Supporting Information

NCI In Vitro Cancer Screen Methodology

For the NCI60 cancer screen, 96 well microtiter plates are used to inoculate 100 μL of human tumor cells in medium with plating densities between 5,000 and 40,000 cells per well, depending on the growth rates of individual cell lines. The cells are grown in RPMI 1640 medium, containing 5% fetal bovine serum and 2 mM L-glutamine. The plates are then incubated at a temperature of 37°C in an environment of 5% CO2, 95% air, and 100% relative humidity. The cells are then left to incubate for 24 hours before exposure to the experimental compounds. The experimental compounds are dissolved in dimethyl sulfoxide at 400 times the maximum concentration that will be administered to the cells. The solution is kept frozen before use in the screen.

After the initial incubation, two plates of each cell line are fixed *in situ* with TCA in order to measure the cell population for each cell line at the time of initial exposure to the drug. The solution of the compound in dimethyl sulfoxide is melted and diluted using complete medium with 50 μg/ml gentamicin until the solution is double the concentration of the maximum test concentration. The final concentrations of the compound are then made through serial dilutions of four, ten, or ½ log times dilute from the initial concentration. 100 μL aliquots of each concentration are added to specific microtiter wells which hold 100 μL of medium. This gives the final experimental drug concentration exposed to the cell lines, as well as a control cell line.

After the administration of the experimental compound, the plates are incubated for a further 48 hours in the same conditions as the initial incubation, a temperature of 37°C in an environment of 5% CO2, 95% air, and 100% relative humidity. The assay is terminated by the introduction of cold TCA to the microtiter plates for adherent cells. The cells are then fixed *in situ* through the slow administration of 50 μL of TCA (cold, 50% w/v) and left to incubate for one hour at 4°C. The resulting supernatant fluid is then disposed of and the plates are washed with tap water five times and air dried. 100 μL of sulforhodamine B solution at 0.4% w/v in 1% acetic acid is then introduced to each well and the plates are incubated for 10 minutes at room temperature. Unbound stain is then discarded by washing the plates five times with 1% acetic acid and air drying them. The remaining bound stain is then dissolved in 10 mM trizma base, and the absorbance is

measured on an automated plate reader set to a wavelength of 515 nm. The same procedure laid out above is used for suspension cells, except the termination of the assay is performed by adding 50 μl of 80% TCA, resulting in a final concentration of 16% TCA, to fix settled cells at the bottom of the wells.

The percent growth of each cell line is then able to be calculated using the seven absorbance values found using the above procedure: initial concentration, control growth, and the experimental growth at the five concentration levels. IC_{50} determinations and all graphs utilized GraphPad Prism software by using the equation *"[Inhibitor] vs. normalized response*"

