KBr): 3083, 2919, 2738, 1615, 1568, 1535, 1464, 1361, 1328, 1254, 1200, 1140, 1106, 1056, 875, 818 cm^{-1}.

7. Copies of ^{1}H and ^{13}C NMR spectra:

^{1}H-NMR of 1a



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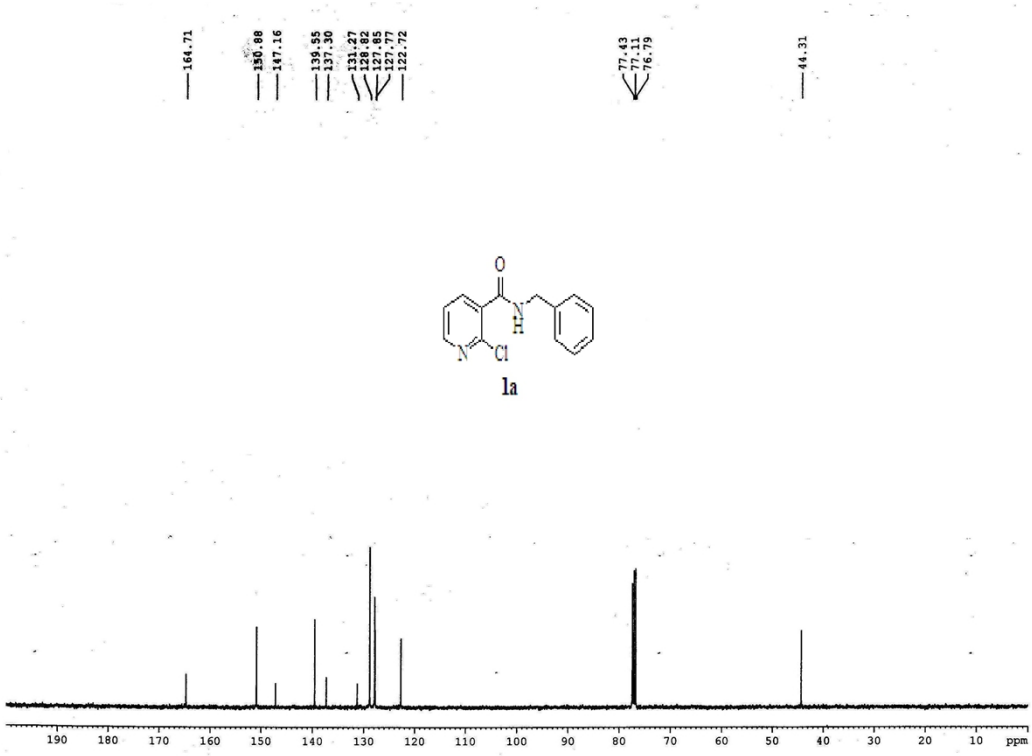

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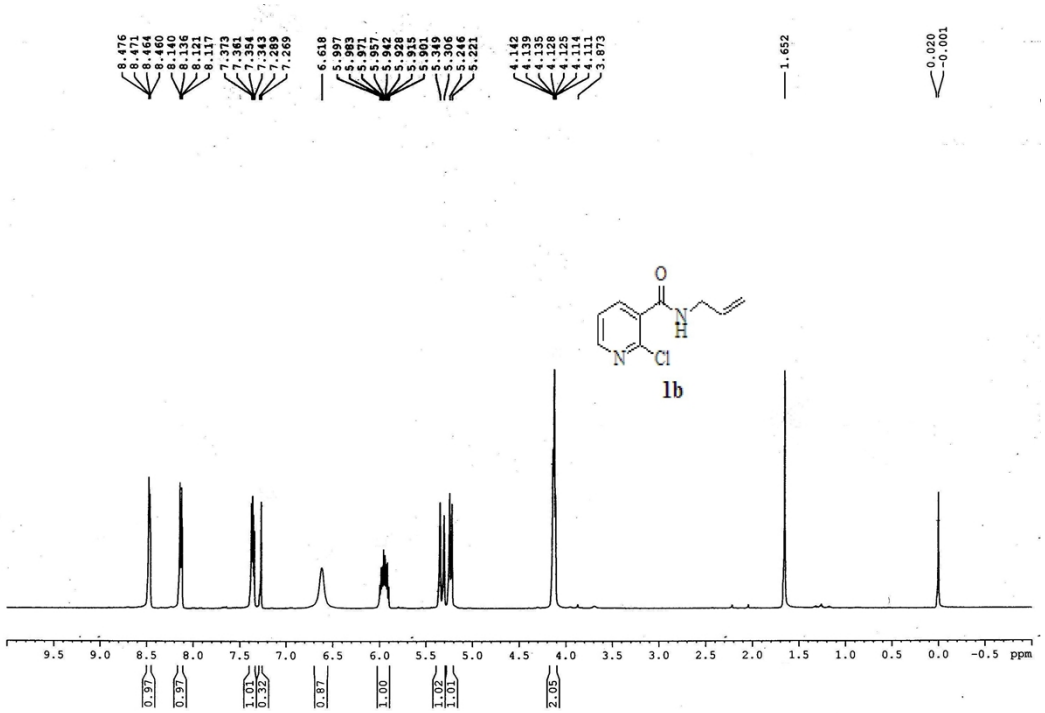

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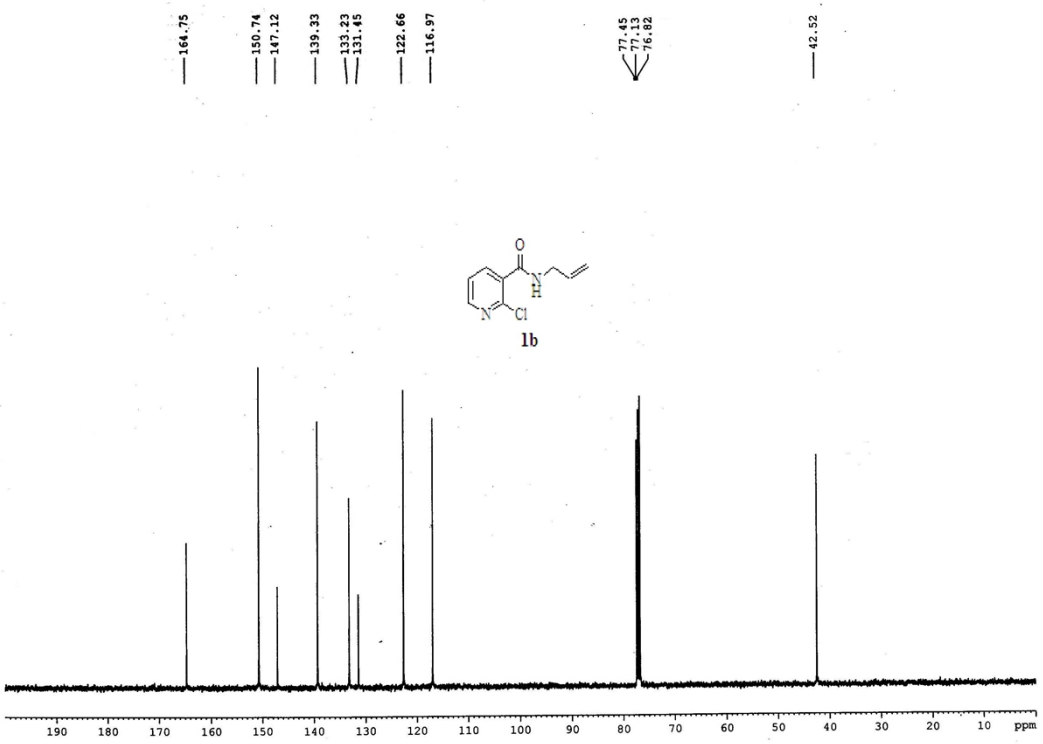

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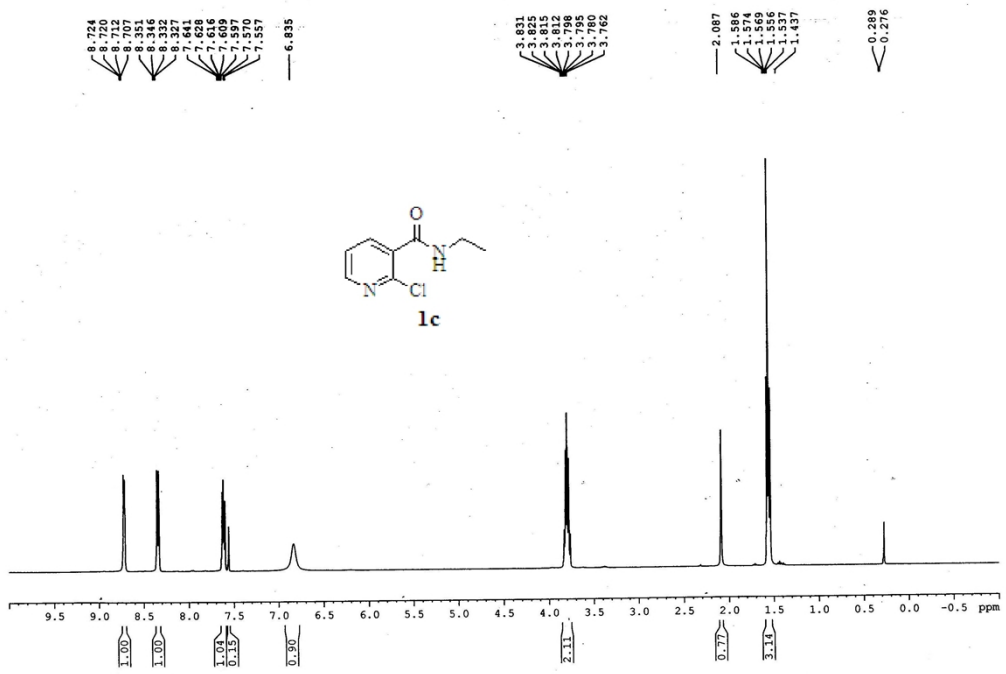

