Supplementary data for article:

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A highly regioselective, protecting group controlled, synthesis of bicyclic compounds via Pd-catalysed intramolecular cyclisations

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SUPPLEMENTARY INFORMATION

Table of contents

1.	General	S2
2.	Synthetic procedures	S2
	2.1. General procedure for the synthesis of compound 11	S2
	2.2. General procedure for the synthesis of compound 13 and 14	S3
3.	Spectral data for key compounds and products	S4

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1. General

The NMR spectra were recorded on a Bruker Avance III (500 MHz) spectrometer. Chemical shifts are given in parts per million (δ) downfield from tetramethylsilane as the internal standard. Deuterochloroform was used as a solvent, unless otherwise stated. Mass spectral data were recorded using Agilent MSD TOF spectrometer coupled with Agilent 1200 HPLC. IR spectra were recorded on a IR Termo Scientific NICOLET iS10 (4950) spectrometer. Flash chromatography employed silica gel 60 (230-400 mesh) while thin layer chromatography was carried out using alumina plates with 0.25mm silica layer (Kieselgel 60 F₂₅₄, Merck). The solvents were purified by distillation before use.

2. Synthetic procedures

2.1 General procedure for the synthesis of compound 11 (table 1)

A mixture of compound **5** (30mg, 0.066mmol), Pd(OAc)₂ (1.5mg, 0.0066mmol), PPh₃ (3.5mg, 0.0131mmol), base (2 eq) in toluene (6.5 mL) was refluxed under nitrogen atmosphere for 15h. The solvent was evaporated under reduced pressure and the residue was dissolved in DCM (20 mL), washed with water, dried (Na₂SO₄) and filtered. The solvent was then evaporated under reduced pressure and the residue was purified by flash chromatography (SiO₂, 8:2 v/v petroleum ether-ether) to afford the product **11** as light yellow oil.

IR v_{max} : 2927, 2856, 1615, 1390, 776, 740

¹**H NMR** (**500 MHz, CDCl**₃) δ -0.12, 0.03 (2s, 6H, 2CH₃ from TBDMS), 0.63 (s, 9H, C(CH₃)₃ from TBDMS), 3.25 (s, 3H, N-CH₃), 3.61 (dd, 1H, J=6.5Hz, J=3.5Hz, CH-C₆H₄), 3.97 (dd, 1H, J=6.5Hz, J=3Hz, NC**H**-CH(OTBDMS)), 4.55 (t, 1H, J=6.5Hz, CH(OTBDMS)), 5.83(dd, 1H, J=6Hz, J=3Hz, CH(C₆H₄)CH=C**H**), 6.06 (dd, 1H, J=6Hz, J=3.5Hz, CH(C₆H₄)C**H**=CH), 7.10 (dd, 1H, ArH), 7.26-7.34 (m, 2H, ArH), 8.57 (dd, 1H, ArH)

¹³C NMR (125 MHz, CDCl₃) δ -5.0, -4.96, 17.63, 25.3, 40.03, 56.02, 66.5, 69.6, 126.5, 127.4, 129.21, 130.8, 133.9, 134.71,138.32, 139.51, 167.83 m/z (EI) 329.1 (M⁺), 314.1, 272.1, 215.0, 198.1, 156

HRMS (ESI): calculated for $C_{19}H_{27}NO_2Si$ (M+H)⁺ 330.18838, found 330.18711

2.2 General procedure for the synthesis of compound 13 and 14 (table 2)

A mixture of compound 12 (104mg, 0.303mmol), $Pd(OAc)_2$ (6.8mg, 0.0303mmol), PPh_3 (15.9mg, 0.0606mmol), base (2 eq) in toluene (30.3 mL) was refluxed under nitrogen atmosphere for 15h. The solvent was evaporated under reduced pressure and the residue was dissolved in DCM (50 mL), washed with water, dried (Na₂SO₄) and filtered. The solvent was then evaporated under reduced pressure and the

residue was purified by flash chromatography (SiO_2 , 9:1 v/v ether-petroleum ether) to afford the product **13**. Further elution (95:5 v/v ether-petroleum ether) afforded the product **14** as light yellow oil.

Compound 13

IR ν_{max}:1745, 1615,1387, 1264, 1241, 703

¹H NMR (500 MHz, CDCl₃) δ 2.34 (dd, 1H, J=14.5Hz, J=3Hz, CH₂CH-N), 2.52 (dd, 1H, J=19Hz, J=3Hz, CH₂C=O), 2.58-2.64(m, 1H, CH₂CH-N), 2.78 (dd, 1H, J=19Hz, J=8.5Hz, CH₂C=O), 3.36 (s, 3H, N-CH₃), 3.76 (t, 1H, J=7.5Hz, CH-C₆H₄), 3.81 (d, 1H, J=8Hz, CH-N), 7.22 (dd, 1H, ArH), 7.24-7.42 (m, 2H, ArH), 8.57 (dd, 1H, ArH) (13C NMR (125 MHz, CDCl₃) δ 33.8, 40.2, 42.4, 48.2, 63.3, 127.1, 129.0, 130.54, 131.7, 135.0, 143.9, 165.8, 212.0

m/z (EI) 215.1 (M⁺), 197.1, 172.1, 158.1, 144.1, 131.1

HRMS (ESI): calculated for $C_{13}H_{13}NO_2 (M+H)^+ 216.10191$ found 216.10168

Compound 14

IR v_{max} : 1610, 1593,1389, 1251, 761, 739

¹**H NMR** (**500 MHz, CDCl**₃) δ 2.1 (d, 1H, J=12.5Hz, CH₂ from ring), 2.46 (dt, 1H, J=12.5Hz, CH₂ from ring), 3.27 (s, 3H, N-CH₃), 3.75 (dd, 1H, J=6.5Hz, J=3Hz, CH-C₆H₄), 4.31 (dd, 1H, J=7.5Hz, J=2.5Hz, CH-N), 5.88 (dd, 1H, J=5.5Hz, J=2.5Hz, =**CH**-CH-N), 6.05 (dd, 1H, J=5.5Hz, J=3Hz, C**H**=CH-CH-N), 7.22 (dd, 1H, ArH), 7.26-7.30 (m,1H, ArH), 7.32-7.35 (m, 1H, ArH), 8.6 (dd, 1H, ArH)

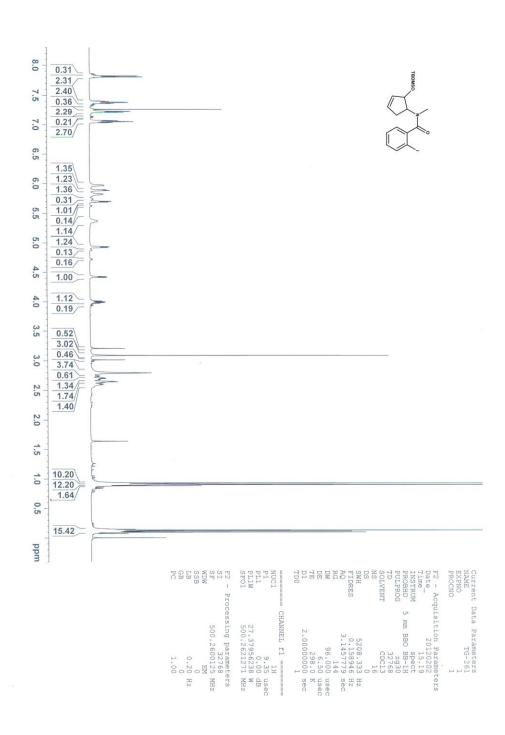
¹³C NMR (125 MHz, CDCl₃) δ 37.1, 39.0, 51.4, 65.3, 126.5, 127.9, 128.11, 131.02, 132.0, 135.6, 138.13, 144.44, 166.4

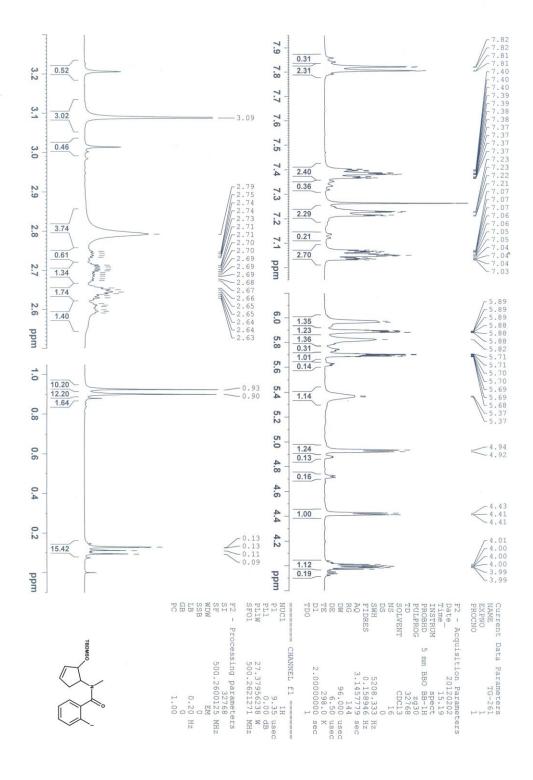
m/z (EI) 199.1 (M⁺), 184.0, 170.0, 141.0, 128.1, 115.0