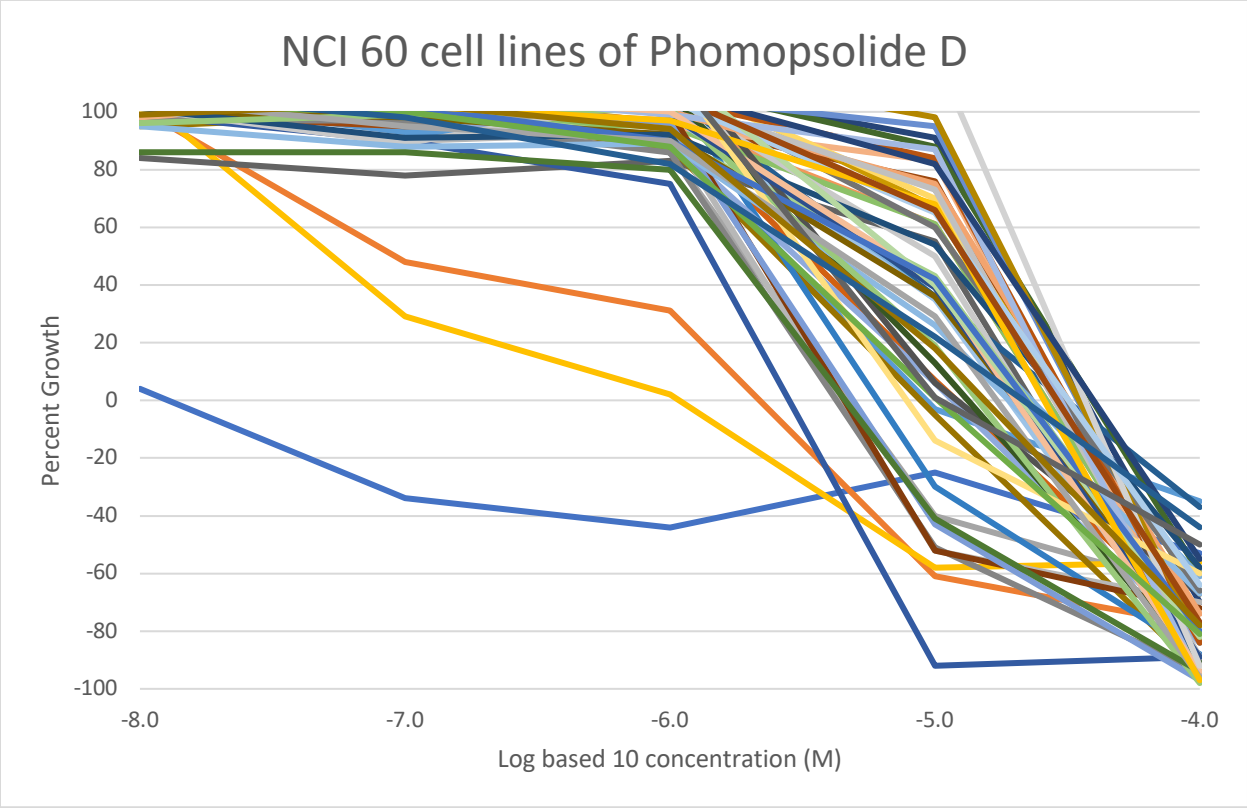
Phomopsolide D

			Percent Growth							
Panel/Cell Line	Time Zero	Ctrl	-8.0	-7.0	-6.0	-5.0	-4.0	Gl50	TGI	LC50
Leukemia										
CCRF-CEM*	0.778	2.587	4	-34	-44	-25	-53	<1.00E-08	1.28E-08	7.94E-05
HL-60(TB}*	0.362	1.714	101	48	31	-61	-78	9.13E-08	2.20E-06	7.66E-06
K-562	0.086	0.686	102	107	86	-40	-66	1.94E-06	4.84E-06	2.46E-05
MOLT-4*	0.326	1.487	105	29	2	-58	-56	5.33E-08	1.08E-06	7.48E-06
RPMl-8226	1.478	3.18	104	93	91	-3	-35	2.72E-06	9.33E-06	>1.00E-04
Non-Small Cell Lung Cancer										
A549/ATCC	0.311	1.578	104	101	108	91	-70	1.79E-05	3.68E-05	7.54E-05
EKVX	0.545	1.477	99	95	96	76	-90	1.43E-05	2.86E-05	5.73E-05
HOP-62	0.460	1.008	84	78	83	55	-96	1.08E-05	2.32E-05	4.95E-05
HOP-92	0.505	1.046	95	99	88	-5	-94	2.57E-06	8.75E-06	3.17E-05
NCI-H226*	0.628	1.845	98	111	106	36	-37	6.24E-06	3.08E-05	>1.00E-04
NCI-H23	0.645	1.719	106	105	109	88	-60	1.81E-05	3.95E-05	8.62E-05
NCI-H322M	0.379	1.14	105	107	105	95	-81	1.80E-05	3.46E-05	6.66E-05
NCI-H460	0.242	1.882	102	102	97	61	-84	1.19E-05	2.64E-05	5.85E-05
NCI-H522	0.567	1.761	101	90	93	-52	-70	1.98E-06	4.40E-06	9.75E-06
Colon Cancer										
COLO 205	0.361	1.31	105	112	103	35	-61	5.95E-06	2.30E-05	7.68E-05
HCC-2998	0.556	1.82	105	97	95	61	-84	1.18E-05	2.62E-05	5.81E-05
HCT-116*	0.154	1.096	99	90	75	-92	-89	1.41E-06	2.81E-06	5.62E-06
HCT-15	0.329	1.815	106	106	96	7	-78	3.29E-06	1.20E-05	4.66E-05
HT29	0.163	0.934	97	97	86	-51	-94	1.82E-06	4.25E-06	9.90E-06
KM12	0.309	1.639	108	135	112	67	-67	1.34E-05	3.15E-05	7.41E-05
SW-620	0.103	0.667	103	110	109	-30	-88	2.66E-06	6.11E-06	2.24E-05
CNS Cancer										

SF-268	0.247	0.845	103	98	90	6	-84	2.96E-06	1.15E-05	4.20E-05
SF-295	0.686	1.94	98	105	95	83	-90	1.56E-05	3.02E-05	5.87E-05
SF-539	0.596	1.795	101	89	105	50	-95	1.00E-05	2.22E-05	4.92E-05
SNB-19	0.352	1.139	109	114	110	70	-78	1.36E-05	2.98E-05	6.49E-05
SNB-75	0.632	1.025	111	113	99	35	-91	5.88E-06	1.90E-05	4.73E-05
U251	0.280	1.393	100	101	91	43	-80	7.22E-06	2.25E-05	5.72E-05
Melanoma										
LOX IMVI*	0.313	2.084	105	103	100	-52	-72	2.12E-06	4.53E-06	9.64E-06
MALME-3M	0.457	0.827	115	115	119	6	-67	4.06E-06	1.20E-05	5.89E-05
M14	0.393	1.12	100	98	92	36	-82	5.72E-06	2.03E-05	5.35E-05
SK-MEL-2	0.689	1.4	101	91	92	54	-58	1.09E-05	3.03E-05	8.41E-05
SK-MEL-28	0.499	1.319	112	113	106	13	-91	4.02E-06	1.34E-05	4.05E-05
SK-MEL-5*	0.262	0.98	102	105	96	-43	-97	2.13E-06	4.89E-06	1.34E-05
UACC-257	0.891	1.892	107	115	100	75	-74	1.48E-05	3.20E-05	6.94E-05
UACC-62	0.491	2.066	103	112	104	73	-89	1.38E-05	2.81E-05	5.72E-05
Ovarian Cancer										
IGROV1	0.309	1.307	95	88	89	26	-67	4.17E-06	1.90E-05	6.58E-05
OVCAR-3	0.548	1.402	96	99	101	19	-98	4.17E-06	1.44E-05	3.88E-05
OVCAR-4	0.440	1.025	109	110	99	39	-89	6.65E-06	2.03E-05	4.98E-05
OVCAR-5	0.410	0.777	106	110	104	84	-84	1.60E-05	3.16E-05	6.26E-05
OVCAR-8	0.477	1.972	109	107	108	60	-66	1.20E-05	3.00E-05	7.49E-05
SK-OV-3	0.510	1.293	112	120	115	98	-82	1.84E-05	3.50E-05	6.63E-05
Renal Cancer										
786-0	0.390	1.626	86	86	80	-41	-94	1.77E-06	4.57E-06	1.46E-05
A498	0.400	0.834	102	107	99	87	-96	1.60E-05	3.00E-05	5.63E-05
ACHN	0.379	1.531	103	106	100	41	-94	6.94E-06	2.00E-05	4.72E-05
CAKl-1*	0.438	0.565	126	150	177	120	-92	2.14E-05	3.68E-05	6.33E-05
RXF 393	0.429	0.981	101	111	116	-14	-60	3.22E-06	7.83E-06	6.10E-05
SN12C	0.431	1.871	104	110	104	65	-64	1.32E-05	3.20E-05	7.79E-05
TK-10	0.500	1.39	108	111	115	40	-82	7.38E-06	2.13E-05	5.46E-05
UO-31	0.343	1.559	102	102	90	42	-80	6.80E-06	2.21E-05	5.70E-05
Prostate Cancer										
PC-3	0.168	0.82	104	95	90	29	-96	4.52E-06	1.70E-05	4.28E-05
DU-145	0.242	1.064	103	102	97	68	-97	1.29E-05	2.59E-05	5.20E-05
Breast Cancer										
MCF7	0.312	1.31	102	100	88	1	-81	2.75E-06	1.04E-05	4.21E-05
NCI/ADR-RES	0.463	1.389	105	111	107	82	-55	1.71E-05	3.96E-05	9.18E-05
MDA-MB-231/ATCC	0.408	1.265	105	113	106	66	-77	1.29E-05	2.88E-05	6.44E-05
HS 578T	0.298	0.628	110	121	115	1	-50	3.71E-06	1.05E-05	9.85E-05
MDA-MB-435	0.421	1.754	99	103	94	18	-78	3.81E-06	1.55E-05	5.12E-05