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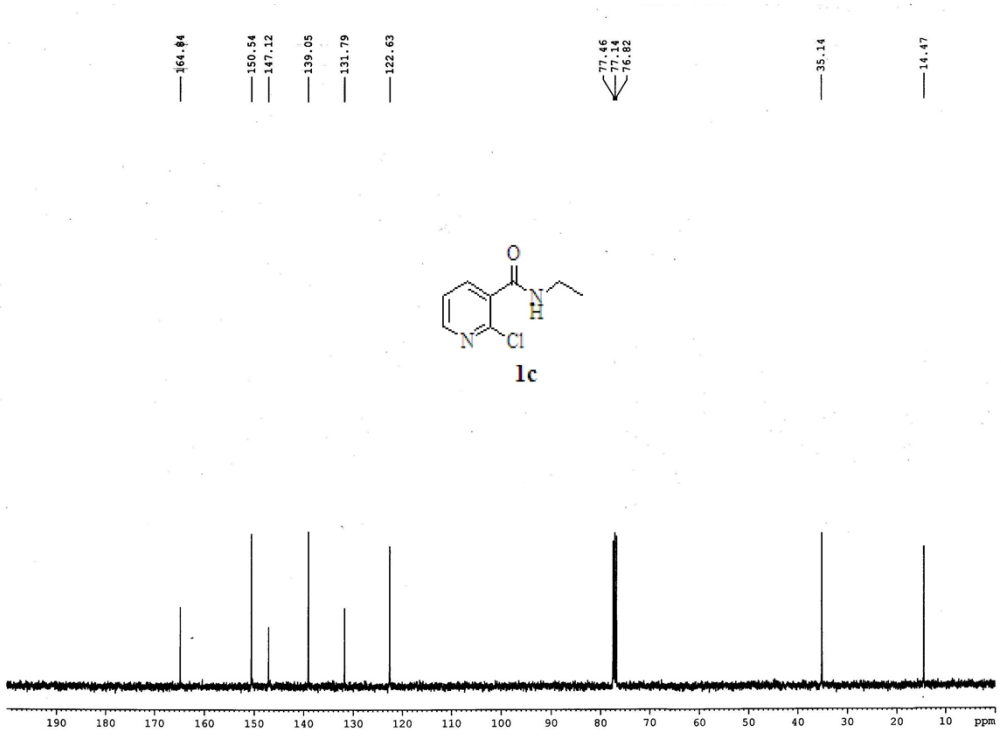

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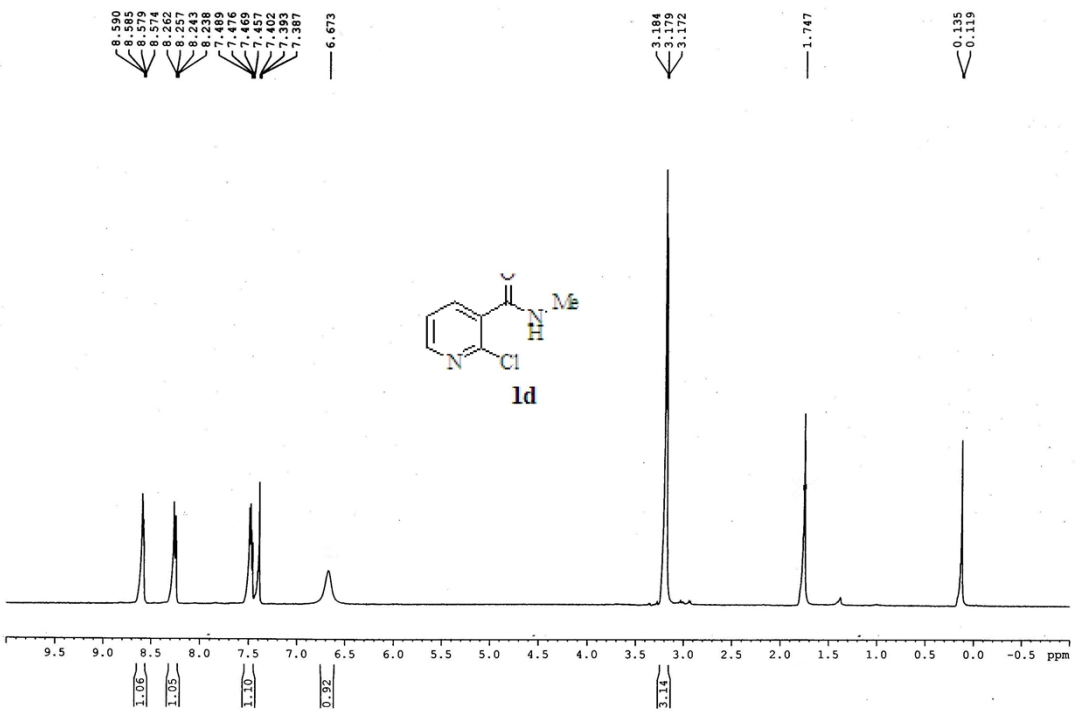

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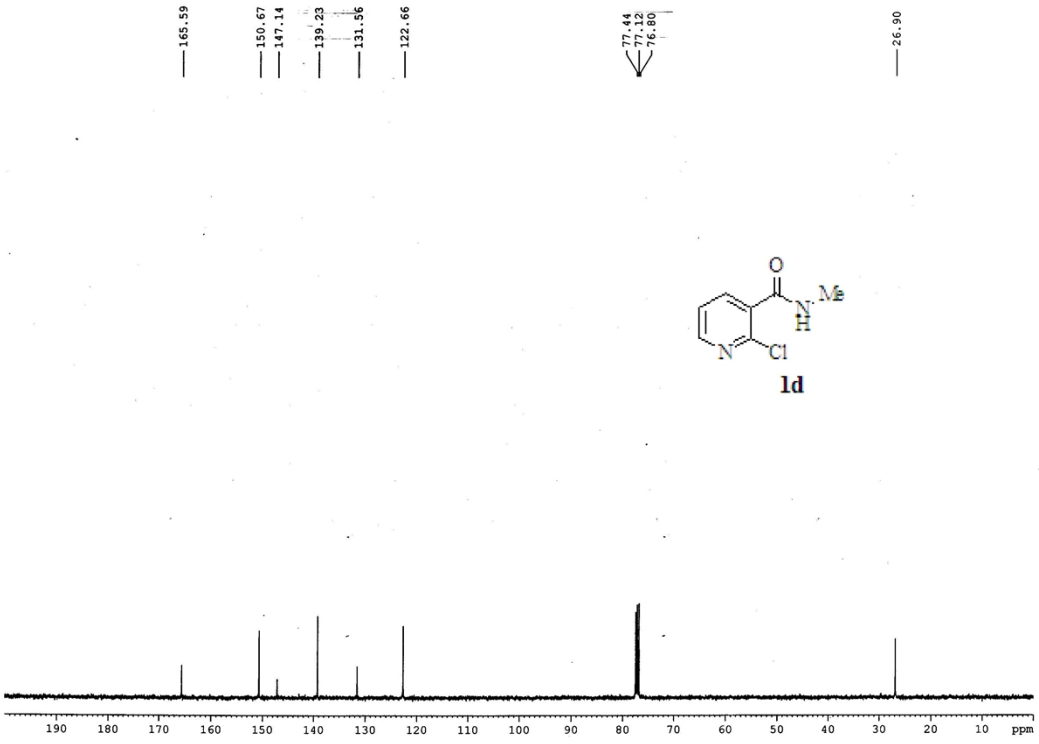

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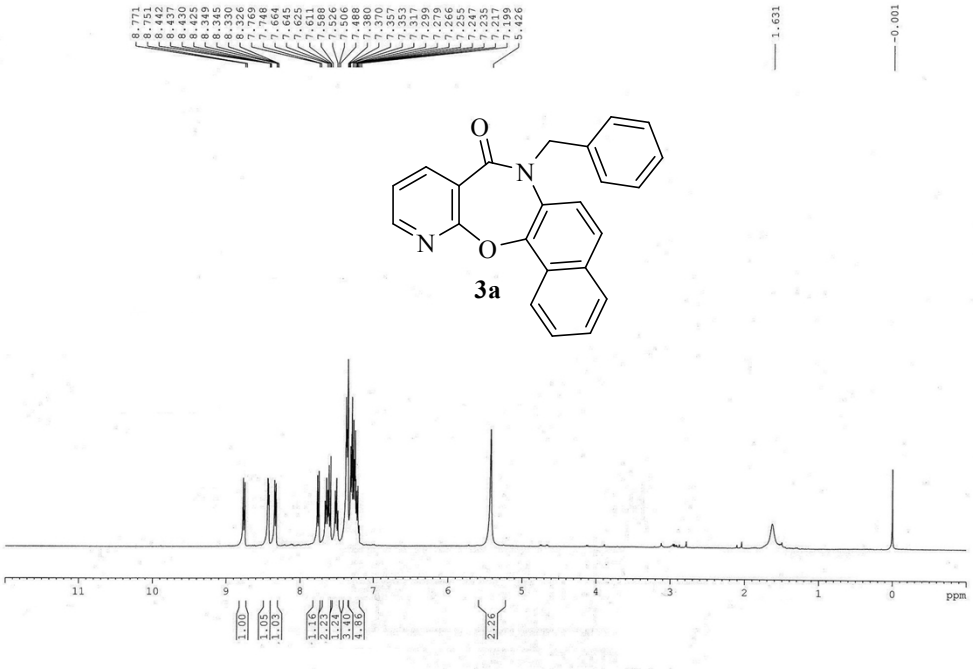