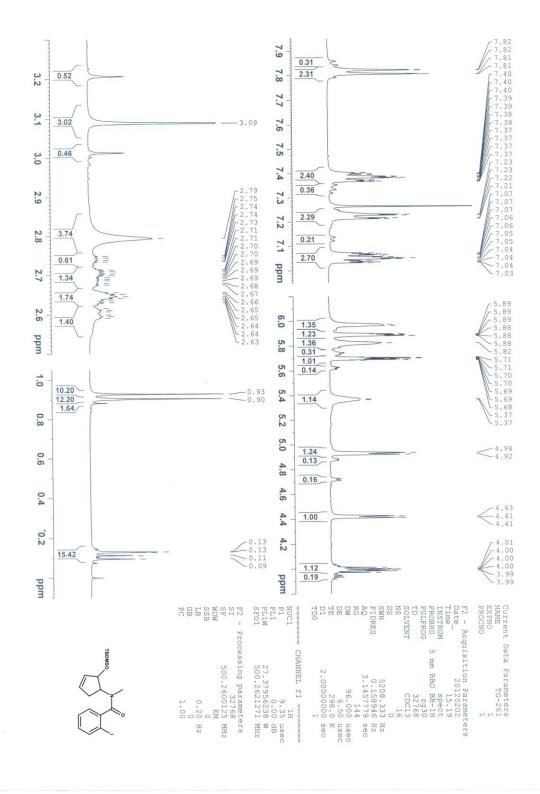
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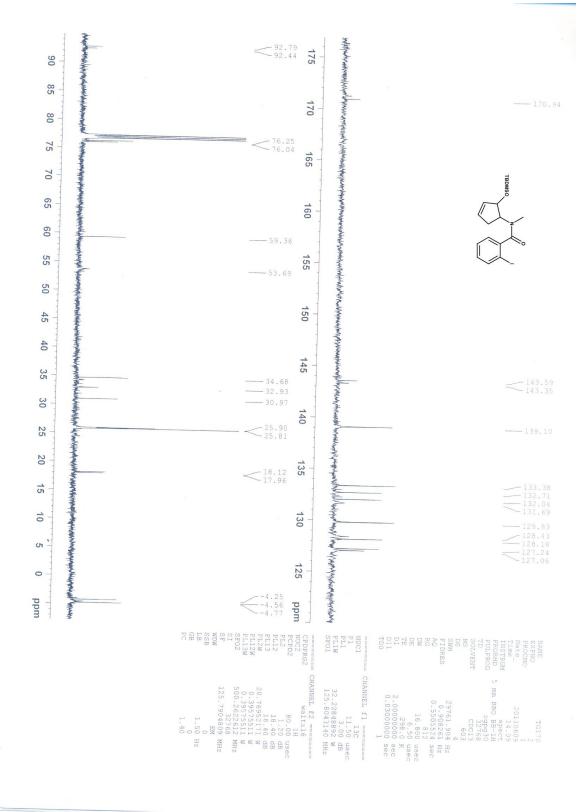
3. Spectral data for key compounds and products

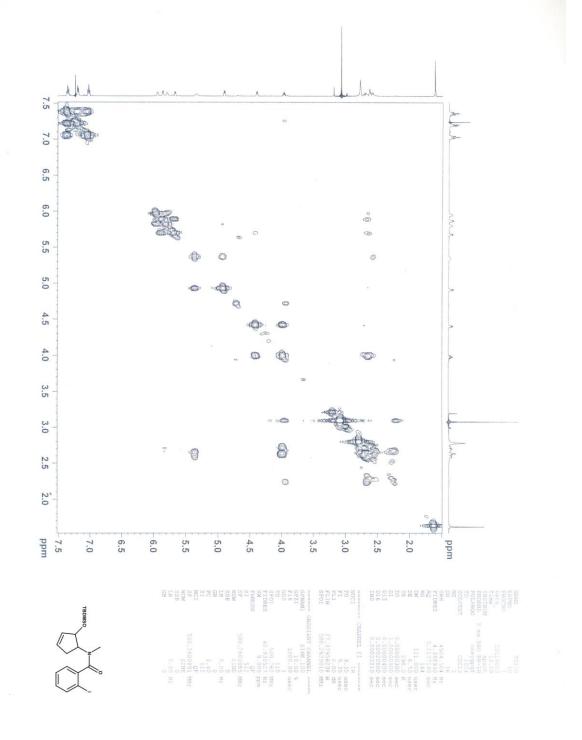
Spectral data for compound 5 (isolated as a mixture of diastereomers):