T-47D	0.615	1.311	106	98	82	22	-44	3.40E-06	2.15E-05	>1.00E-04

*Cell line data omitted as an outlier



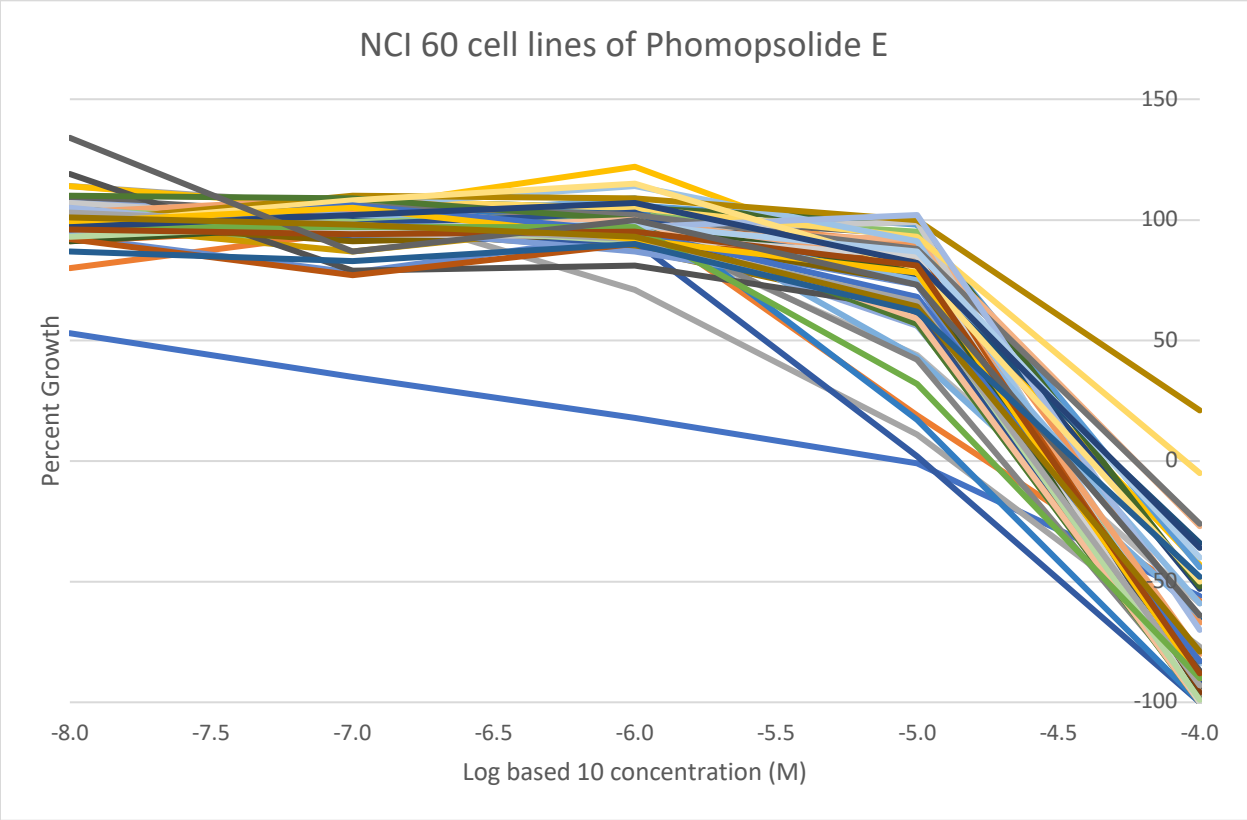
Phomopsolide E

			Percent Growth							
Panel/Cell Line	Time Zero	Ctrl	-8.0	-7.0	-6.0	-5.0	-4.0	Gl50	TGI	LC50
Leukemia										
CCRF-CEM*	0.778	2.565	53	35	18	-1	-56	1.40E-08	9.10E-06	7.81E-05
HL-60(TB}	0.362	1.688	80	95	101	19	-58	4.17E-06	1.76E-05	7.95E-05
K-562	0.086	0.57	114	106	71	11	-77	2.22E-06	1.33E-05	4.95E-05
MOLT-4	0.326	1.329		105	122	79	-43	1.72E-05	4.43E-05	>1.00E-04
RPMl-8226	1.478	2.918	99	99	106	98	-44	2.19E-05	4.91E-05	>1.00E-04
Non-Small Cell Lung Cancer										
A549/ATCC	0.311	1.588	95	98	97	90	-53	1.91E-05	4.28E-05	9.59E-05
EKVX	0.545	1.413	105	98	101	87	-92	1.61E-05	3.06E-05	5.81E-05
HOP-62	0.460	0.836	109	102	101	94	-94	1.71E-05	3.16E-05	5.84E-05
HOP-92	0.505	0.998	106	96	88	63	-93	1.21E-05	2.53E-05	5.28E-05
NCI-H226	0.628	1.804	93	100	104	77	-65	1.55E-05	3.47E-05	7.79E-05
NCI-H23	0.645	1.654	94	108	105	99	-52	2.12E-05	4.53E-05	9.71E-05
NCI-H322M	0.379	0.992	93	78	94	73	-99	1.36E-05	2.66E-05	5.18E-05