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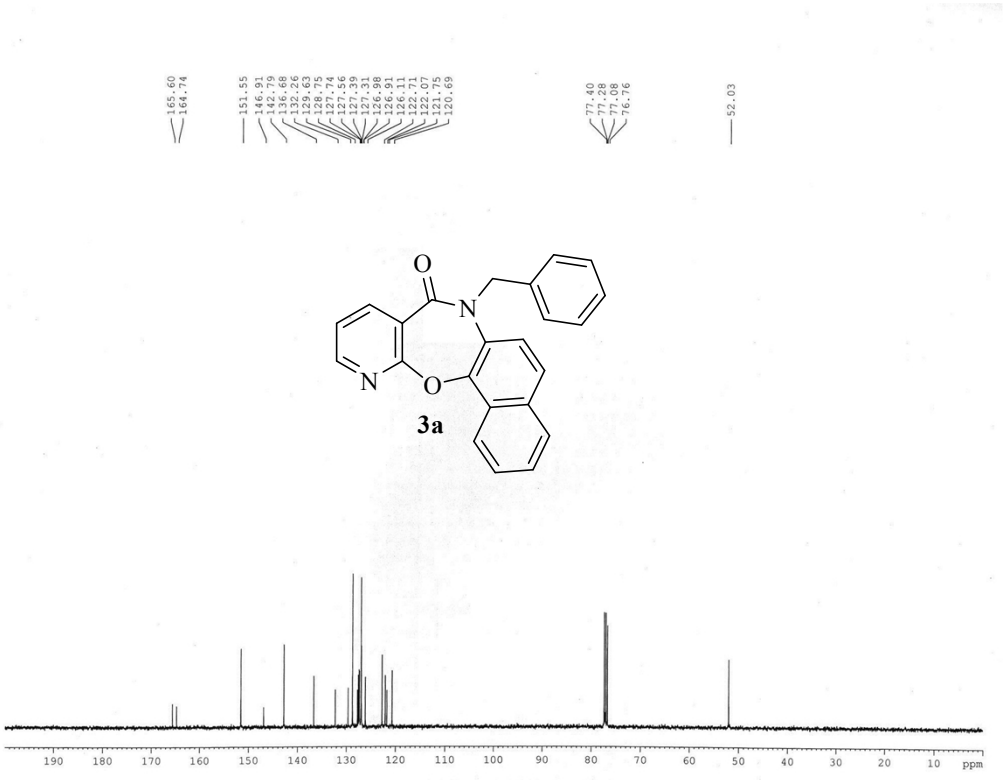

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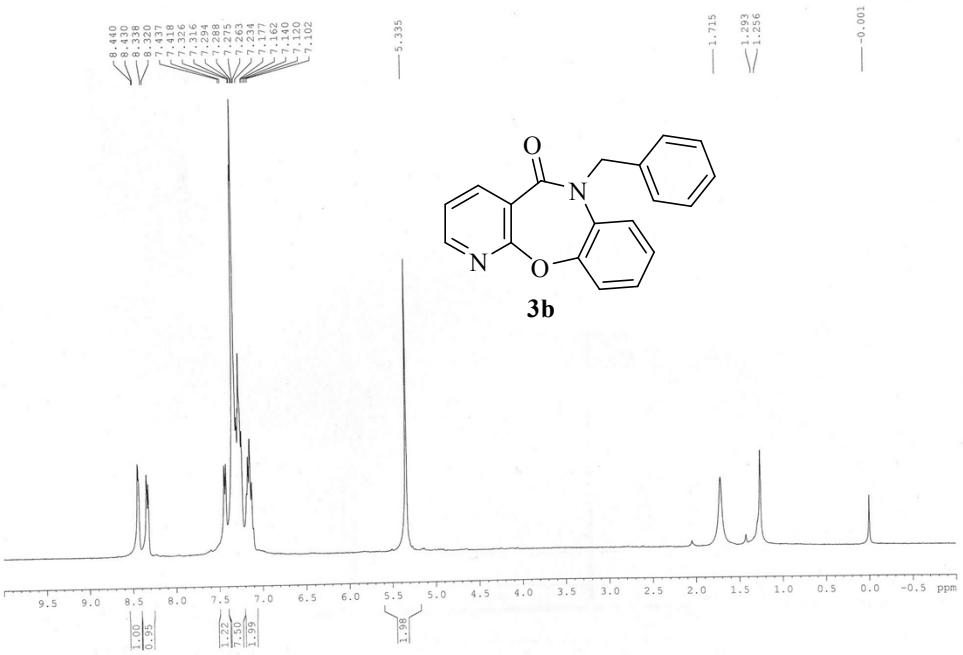

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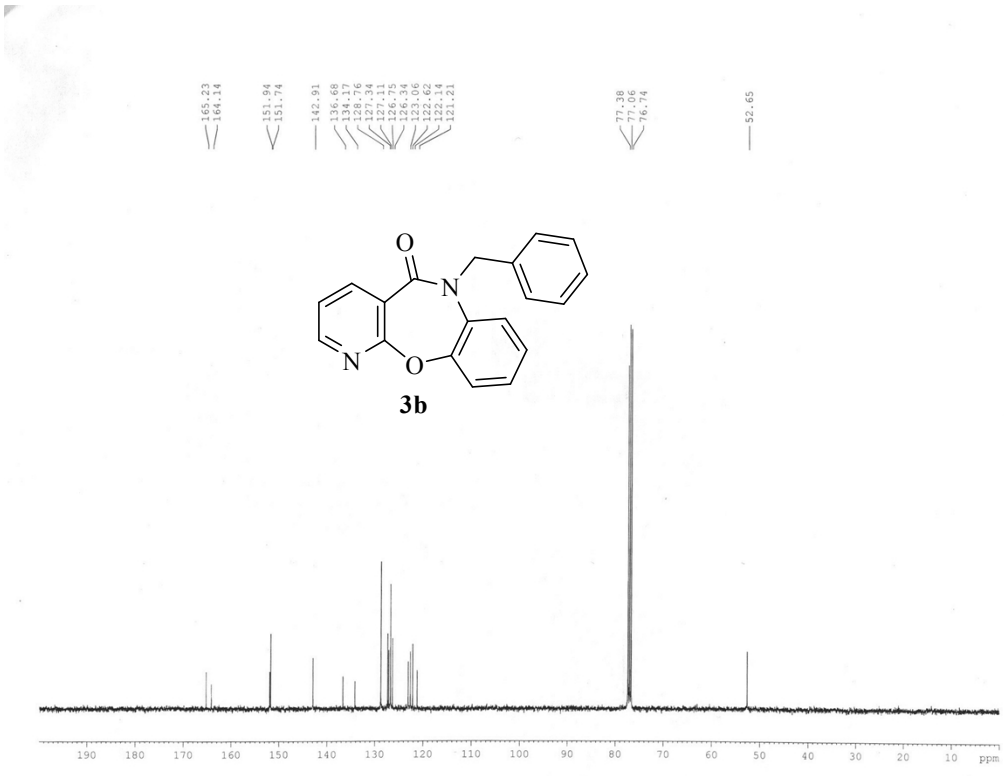

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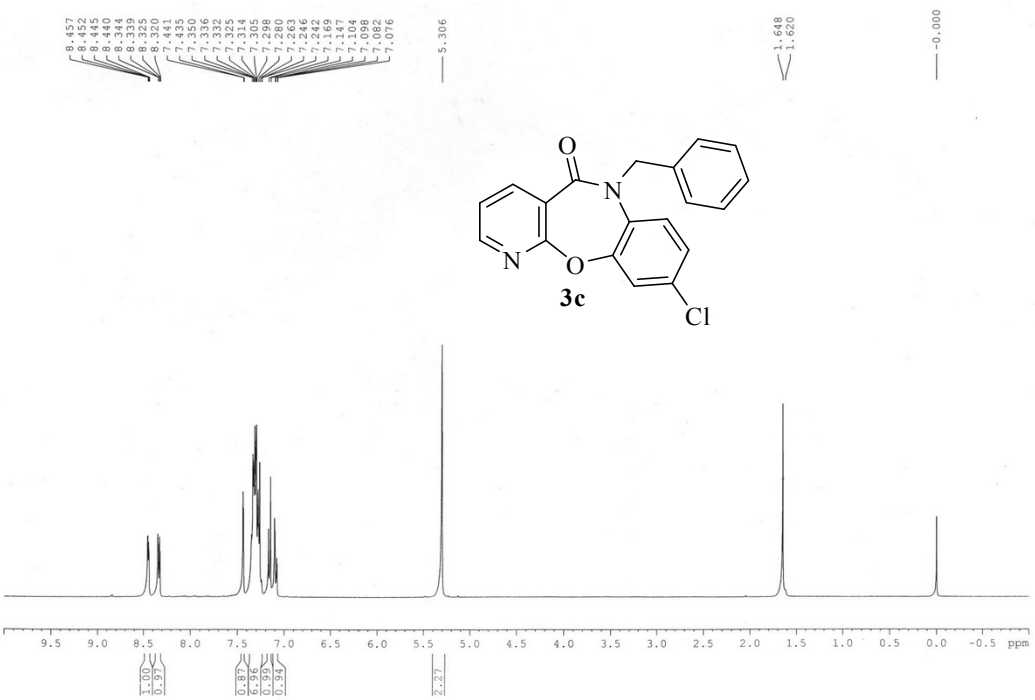