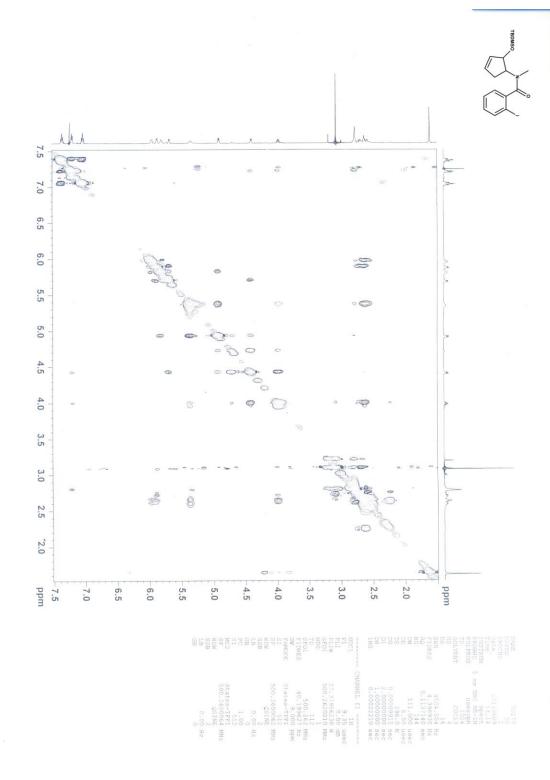


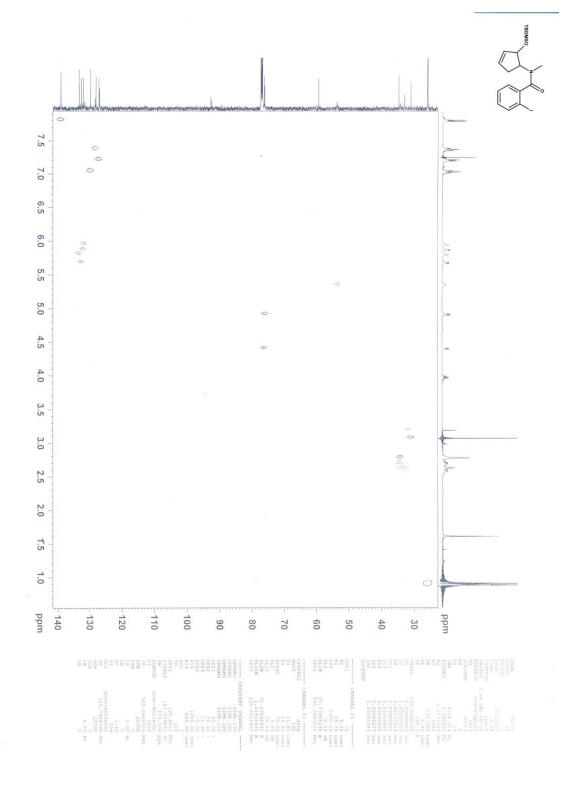


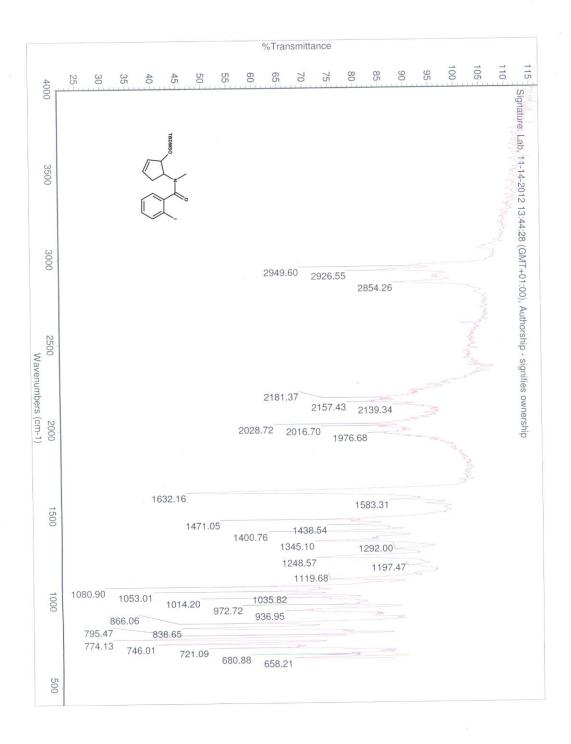




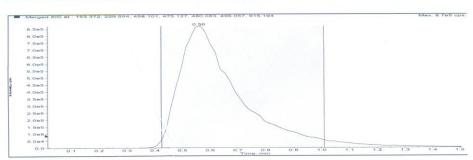




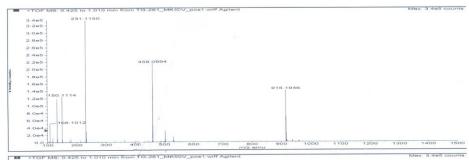




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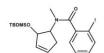
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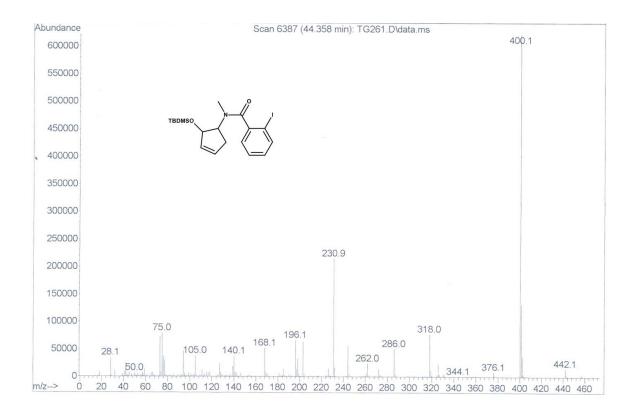


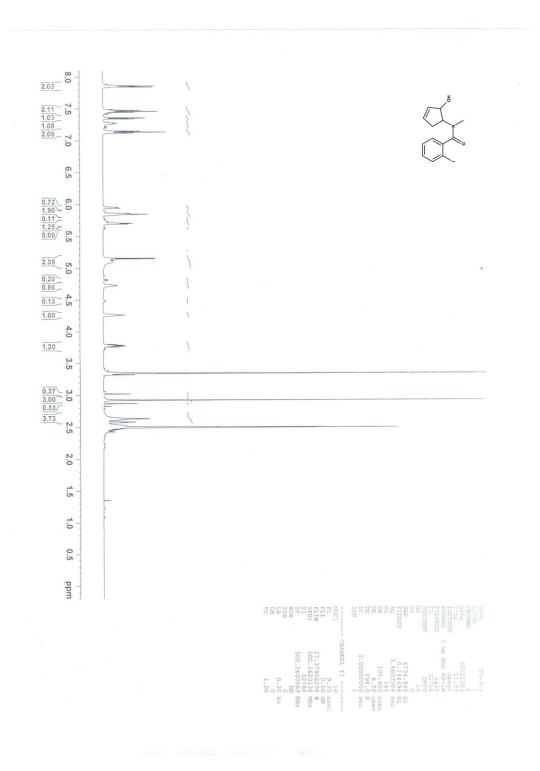


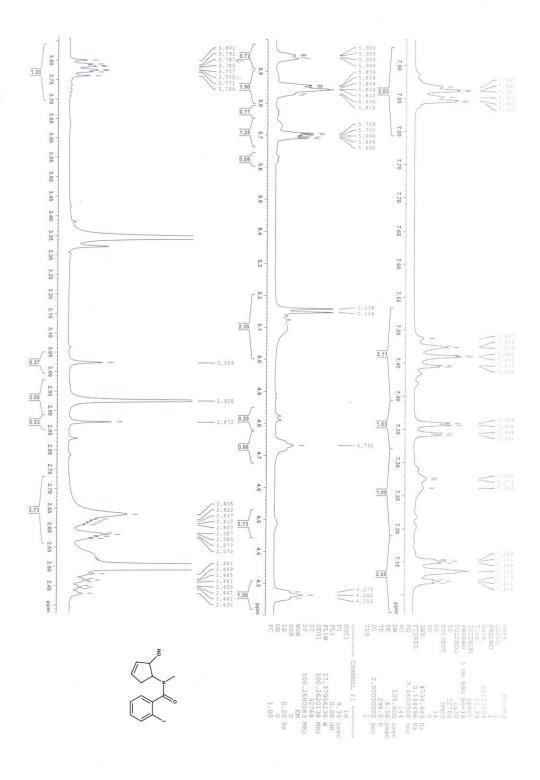
Formula	Compound name	Mass	Peak RT (min)	Peak area	Description
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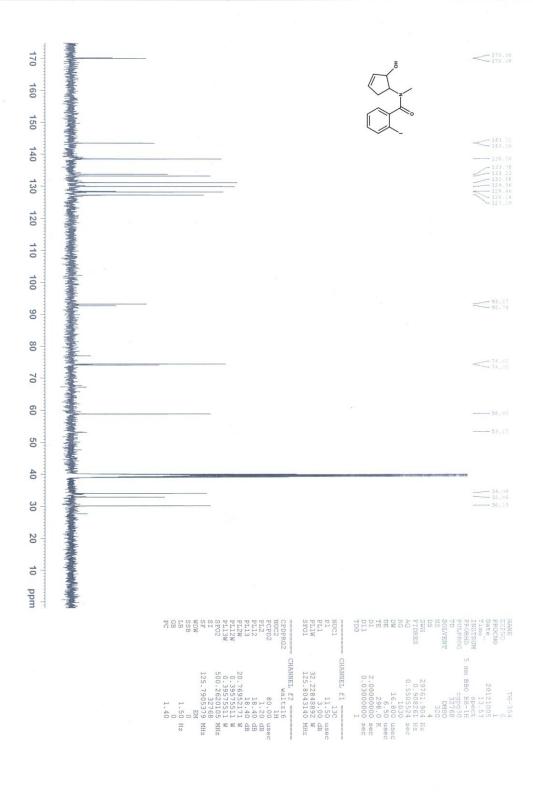
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[M+H]+	224554.37	458.10068	458.09941	-1.26829	-2.77	
[2M+H]+	147607.53	915.19407	915.19464	0.56491	0.62	