NCI-H460	0.242	1.775	103	103	101	90	-67	1.80E-05	3.74E-05	7.76E-05
NCI-H522	0.567	1.768	102	102	96	44	-59	7.79E-06	2.68E-05	8.11E-05
Colon Cancer										
COLO 205	0.361	1.223	99	100	109	43	-64	7.85E-06	2.52E-05	7.38E-05
HCC-2998	0.556	1.428	94	93	102	95	-90	1.75E-05	3.26E-05	6.06E-05
HCT-116	0.154	1.023	104	93	91	2	-100	2.89E-06	1.05E-05	3.24E-05
HCT-15	0.329	1.882	91	97	98	57	-92	1.11E-05	2.40E-05	5.20E-05
HT29	0.163	0.912	103	105	98	42	-97	7.24E-06	2.01E-05	4.58E-05
KM12	0.309	1.553	98	87	99	78	-96	1.44E-05	2.80E-05	5.45E-05
SW-620	0.103	0.625	100	101	106	17	-100	4.25E-06	1.40E-05	3.74E-05
CNS Cancer										
SF-268	0.247	0.831	107	102	96	56	-87	1.10E-05	2.45E-05	5.48E-05
SF-295	0.686	2.016	100	106	95	92	-27	2.25E-05	5.95E-05	>1.00E-04
SF-539	0.596	1.695	107	100	96	99	-96	1.78E-05	3.21E-05	5.79E-05
SNB-19*	0.352	1.153	101	108	105	93	-5	2.74E-05	8.89E-05	>1.00E-04
SNB-75	0.632	0.99	96	106	114	91	-84	1.72E-05	3.32E-05	6.40E-05
U251	0.280	1.435	103	96	97	78	-100	1.44E-05	2.75E-05	5.25E-05
Melanoma										
LOX IMVI	0.313	2.057	104	101	94	67	-96	1.27E-05	2.57E-05	5.23E-05
MALME-3M	0.457	0.762	119	79	81	63	-87	1.22E-05	2.62E-05	5.66E-05
M14	0.393	1.065	99	91	94	74	-83	1.42E-05	2.95E-05	6.15E-05
SK-MEL-2	0.689	1.427	102	101	95	77	-34	1.74E-05	4.91E-05	>1.00E-04
SK-MEL-28	0.499	1.272	91	98	100	78	-99	1.45E-05	2.77E-05	5.30E-05
SK-MEL-5	0.262	0.959	97	97	87	68	-100	1.28E-05	2.54E-05	5.04E-05
UACC-257	0.891	1.841	103	109	100	84	-80	1.61E-05	3.25E-05	6.57E-05
UACC-62	0.491	1.901	100	94	93	84	-100	1.53E-05	2.87E-05	5.35E-05
Ovarian Cancer										
IGROV1	0.309	1.295	95	102	98	75	-59	1.53E-05	3.62E-05	8.58E-05
OVCAR-3	0.548	1.447	104	99	102	57	-100	1.10E-05	2.30E-05	4.80E-05
OVCAR-4	0.440	0.982	97	98	103	60	-92	1.17E-05	2.49E-05	5.31E-05
OVCAR-5	0.410	0.737	92	77	90	85	-89	1.59E-05	3.08E-05	5.97E-05
OVCAR-8	0.477	1.929	99	106	102	88	-26	2.16E-05	5.89E-05	>1.00E-04
SK-OV-3*	0.510	1.227	99	110	109	100	21	4.29E-05	>1.00E-04	>1.00E-04
Renal Cancer										
786-0	0.390	1.546	110	109	100	57	-100	1.10E-05	2.30E-05	4.80E-05
A498	0.400	0.843	105	94	97	102	-70	2.01E-05	3.93E-05	7.69E-05
ACHN	0.379	1.485	99	96	100	59	-100	1.14E-05	2.35E-05	4.85E-05
CAKl-1	0.438	0.621	96	96	93	85	-100	1.54E-05	2.87E-05	5.36E-05
RXF 393	0.429	0.99	98	108	115	80	-50	1.70E-05	4.11E-05	9.92E-05
SN12C	0.431	1.793	100	97	98	87	-40	1.95E-05	4.81E-05	>1.00E-04
TK-10	0.500	1.285	93	98	91	67	-99	1.27E-05	2.54E-05	5.07E-05
UO-31	0.343	1.513	96	106	95	68	-83	1.32E-05	2.83E-05	6.06E-05

Prostate Cancer										
PC-3	0.168	0.79	103	98	92	66	-93	1.26E-05	2.60E-05	5.36E-05
DU-145	0.242	1.011	99	105	92	78	-90	1.46E-05	2.90E-05	5.77E-05
Breast Cancer										
MCF7	0.312	1.276	97	97	97	32	-90	5.32E-06	1.84E-05	4.71E-05
NCI/ADR-RES	0.463	1.344	97	102	107	82	-36	1.87E-05	4.98E-05	>1.00E-04
MDA-MB-231/ATCC 0.408	0.408	1.115	96	94	95	81	-88	1.52E-05	3.01E-05	5.93E-05
HS 578T	0.298	0.617	134	87	100	73	-64	1.47E-05	3.39E-05	7.85E-05
MDA-MB-435	0.421	1.821	101	98	93	64	-79	1.26E-05	2.82E-05	6.30E-05
T-47D	0.615	1.268	87	83	90	62	-48	1.29E-05	3.68E-05	>1.00E-04