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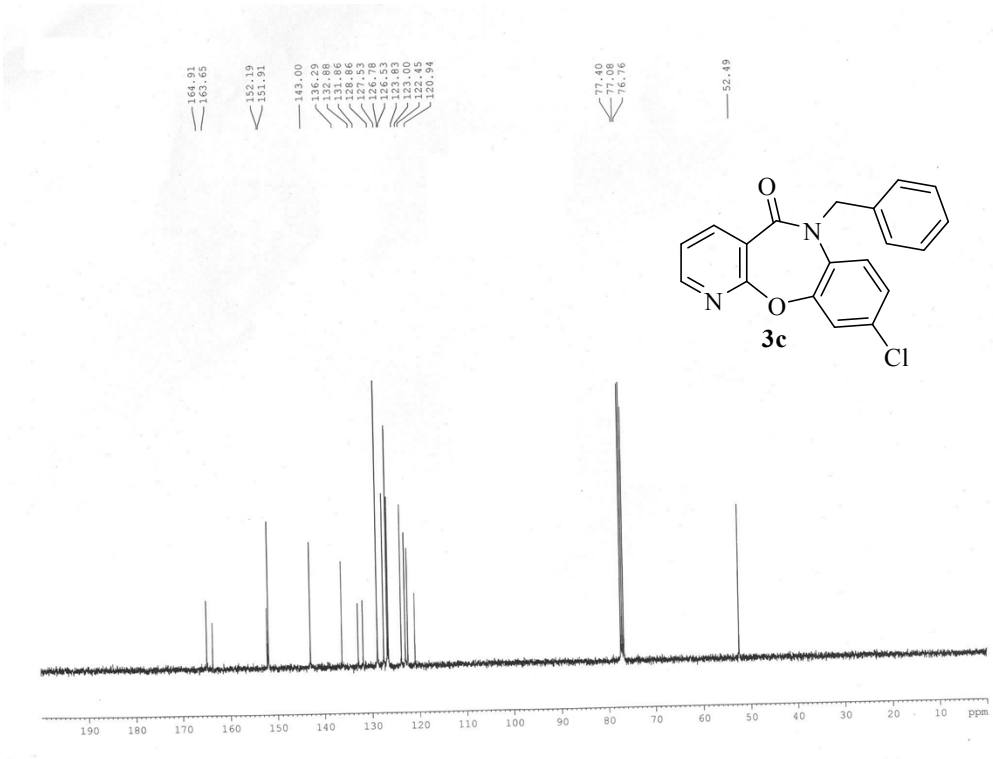

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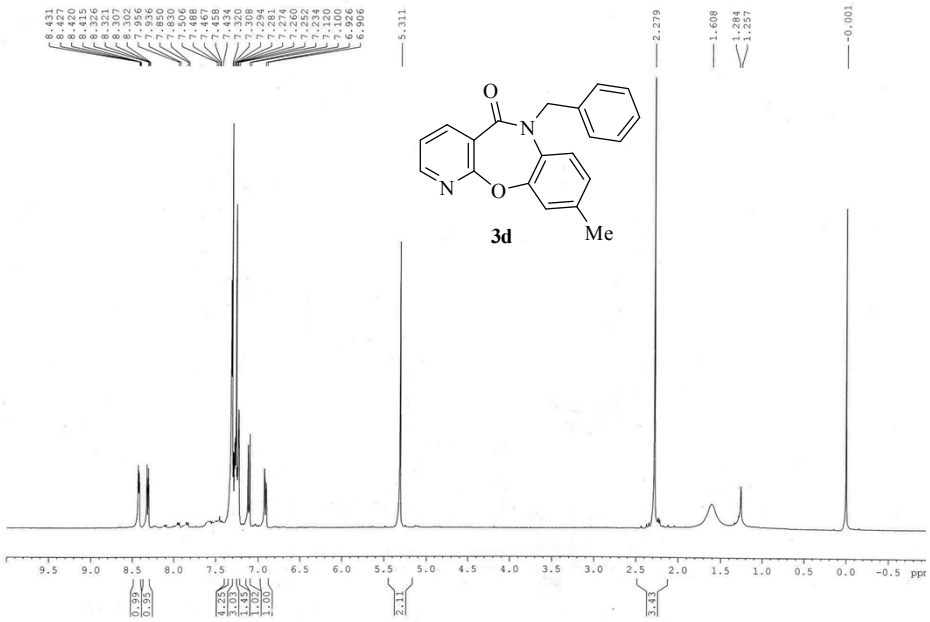

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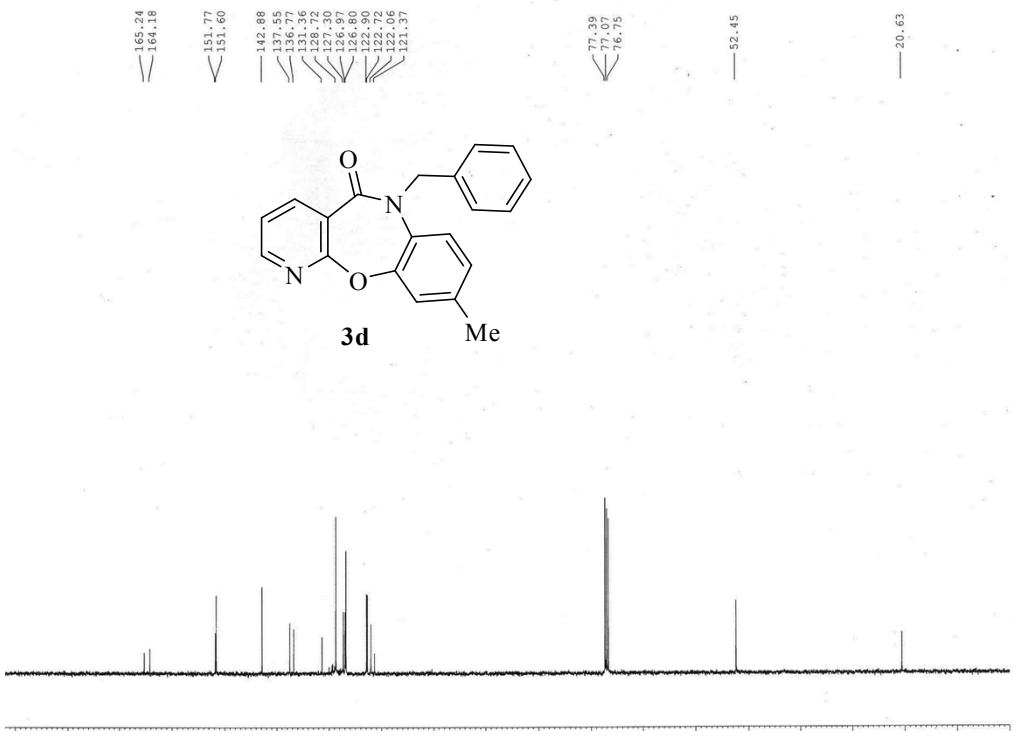

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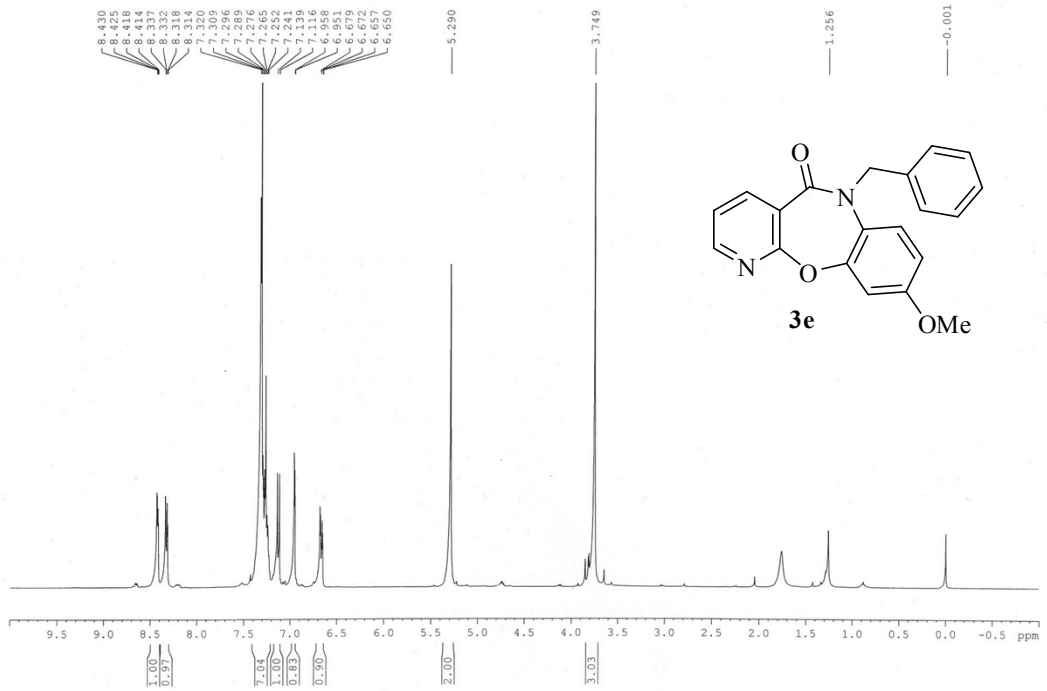