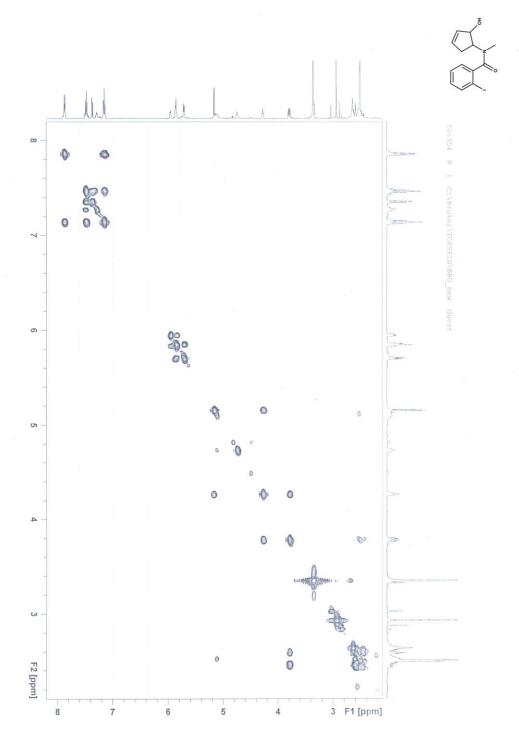


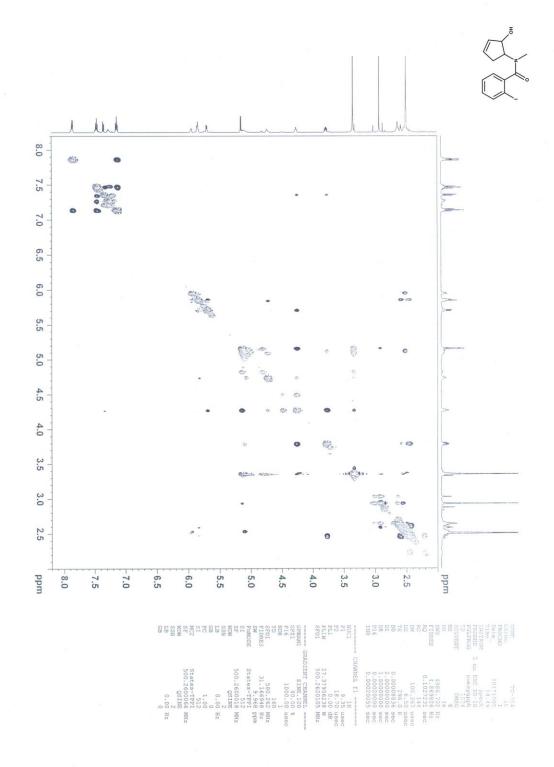


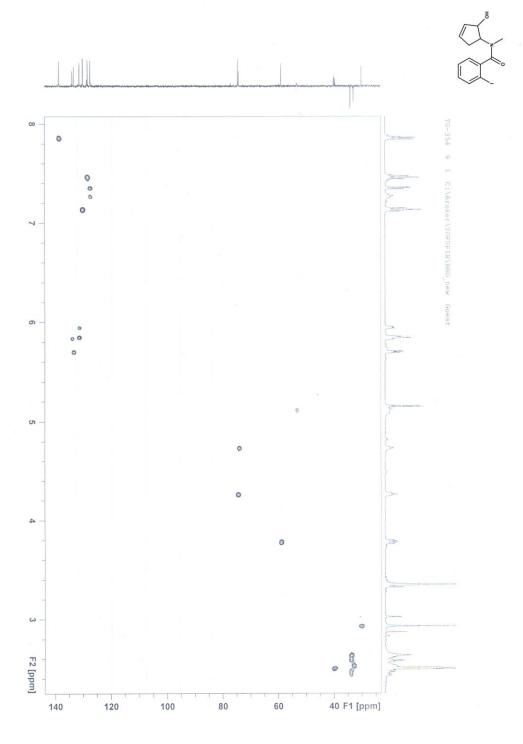


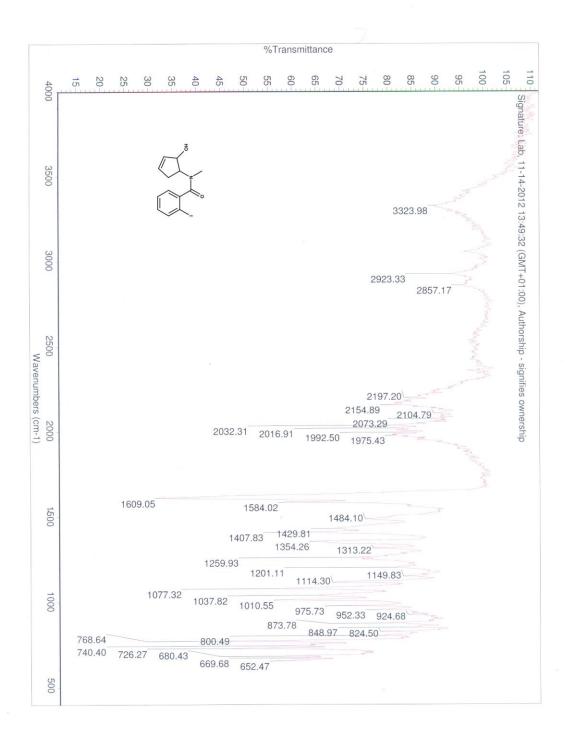




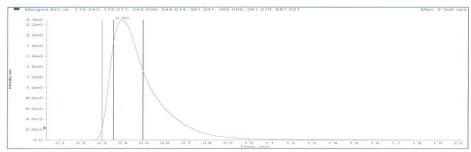




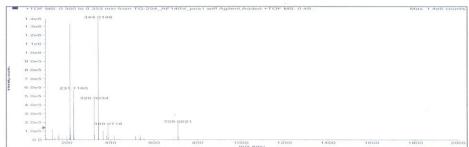


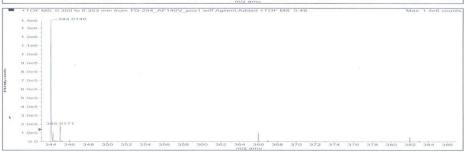


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Merged XIC, Period#:1 Experiment#:1

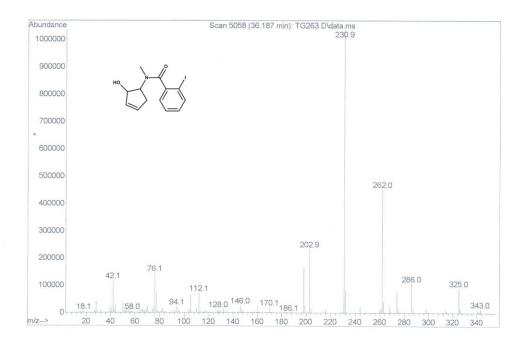


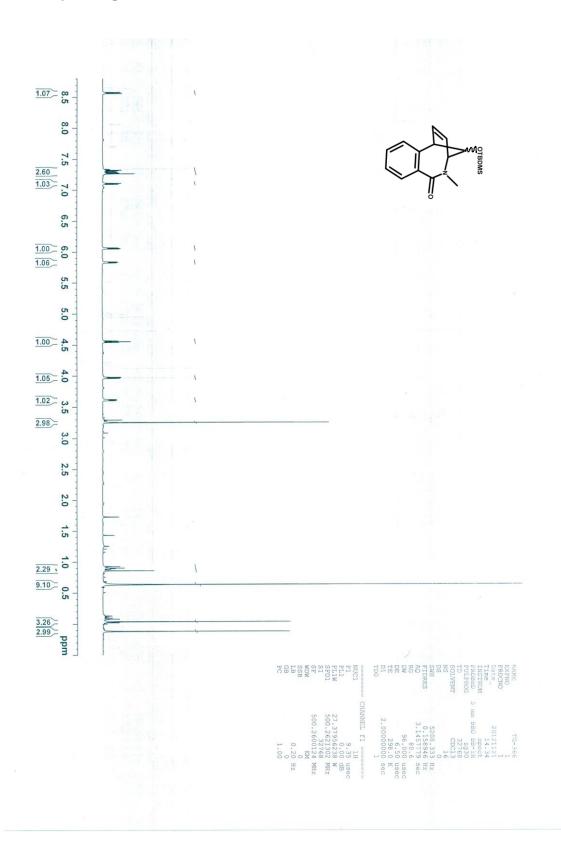


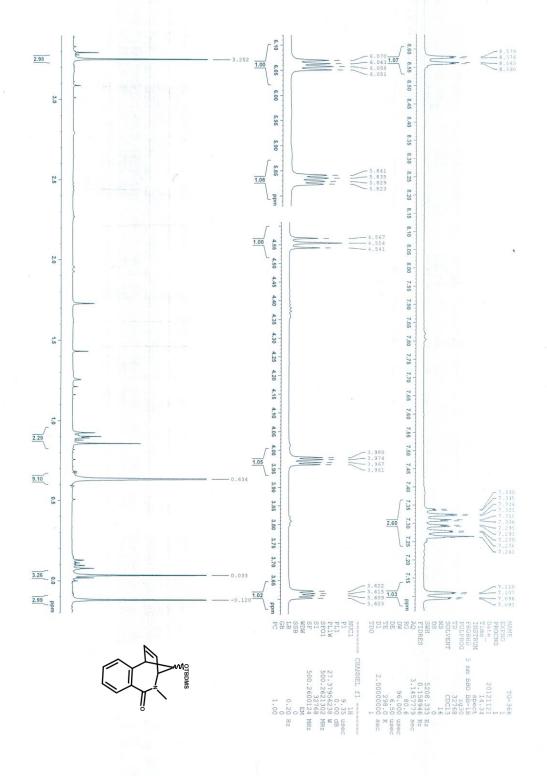
Formula	Compound name	Mass	Peak RT (min)	Peak area	Description
C13H14INO2		343.00692	0.40	2.95065 E7	

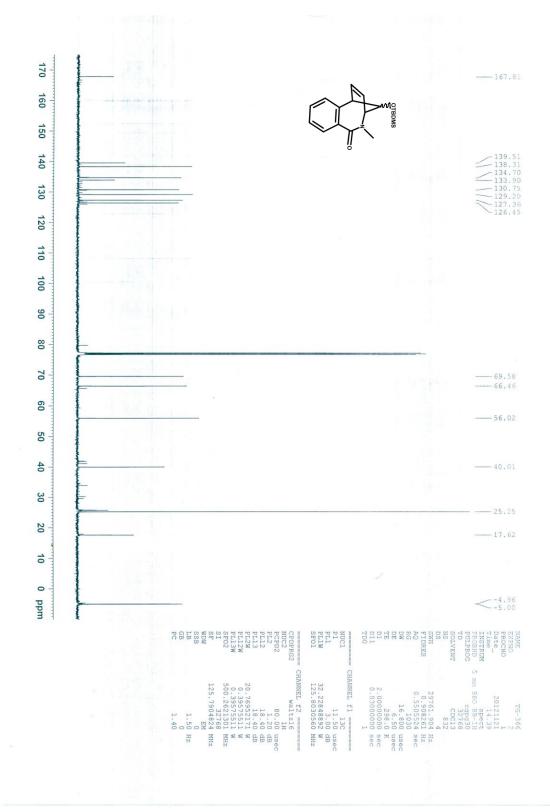
Species	Abundance (counts)	Ion Mass	Measured Mass	Error (mDa)	Error (ppm)	Ret. Time Error (min)
[M+H]+	1390280.79	344.01420	344.01458	0.37701	1.10	
[M+Na]+	104798.06	365.99614	365.99588	-0.26409	-0.72	
[M+K]+	53656.88	381.97008	381.96972	-0.36353	-0.95	