*Cell line data omitted as an outlier



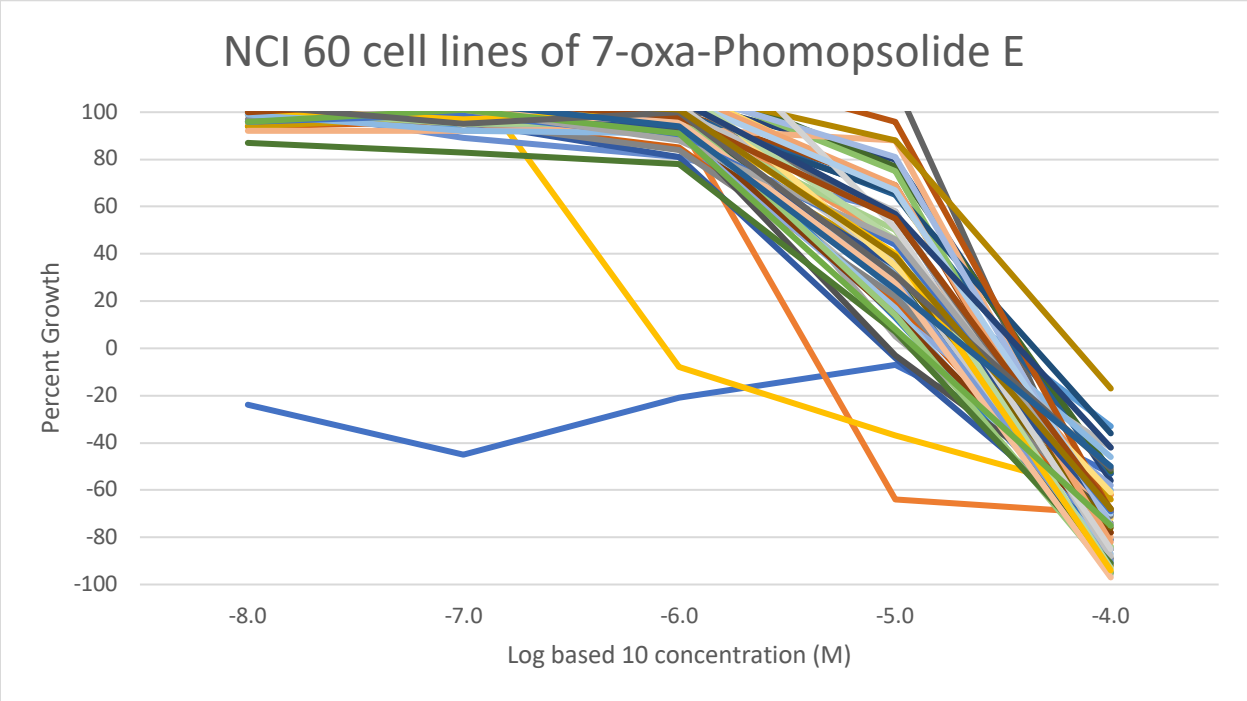
7-Oxa-phomopsolide E

			Percent Growth							
Panel/Cell Line	Time Zero	Ctrl	-8.0	-7.0	-6.0	-5.0	-4.0	Gl50	TGI	LC50
Leukemia										
CCRF-CEM*	0.778	2.565	-24	-45	-21	-7	-53	<1.00E-08	<1.00E-08	8.43E-05
HL-60(TB}*	0.362	1.688	108	107	96	-64	-70	1.95E-06	4.00E-06	8.22E-06
K-562	0.086	0.570	111	125	114	5	-70	3.87E-06	1.16E-05	5.43E-05