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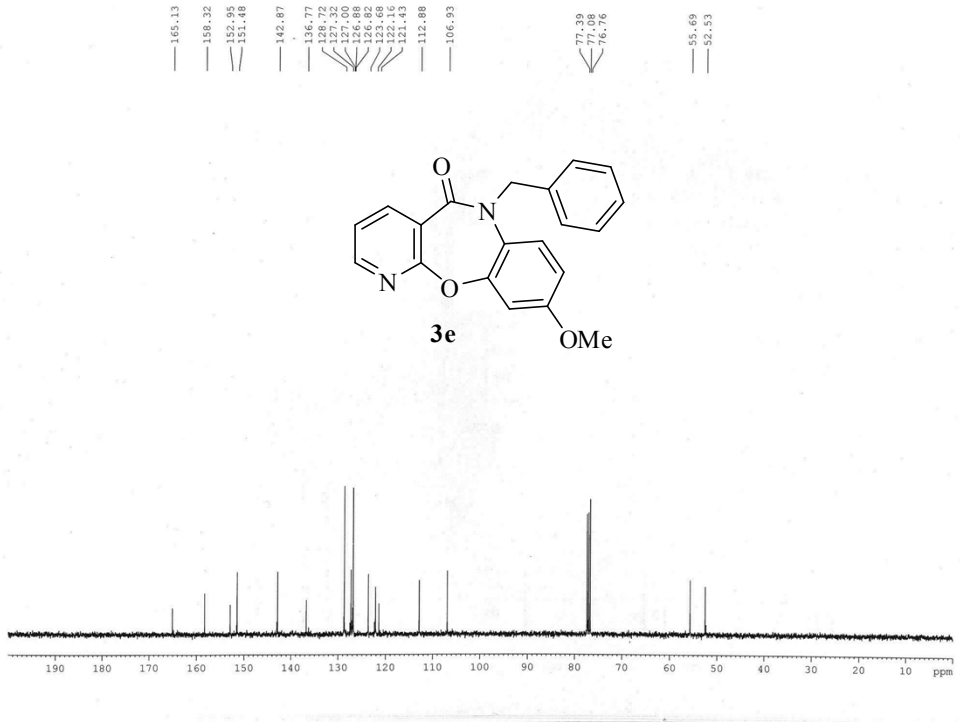

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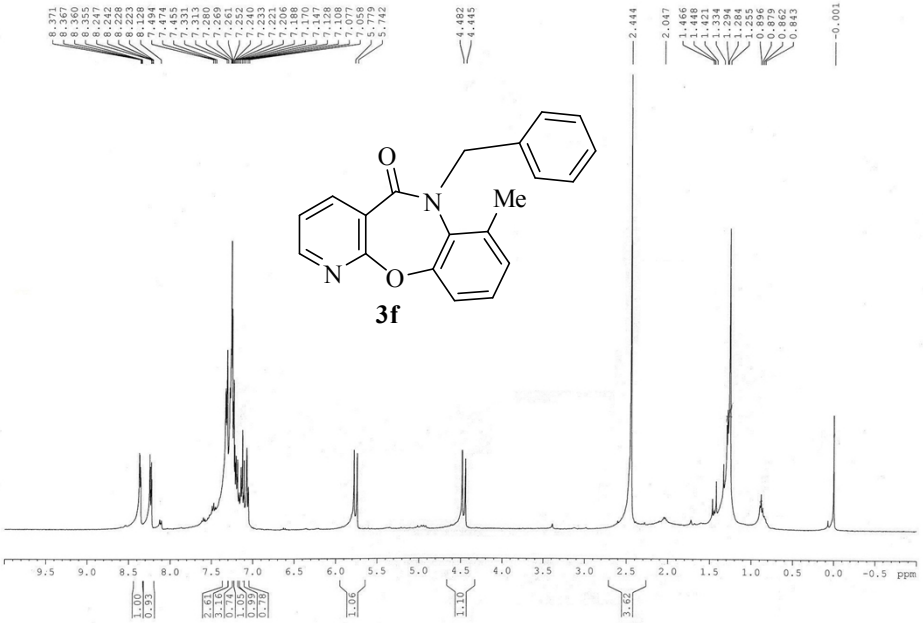

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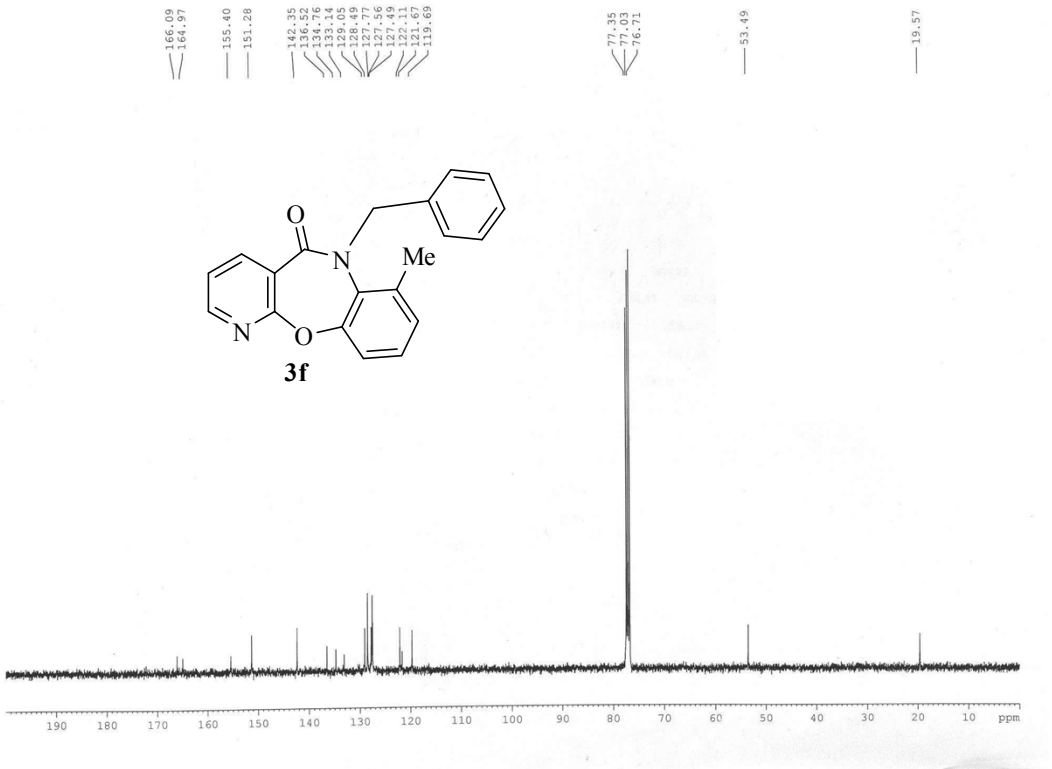

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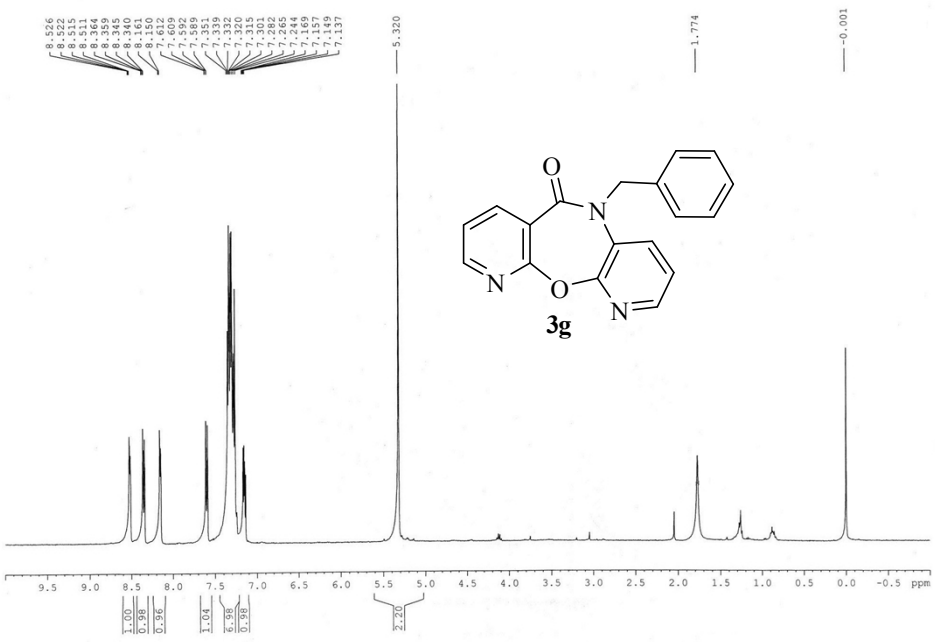