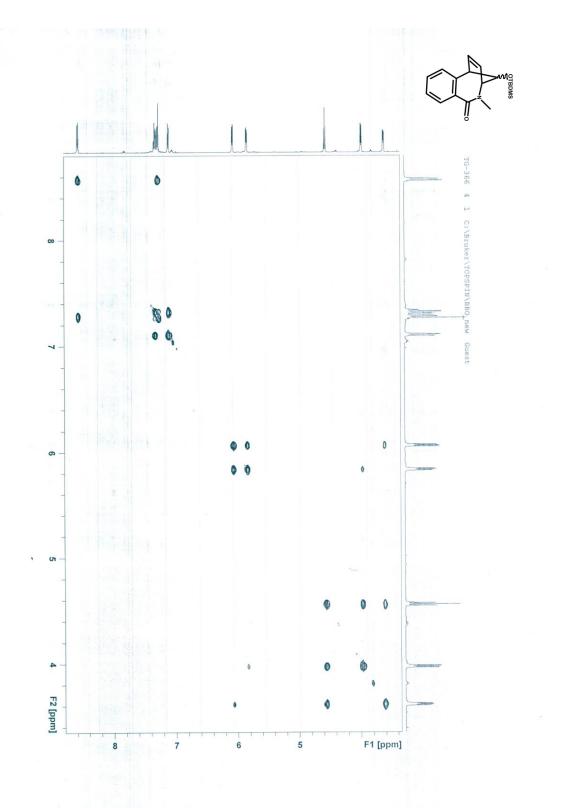


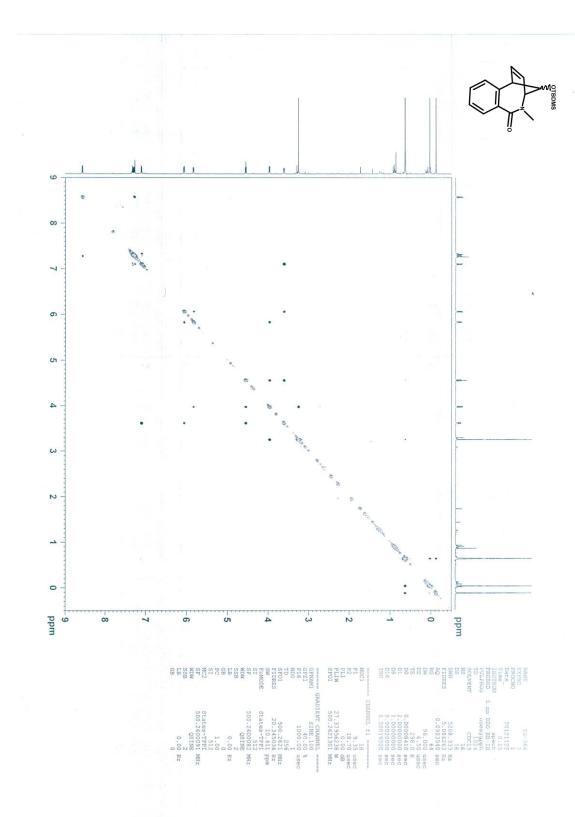


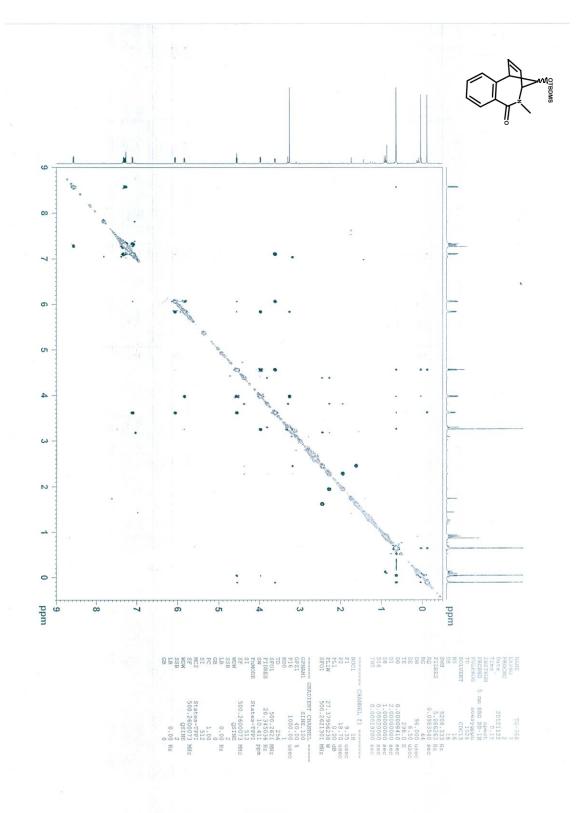


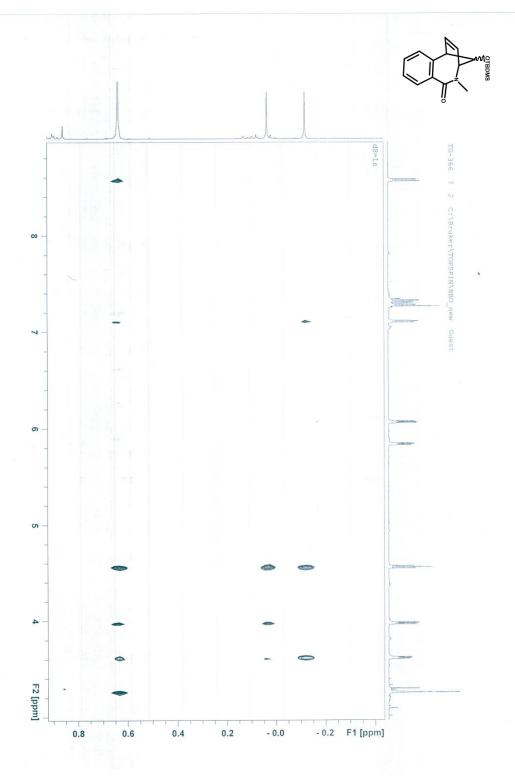


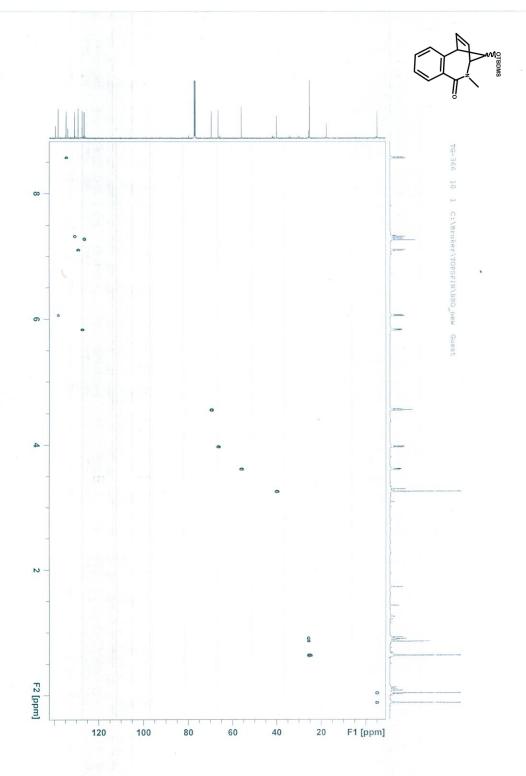


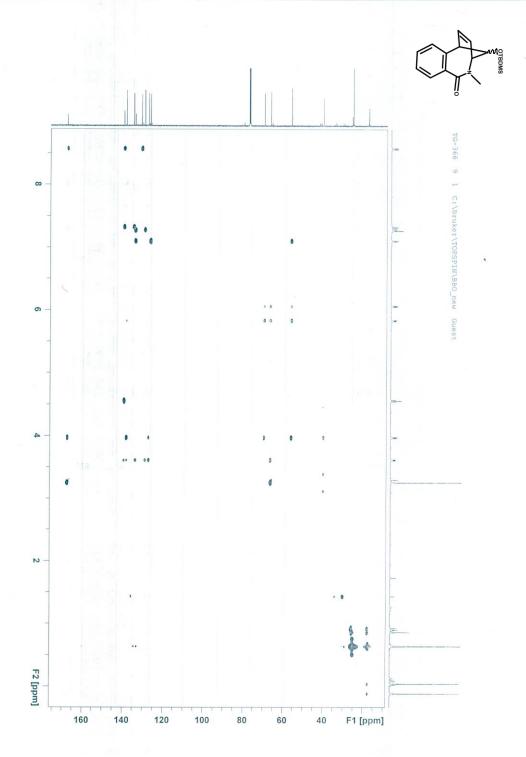


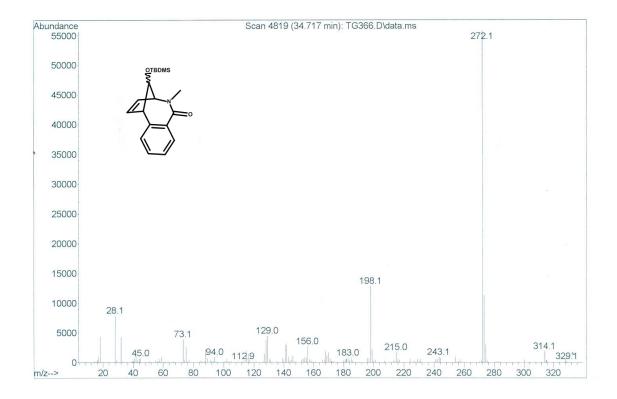


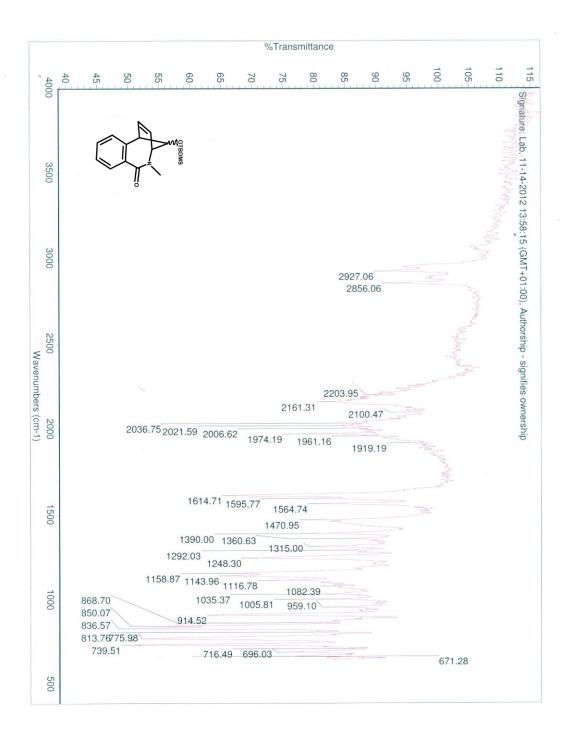




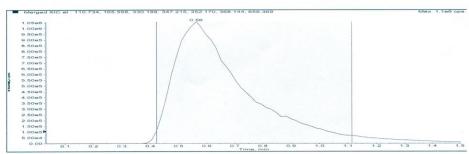




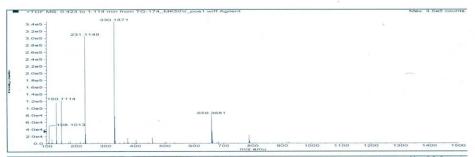


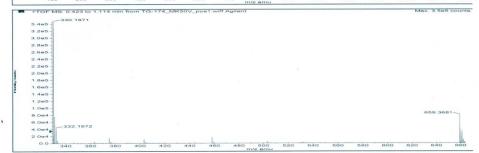


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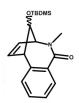