MOLT-4	0.326	1.329	111	118	-8	-37	-62	3.47E-07	8.69E-07	3.41E-05
RPMl-8226	1.478	2.918	115	92	110	36	-33	6.53E-06	3.31E-05	>1.00E-04
Non-Small Cell Lung Cancer										
A549/ATCC	0.311	1.588	101	103	105	80	-56	1.66E-05	3.88E-05	9.04E-05
EKVX	0.545	1.413	100	97	100	69	-85	1.33E-05	2.80E-05	5.91E-05
HOP-62	0.460	0.836	110	99	98	112	-89	2.04E-05	3.62E-05	6.43E-05
HOP-92	0.505	0.998	99	97	93	29	-92	4.72E-06	1.74E-05	4.49E-05
NCI-H226	0.628	1.804	106	106	100	65	-53	1.34E-05	3.55E-05	9.38E-05
NCI-H23	0.645	1.654	110	108	115	77	-52	1.62E-05	3.94E-05	9.59E-05
NCI-H322M	0.379	0.992	103	89	81	58	-90	1.13E-05	2.46E-05	5.37E-05
NCI-H460	0.242	1.775	105	103	100	46	-62	8.28E-06	2.66E-05	7.80E-05
NCI-H522	0.567	1.768	103	101	97	18	-42	3.92E-06	1.99E-05	>1.00E-04
Colon Cancer										
COLO 205	0.361	1.223	102	113	100	24	-60	4.51E-06	1.92E-05	7.63E-05
HCC-2998	0.556	1.428	108	119	112	75	-84	1.44E-05	2.96E-05	6.11E-05
HCT-116	0.154	1.023	110	96	81	-4	-81	2.32E-06	9.07E-06	3.94E-05
HCT-15	0.329	1.882	94	96	85	20	-78	3.48E-06	1.60E-05	5.15E-05
HT29	0.163	0.912	97	96	84	22	-74	3.50E-06	1.69E-05	5.60E-05
KM12	0.309	1.553	94	98	90	37	-64	5.71E-06	2.33E-05	7.28E-05
SW-620	0.103	0.625	107	110	104	13	-85	3.92E-06	1.36E-05	4.37E-05
CNS Cancer										
SF-268	0.247	0.831	103	96	91	15	-58	3.46E-06	1.61E-05	7.75E-05
SF-295	0.686	2.016	92	92	93	88	-80	1.68E-05	3.34E-05	6.63E-05
SF-539	0.596	1.695	96	102	103	36	-96	6.27E-06	1.88E-05	4.49E-05
SNB-19	0.352	1.153	106	111	110	67	-72	1.32E-05	3.03E-05	6.92E-05
SNB-75	0.632	0.990	108	108	96	17	-87	3.77E-06	1.45E-05	4.42E-05
U251	0.280	1.435	101	95	95	50	-84	9.98E-06	2.36E-05	5.55E-05
Melanoma										
LOX IMVI	0.313	2.057	103	100	95	14	-78	3.60E-06	1.43E-05	4.99E-05
MALME-3M	0.457	0.762	103	101	93	-3	-70	2.83E-06	9.37E-06	5.00E-05
M14	0.393	1.065	101	101	91	33	-76	5.09E-06	2.00E-05	5.73E-05
SK-MEL-2	0.689	1.427	108	98	97	66	-36	1.44E-05	4.44E-05	>1.00E-04
SK-MEL-28	0.499	1.272	111	110	98	30	-95	5.08E-06	1.74E-05	4.38E-05
SK-MEL-5	0.262	0.959	101	105	96	29	-91	4.83E-06	1.74E-05	4.56E-05
UACC-257	0.891	1.841	111	115	108	69	-82	1.34E-05	2.86E-05	6.11E-05
UACC-62	0.491	1.901	103	105	100	58	-88	1.13E-05	2.48E-05	5.46E-05
Ovarian Cancer										
IGROV1	0.309	1.295	99	92	91	33	-46	5.13E-06	2.62E-05	>1.00E-04
OVCAR-3	0.548	1.447	101	105	100	14	-95	3.82E-06	1.35E-05	3.87E-05

OVCAR-4	0.440	0.982	112	107	91	35	-70	5.44E-06	2.16E-05	6.45E-05
OVCAR-5	0.410	0.737	108	115	121	96	-69	1.91E-05	3.82E-05	7.65E-05
OVCAR-8	0.477	1.929	106	105	105	55	-71	1.09E-05	2.73E-05	6.80E-05
SK-OV-3	0.510	1.227	118	128	109	88	-17	2.31E-05	6.93E-05	>1.00E-04
Renal Cancer										
786-0	0.390	1.546	87	83	78	7	-91	2.48E-06	1.18E-05	3.83E-05
A498	0.400	0.843	108	110	109	81	-75	1.58E-05	3.30E-05	6.89E-05
ACHN	0.379	1.485	102	100	96	28	-97	4.75E-06	1.67E-05	4.18E-05
CAKl-1	0.438	0.621	133	147	144	51	-85	1.02E-05	2.37E-05	5.54E-05
RXF 393	0.429	0.990	106	120	113	35	-61	6.42E-06	2.31E-05	7.69E-05
SN12C	0.431	1.793	103	107	106	67	-70	1.33E-05	3.08E-05	7.18E-05
TK-10	0.500	1.285	115	121	109	46	-93	8.54E-06	2.13E-05	4.89E-05
UO-31	0.343	1.513	96	99	90	44	-69	7.41E-06	2.45E-05	6.76E-05
Prostate Cancer										
PC-3	0.168	0.790	102	101	88	46	-68	7.85E-06	2.52E-05	6.96E-05
DU-145	0.242	1.011	101	97	100	40	-94	6.86E-06	1.99E-05	4.69E-05
Breast Cancer										
MCF7	0.312	1.276	96	101	91	8	-75	3.14E-06	1.25E-05	4.97E-05
NCI/ADR-RES	0.463	1.344	105	109	105	57	-42	1.19E-05	3.77E-05	>1.00E-04
MDA-MB-231/ATCC 0.408	0.408	1.115	100	105	98	55	-68	1.09E-05	2.80E-05	7.17E-05
HS 578T	0.298	0.617	103	95	100	31	-51	5.34E-06	2.40E-05	9.77E-05
MDA-MB-435	0.421	1.821	102	106	101	39	-68	6.72E-06	2.33E-05	6.85E-05
T-47D*	0.615	1.268	102	104	94	25	-50	4.31E-06	2.14E-05	>1.00E-04