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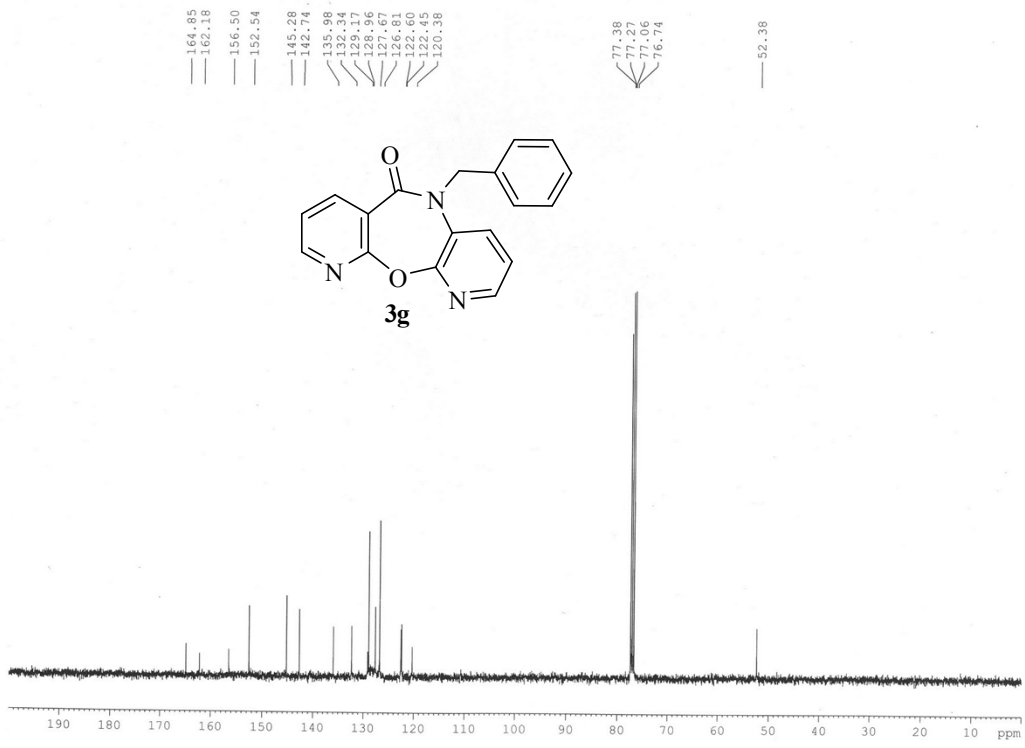

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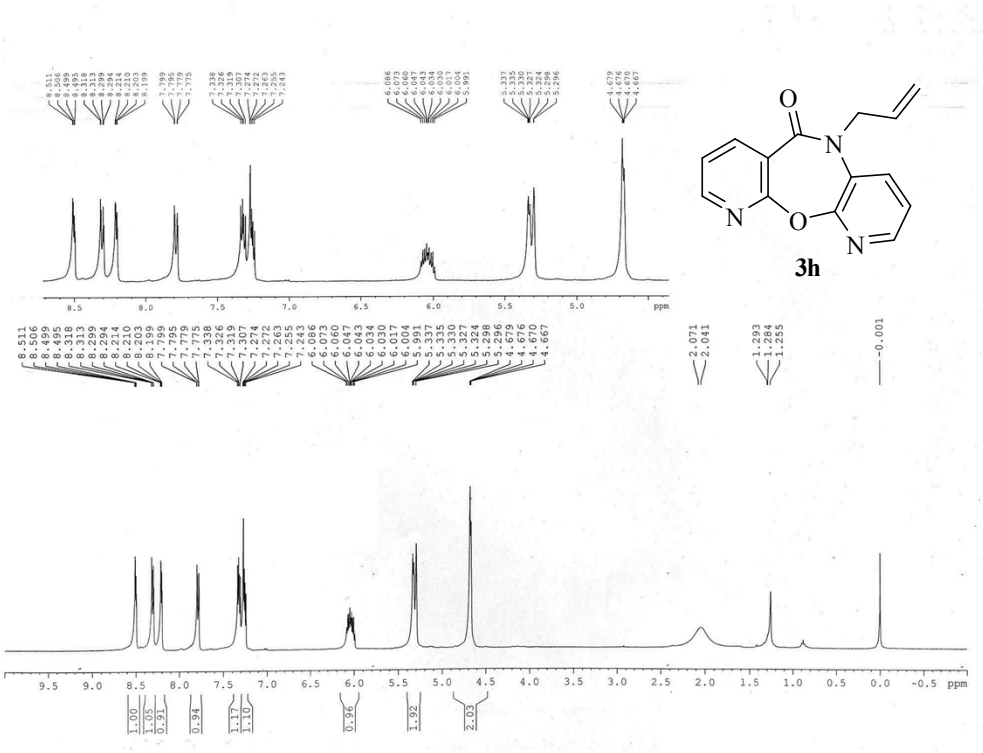

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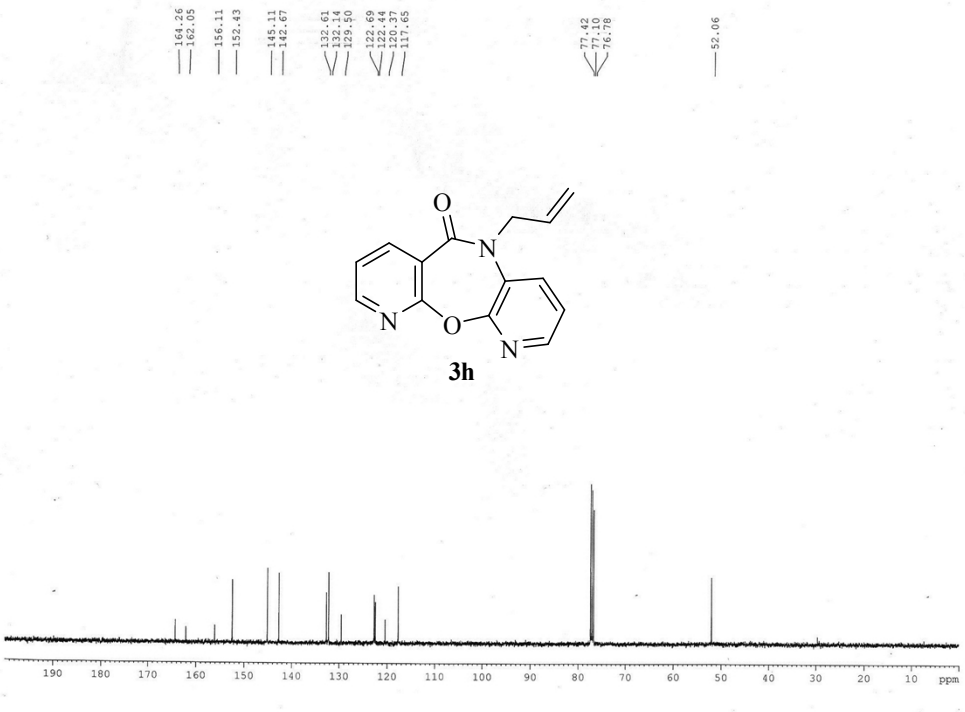

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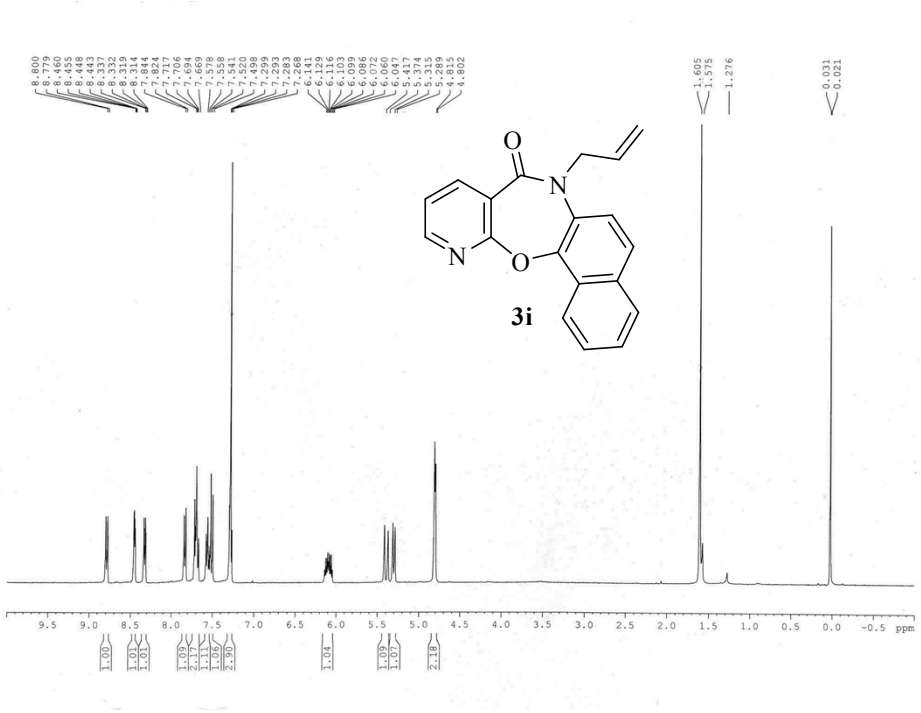