Merged XIC, Period# : 1 Experiment# : 1

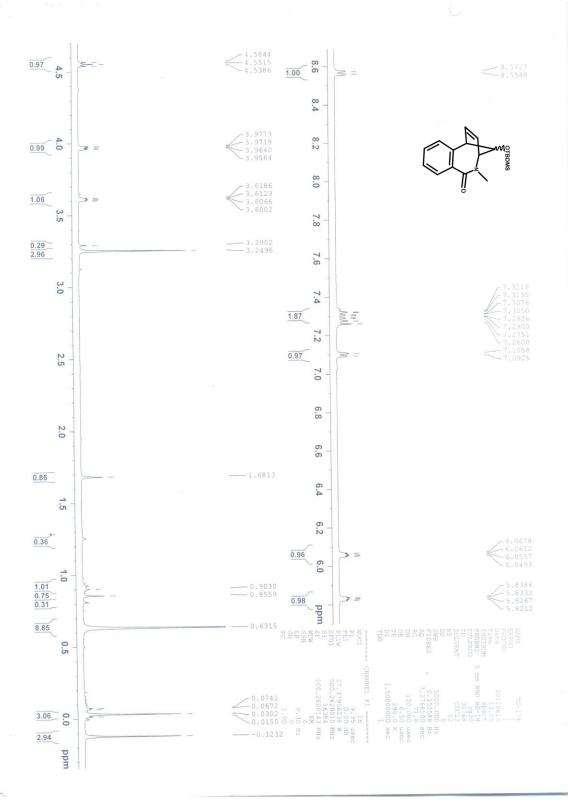


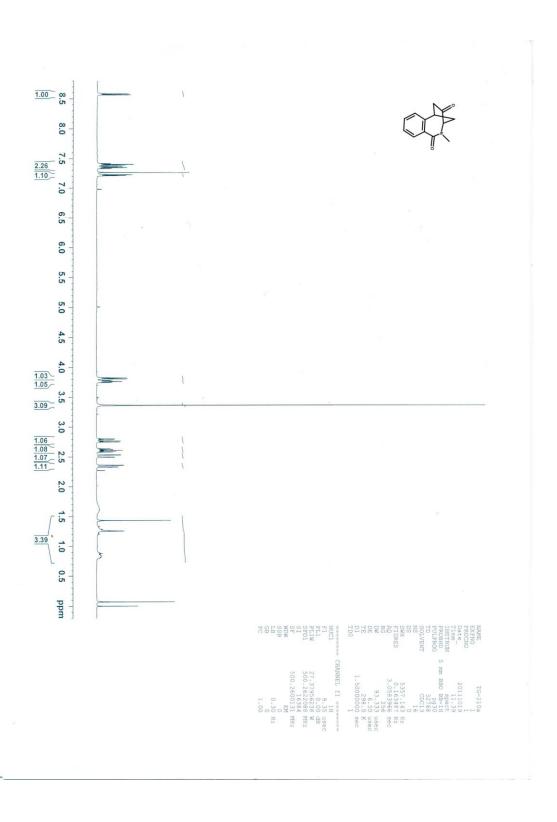


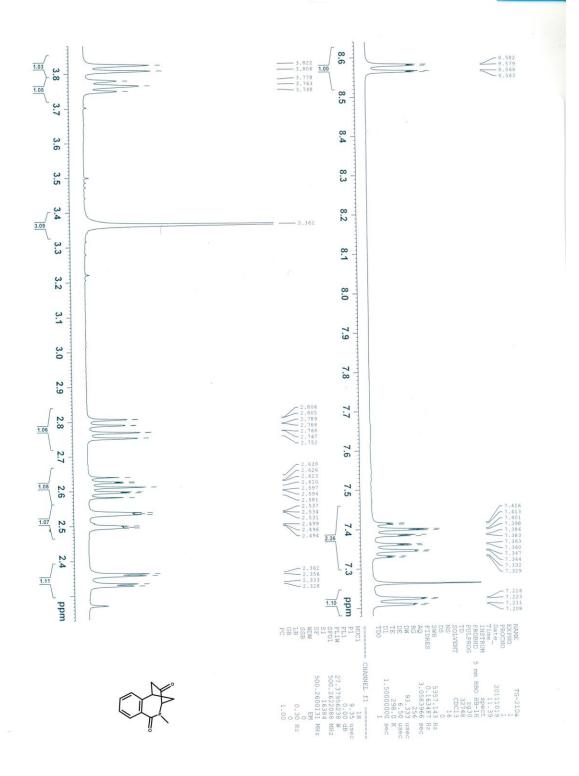
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C19H27NO2Si		329.18111	0.56	1.86376 E7	

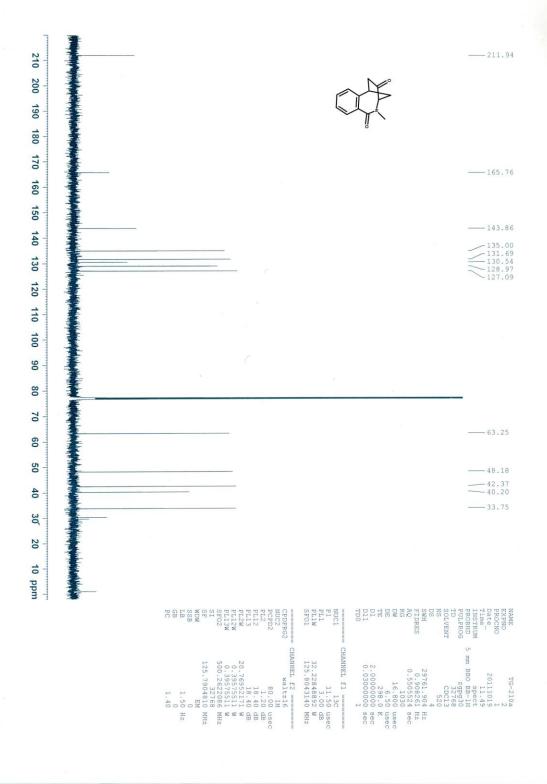
Species	Abundance (counts)	Ion Mass	Measured Mass	Error (mDa)	Error (ppm)	Ret. Time Error (min)
[M+H]+	362047.44	330.18838	330.18711	-1.27458	-3.86	-
[2M+H]+	81932.05	659.36949	659.36808	-1.41020	-2.14	