*Cell line data omitted as an outlier



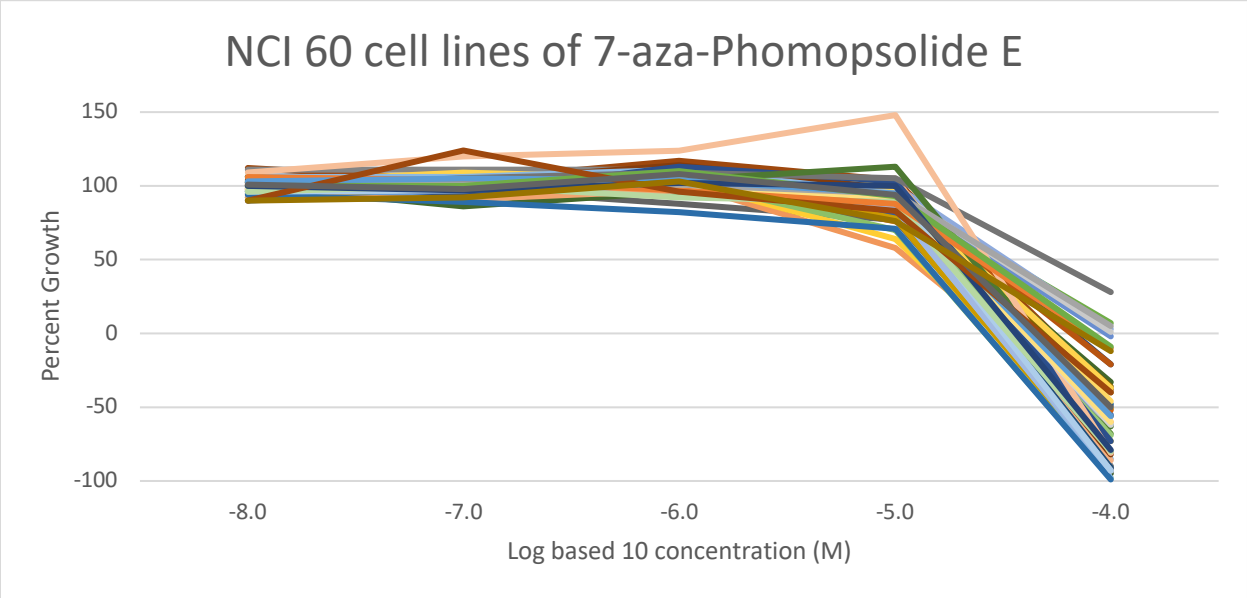
7-aza-phomopsolide E

			Percent Growth							
Panel/Cell Line	Time Zero	Ctrl	-8.0	-7.0	-6.0	-5.0	-4.0	GI50	TGI	LC50
Leukemia										
HL-60(TB)	0.362	1.826	90	97	97	81	-55	1.68E-05	3.93E-05	9.19E-05
K-562*	0.086	0.666	102	101	104	76		2.23E-05	>1.00E-04	>1.00E-04
MOLT-4*	0.326	1.487	106	107	100	99	-49	2.14E-05	4.66E-05	>1.00E-04
RPMI-8226	1.478	2.955	99	104	102	100	-51	2.13E-05	4.57E-05	9.79E-05
Non-Small Cell Lung Cancer										
A549/ATCC*	0.311	1.610	103	99	100	92	7	3.11E-05	>1.00E-04	>1.00E-04
EKVX*	0.545	1.427	106	107	108	101	-21	2.62E-05	6.74E-05	>1.00E-04
HOP-62*	0.460	0.978	112	104	117	104	-38	2.40E-05	5.40E-05	>1.00E-04
HOP-92	0.505	1.030	101	98	88	77	-90	1.46E-05	2.89E-05	5.75E-05
NCI-H226*	0.628	1.770	92	102	103	80	-40	1.79E-05	4.67E-05	>1.00E-04
NCI-H23*	0.645	1.676	92	102	106	102	-48	2.21E-05	4.78E-05	>1.00E-04
NCI-H322M*	0.379	0.811	100	86	96	91	-33	2.14E-05	5.40E-05	>1.00E-04
NCI-H460*	0.242	2.029	99	100	102	93	-2	2.82E-05	9.42E-05	>1.00E-04
NCI-H522	0.567	1.743	94	106	102	58	-60	1.16E-05	3.10E-05	8.27E-05
Colon Cancer										

COLO 205	0.361	1.483	97	98	104	64	-73	1.26E-05	2.93E-05	6.83E-05
HCC-2998	0.556	1.702	96	96	104	94	-85	1.77E-05	3.37E-05	6.41E-05
HCT-116	0.154	1.057	106	101	104	70	-98	1.31E-05	2.60E-05	5.16E-05
HCT-15	0.329	1.677	96	100	108	81	-80	1.56E-05	3.20E-05	6.53E-05
HT29	0.163	1.100	101	109	103	89	-52	1.89E-05	4.26E-05	9.61E-05
KM12	0.309	1.395	111	111	111	92	-90	1.70E-05	3.20E-05	6.03E-05
SW-620	0.103	0.675	98	105	107	78	-93	1.46E-05	2.86E-05	5.60E-05
CNS Cancer										
SF-268	0.247	0.925	103	104	98	84	-68	1.67E-05	3.57E-05	7.63E-05
SF-295*	0.686	1.761	96	104	99	100	3	3.26E-05	>1.00E-04	>1.00E-04
SF-539	0.596	1.800	103	102	97	105	-86	1.94E-05	3.55E-05	6.49E-05
SNB-19*	0.352	1.247	98	101	105	96	1	3.05E-05	>1.00E-04	>1.00E-04
SNB-75*	0.632	1.212	91	105	111	101	-46	2.23E-05	4.87E-05	>1.00E-04
U251	0.280	1.433	102	97	97	85	-94	1.57E-05	2.99E-05	5.67E-05
Melanoma										
LOX IMVI	0.313	2.062	100	101	98	86	-92	1.59E-05	3.04E-05	5.82E-05
MALME-3M	0.457	0.797	104	103	114	98	-82	1.85E-05	3.51E-05	6.64E-05
M14	0.393	1.183	102	99	101	89	-56	1.86E-05	4.10E-05	9.08E-05
SK-MEL-2*	0.689	1.316	100	102	98	88	-36	2.01E-05	5.10E-05	>1.00E-04
SK-MEL-28	0.499	1.423	95	101	105	95	-91	1.74E-05	3.24E-05	6.04E-05
SK-MEL-5	0.262	0.990	102	103	105	94	-95	1.70E-05	3.13E-05	5.77E-05
UACC-257	0.891	1.876	97	99	101	84	-62	1.71E-05	3.76E-05	8.26E-05
UACC-62	0.491	1.849	93	91	97	88	-93	1.61E-05	3.05E-05	5.76E-05
Ovarian Cancer										
IGROV1*	0.309	1.187	102	109	105	97	-37	2.26E-05	5.33E-05	>1.00E-04
OVCAR-3	0.548	1.486	106	106	111	95	-98	1.70E-05	3.09E-05	5.61E-05
OVCAR-4	0.440	1.095	96	99	106	88	-69	1.73E-05	3.61E-05	7.52E-05
OVCAR-5	0.410	0.770	102	95	113	103	-73	1.99E-05	3.83E-05	7.37E-05
OVCAR-8*	0.477	1.986	98	105	102	94	-21	2.43E-05	6.59E-05	>1.00E-04
SK-OV-3*	0.510	1.254	99	105	109	105	28	5.21E-05	>1.00E-04	>1.00E-04
Renal Cancer										
786-0	0.390	1.647	94	89	82	71	-99	1.33E-05	2.61E-05	5.13E-05
A498	0.400	0.840	106	98	104	113	-63	2.28E-05	4.37E-05	8.40E-05
ACHN	0.379	1.557	100	98	101	85	-93	1.57E-05	2.99E-05	5.71E-05
CAKl-1	0.438	0.708	109	120	124	148	-81	2.68E-05	4.44E-05	7.34E-05
RXF 393	0.429	0.936	98	101	106	95	-62	1.93E-05	4.01E-05	8.36E-05
SN12C	0.431	1.753	97	98	100	92	-60	1.89E-05	4.03E-05	8.58E-05
TK-10	0.500	1.321	96	97	105	94	-93	1.72E-05	3.18E-05	5.88E-05
UO-31	0.343	1.398	96	100	92	89	-80	1.69E-05	3.34E-05	6.60E-05