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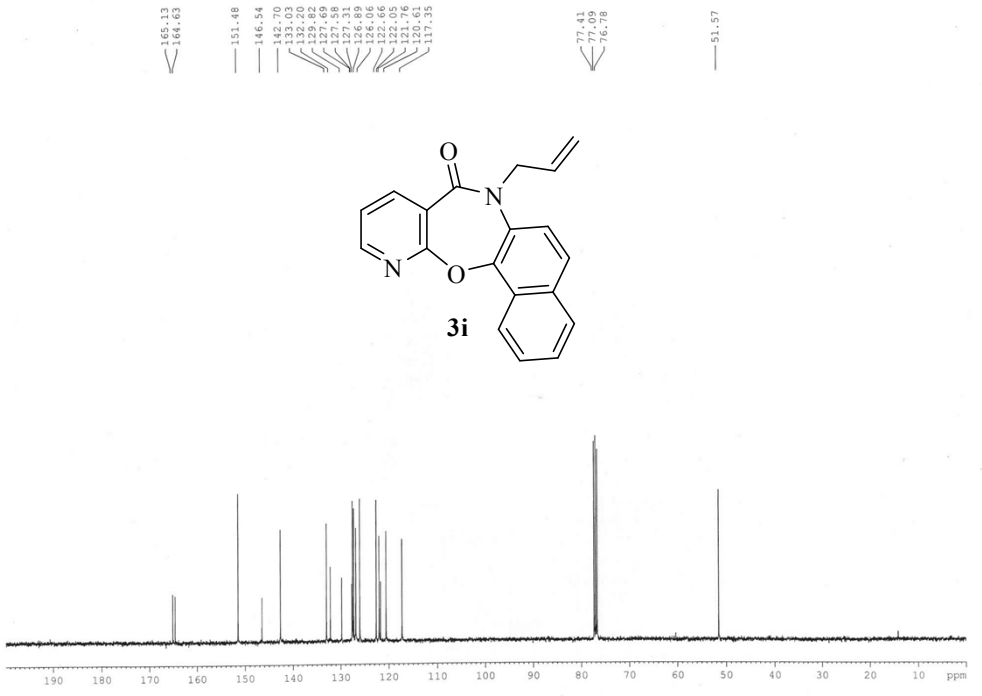

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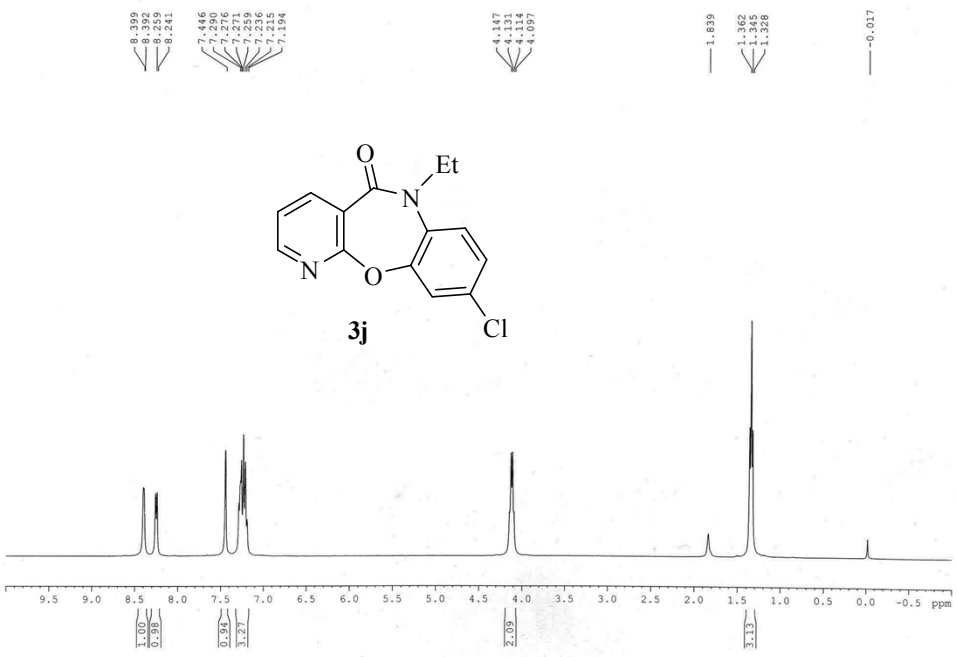

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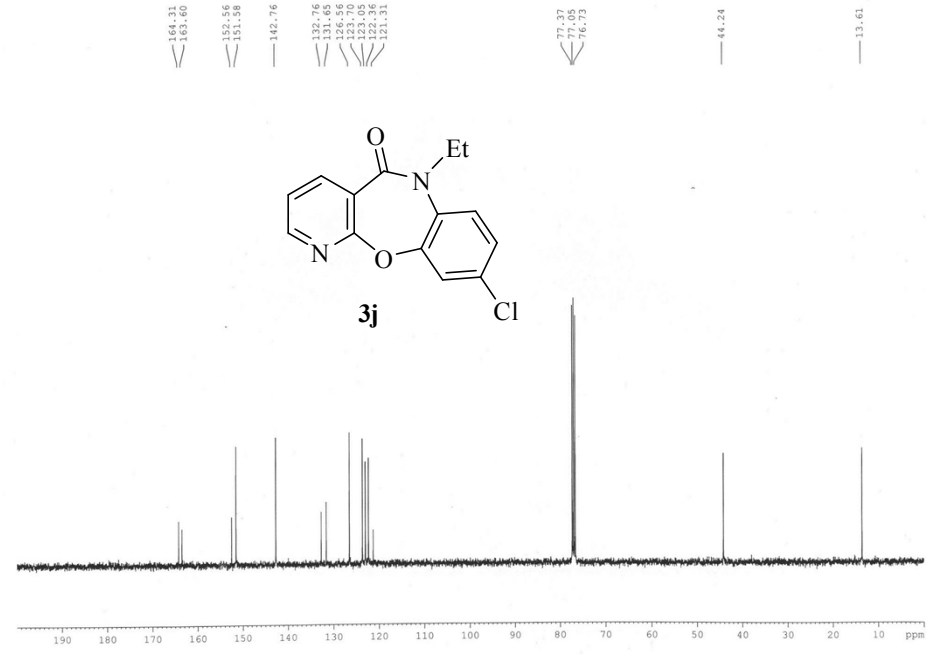

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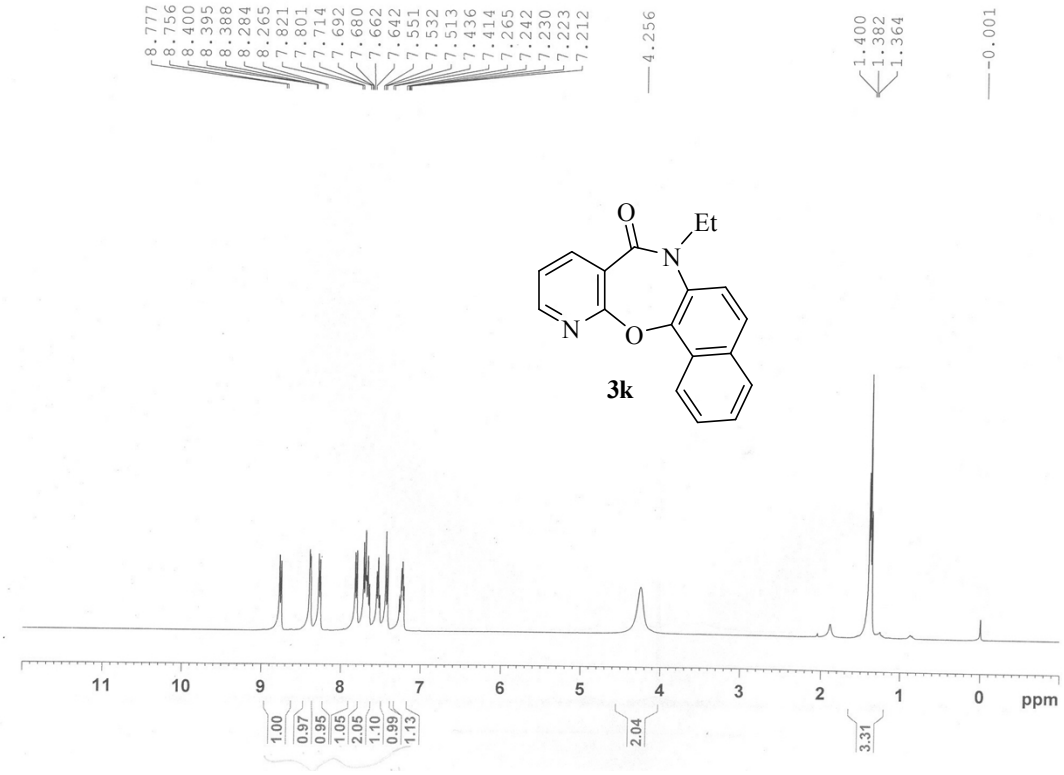