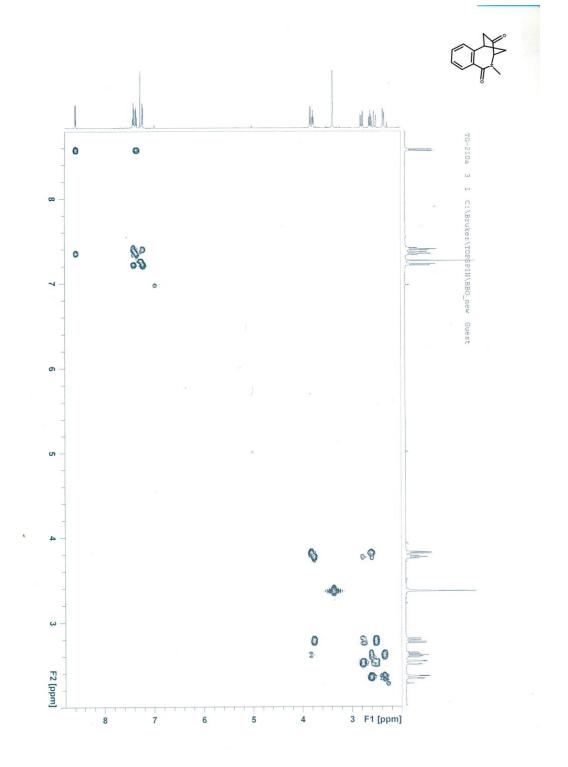


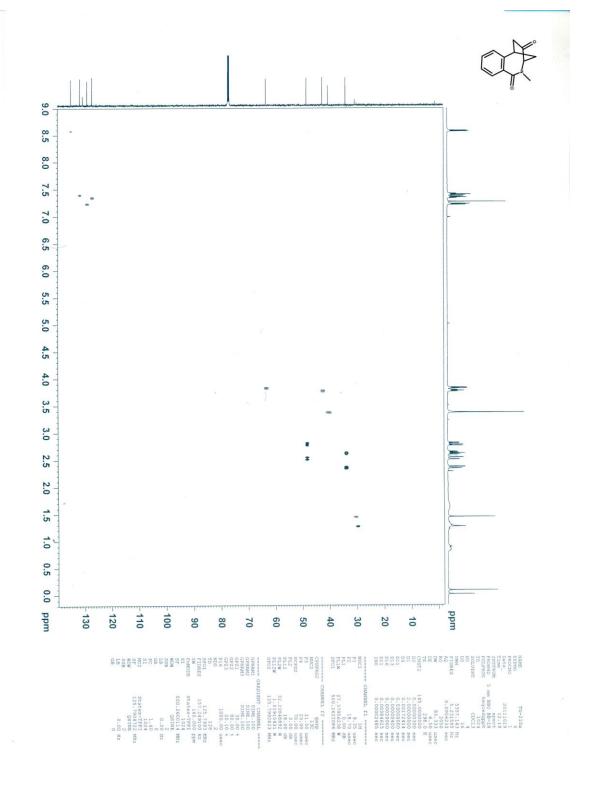


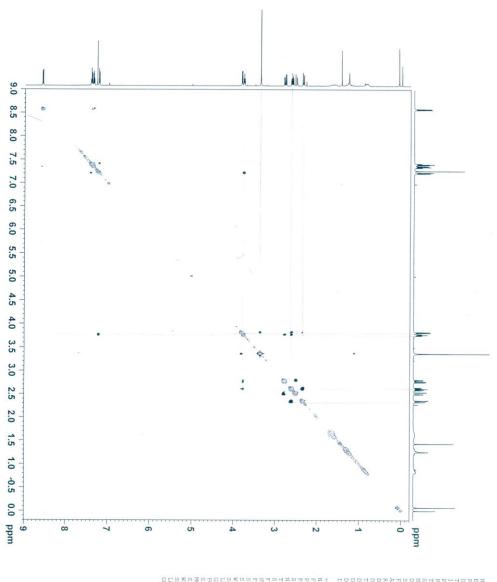








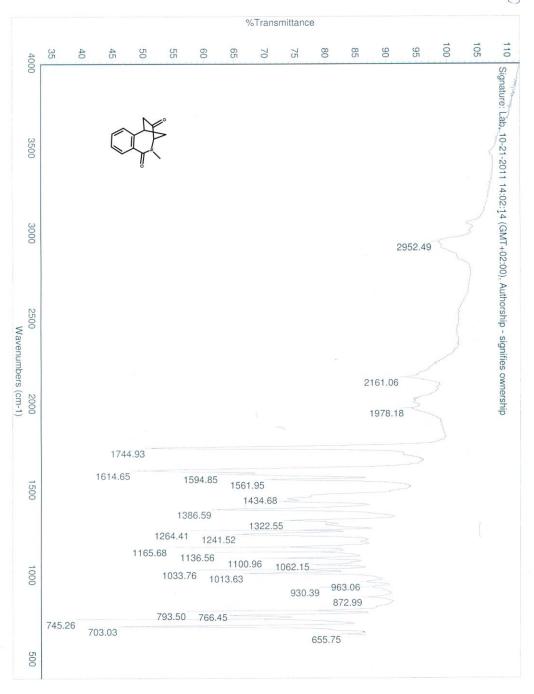




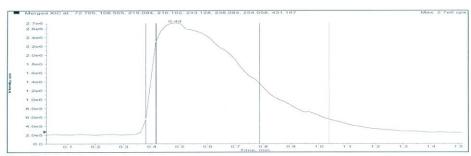
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ST	10	ZHM
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LB	0.00	HZ
GB	0	
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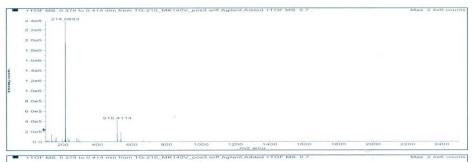
INO 8d	DI	DO	TE	DE	DW	RG	AQ	FIDRES	HWS	DS	SN	SOLVENT	TD	PULPROG	PROBHD	INSTRUM	Time	Date	PROCNO	EXPNO	NAME
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sec	Sec	Sec		Se	usec		sec	2H	HZ												



Sample Name: TG-210 Sample Location: P1-E2 Sample Id: Operator: Milka Data File Name: D:\PE Sciex Data\Projects\Farmaceutski fakultet\Data\TG-210_MK140V_pos3.wiff Acq Time: October 26 2011, 01:29:25 PM Method: D:\TOF_Data\damethods\Night_Seq_Comp_ident1.anm\efc.xml