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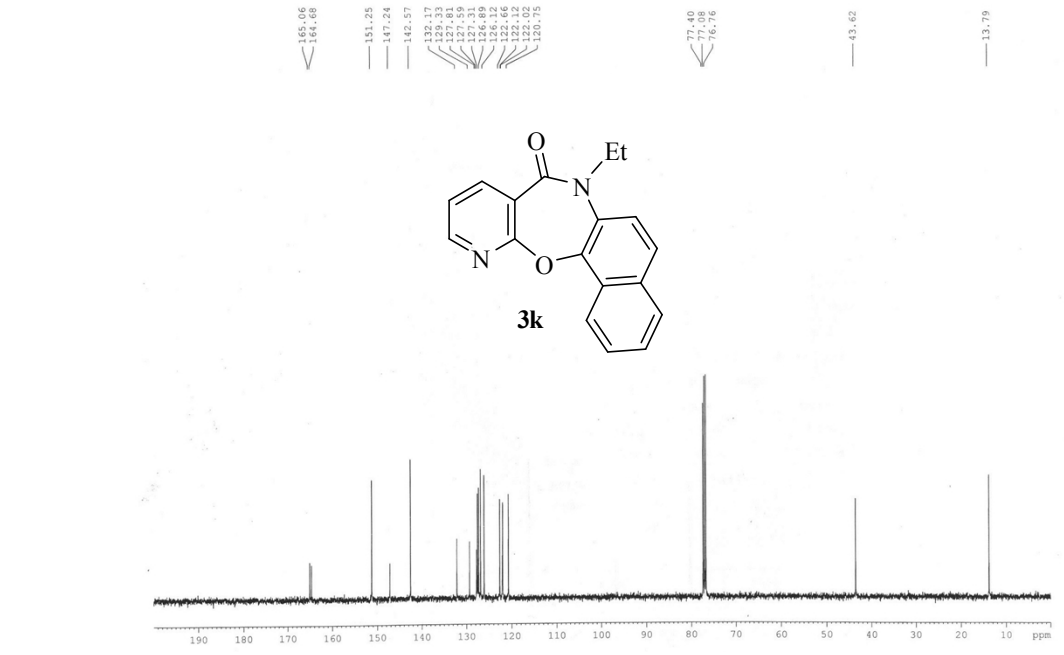

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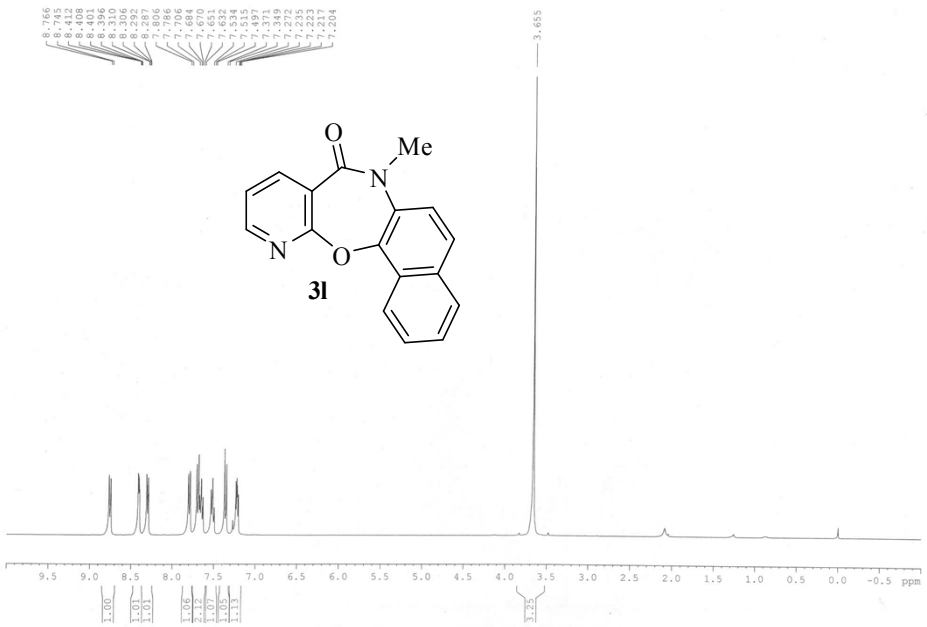

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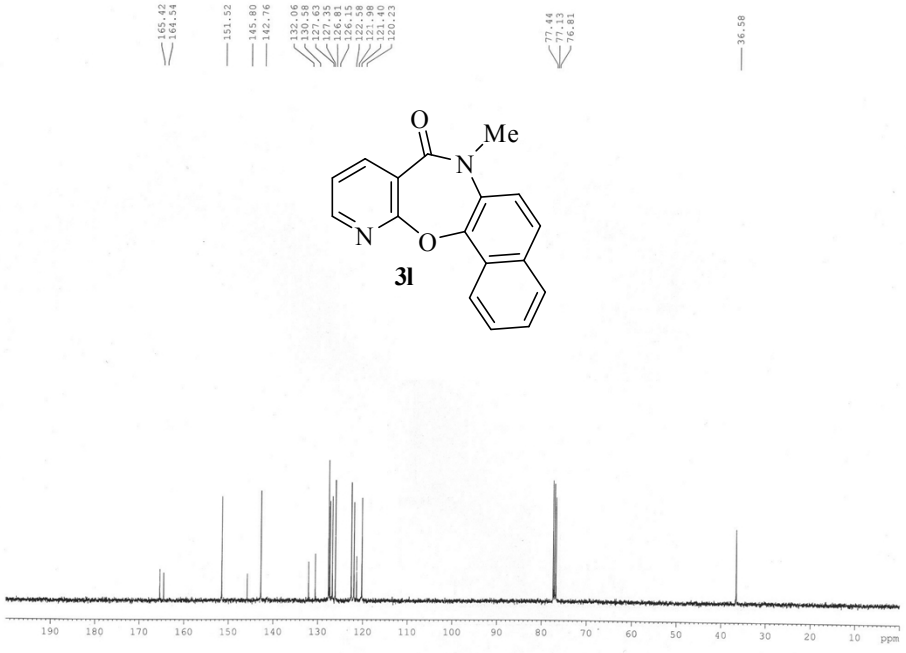

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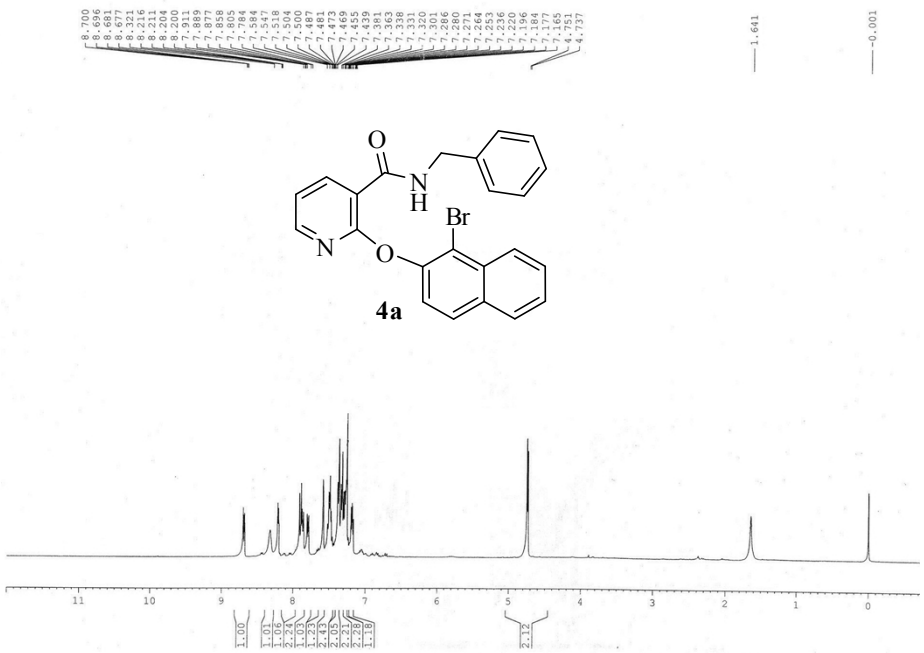
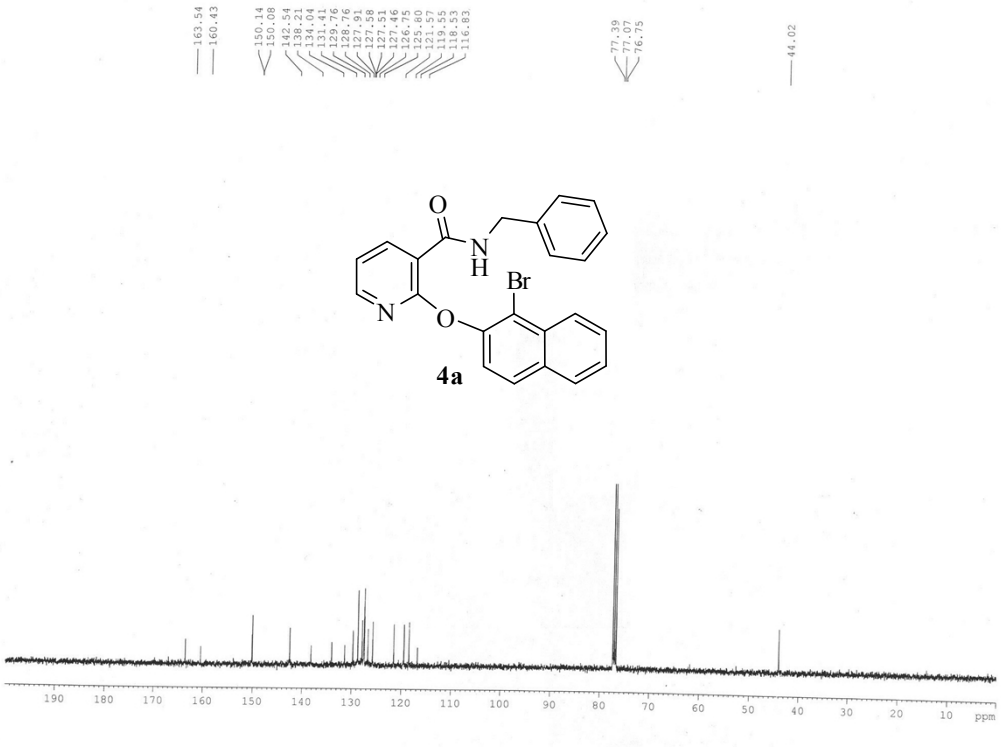


[13]C-NMR of 4a



8. Notes and references:

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