Merged XIC, Period#:1 Experiment#:1

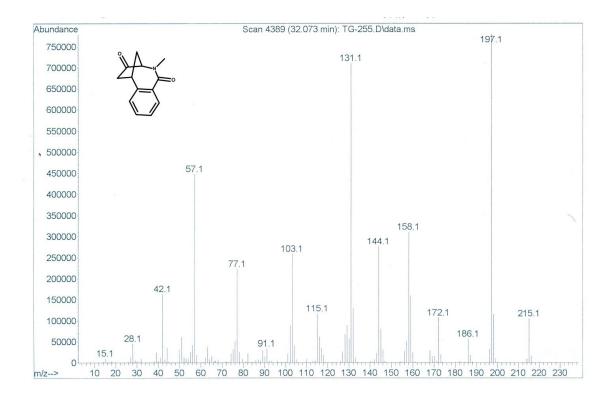


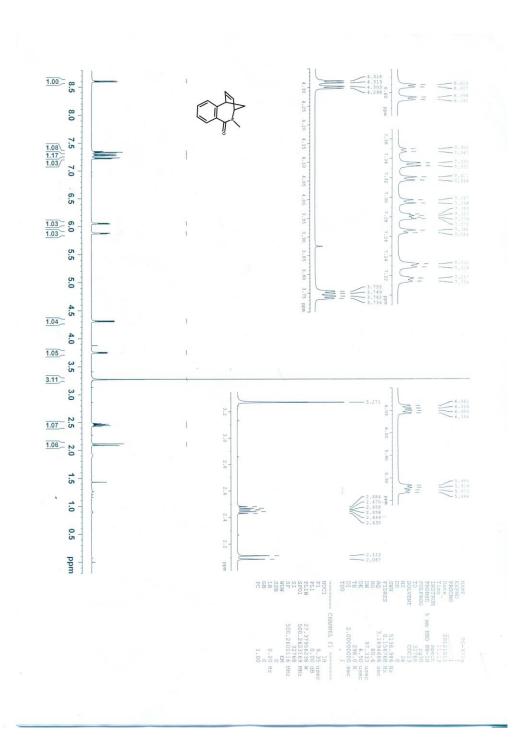


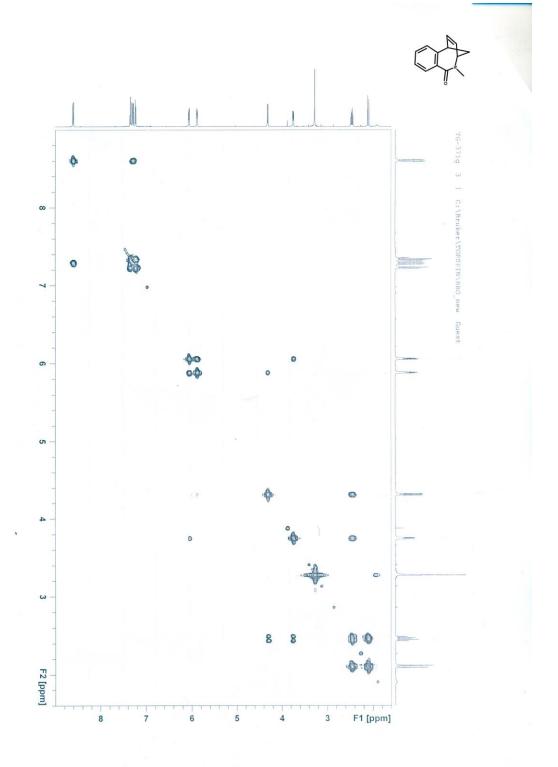
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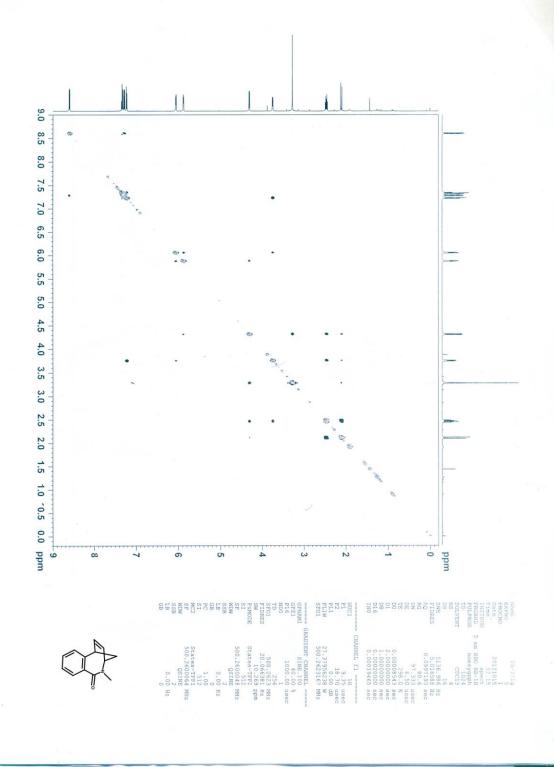
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M+	287271.65	215.09408	215.09187	-2.21182	-10.28	
[M+H]+	1954138.71	216.10191	216.10168	-0.22443	-1.04	-
[M+Na]+	45383.50	238.08385	238.08315	-0.70133	-2.95	

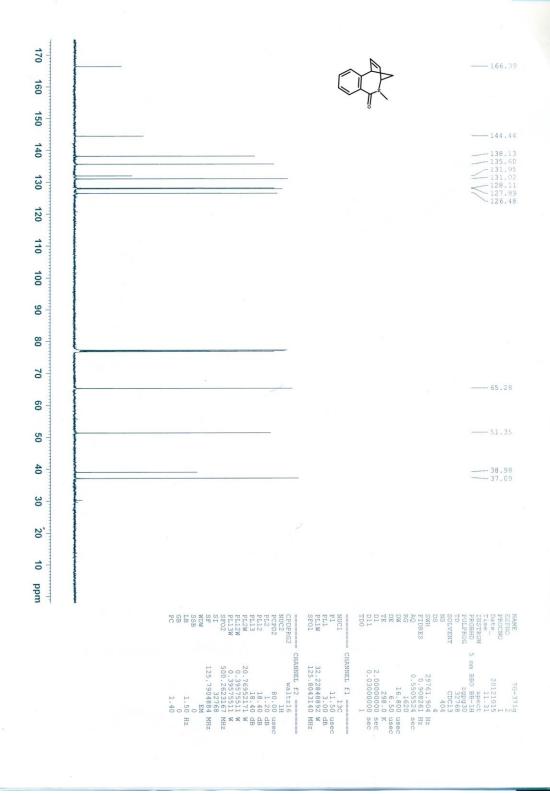


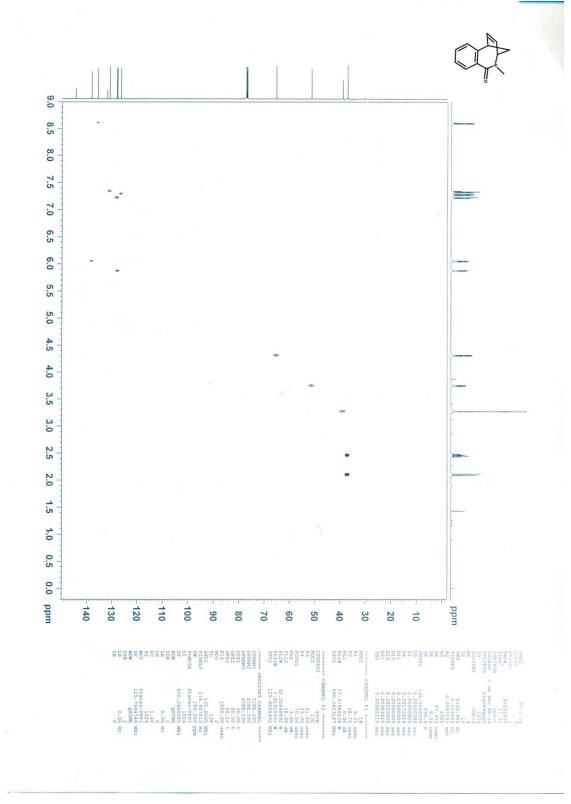




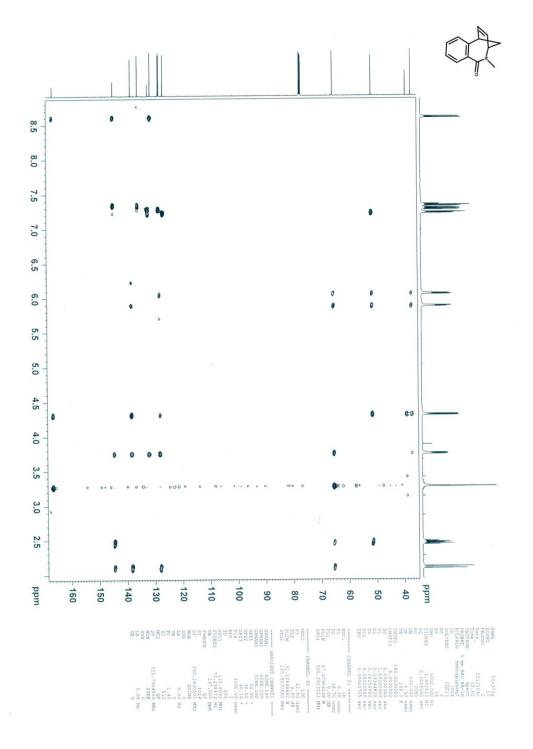


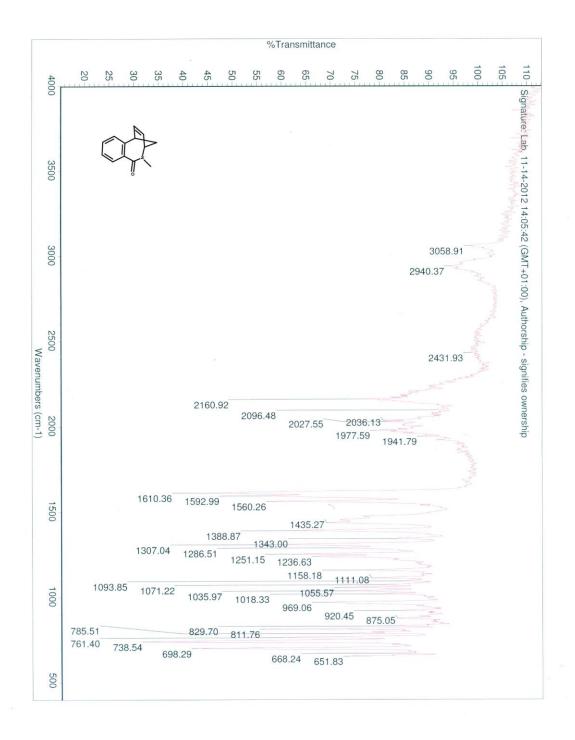




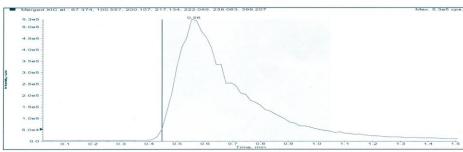




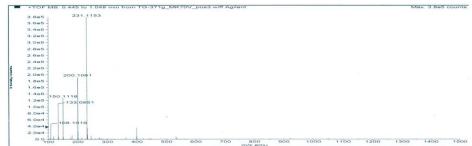




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Merged XIC, Period# : 1 Experiment# : 1





	Formula	Compound name	Mass	Peak RT (min)	Peak area	Description
ı	C13H13NO		199.09971	0.56	7.83144 E6	

Species	Abundance (counts)	Ion Mass	Measured Mass	Error (mDa)	Error (ppm)	Ret. Time Error (min)
[M+H]+	201225.00	200.10699	200.10611	-0.88493	-4.42	-
[2M+H]+	37255.90	399.20670	399.20556	-1.13971	-2.85	-