Prostate Cancer										
PC-3*	0.168	0.827	106	104	97	88	-10	2.45E-05	7.94E-05	>1.00E-04
DU-145*	0.242	1.037	102	101	101	95	5	3.17E-05	>1.00E-04	>1.00E-04
Breast Cancer										
MCF7	0.312	1.632	103	105	104	95	-56	1.97E-05	4.23E-05	9.07E-05
NCI/ADR-RES*	0.463	1.350	100	100	110	93	-9	2.62E-05	8.14E-05	>1.00E-04
MDA-MB-231/ATCC	0.408	1.085	100	97	102	100	-79	1.91E-05	3.63E-05	6.90E-05
HS 578T*	0.298	0.694	90	124	96	83	-40	1.86E-05	4.72E-05	>1.00E-04
MDA-MB-435*	0.421	1.925	101	98	108	94	-50	2.01E-05	4.47E-05	9.94E-05
T-47D*	0.615	1.493	90	92	103	76	-12	2.00E-05	7.39E-05	>1.00E-04

*Cell line data omitted as an outlier

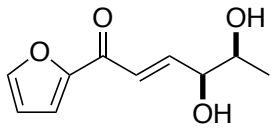


EXPERIMENTAL

General Methods and Materials: Commercial reagents were used without further purification. Dry methylene dichloride, (DCM) was obtained from an in-house dry solvent system which employs nitrogen gas pressure to pass solvent through activated alumina columns. Air and moisture sensitive reactions were carried out under nitrogen atmosphere with help of septa and syringes. Silica coated glass backed thin layer chromatography plates were developed in solvents (% by volume) and stained with *p*-anisaldehyde or potassium permanganate. For compound purification flash column chromatography was performed using 60-200 mesh silica gel. ^{1}H NMR and ^{13}C NMR spectra were recorded on 600 MHz spectrometers. Chemical shift for internal standard $CDCl_3$ was set to δ 7.26 for ^{1}H NMR and δ 77.36 for ^{13}C NMR. For IR, samples were analyzed neat on a

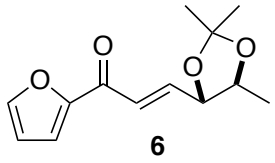
Bruker Alpha-P FT-IR spectrometer. High-resolution mass spectrometry data were obtained from the mass spectrometry center at Barnett Institute at Northeastern. Optical rotations were measured on a Jasco P-2000 digital polarimeter, concentration and solvent of choice are mentioned in parentheses.

(4S,5S,2E)-4,5-Dihydroxy-1-(2-furanyl)-hexa-2-en-1-one (A):



To a 25 mL round bottom flask was added tert-butyl alcohol (3 mL), water (5 mL), $K_3Fe(CN)_6$ (988 mg, 3 mmol), K_2CO_3 (414 mg, 3 mmol), $CH_3SO_2NH_2$ (95 mg, 1 mmol), $(DHQ)_2$-PHAL (15.4 mg, 2 mol%), OsO_4 (2.5 mg, 1 mol%). The mixture was stirred at room temperature until both phases were clear, and then cooled to 0 °C. To this solution was added dienone **(5)** (162 mg, 1 mmol) and the reaction was stirred vigorously for 12 h. The reaction mixture was extracted with ethyl acetate (3 x 20 mL). The combined organic layers were then washed with brine and dried over Na_2SO_4. The solvent was removed *in vacuo*. The crude product was purified by flash chromatography on silica gel (3:1 EtOAc/hexane) to yield the diol **(A)** (180 mg, 92% yield) as a light yellow oil: R_f (EtOAc) = 0.52; $[\alpha]^{25}_D$ = –55 (c 1.31, MeOH); IR (thin film, cm^{-1}) 3417, 2976, 2930, 1665, 1620, 1465, 1397, 1326, 1154, 1055, 770; ^{1}H NMR (270 MHz, $CDCl_3$) δ 7.59 (dd, J = 1.7, 0.5 Hz, 1H), 7.27 (dd, J = 3.7, 0.5 Hz, 1H), 7.11 (d, J = 15.7 Hz, 1H), 7.04 (dd, J = 15.7, 2.2 Hz, 1H), 6.52 (dd, J = 3.7, 1.7 Hz, 1H), 5.27 (br/s, 1H), 4.15 (m, 1H), 3.76 (dq, J = 6.2, 6.2 Hz, 1H), 3.38 (br/s, 1H), 1.24 (d, J = 6.4 Hz, 1H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 177.8, 152.9, 147.2, 146.3, 125.1, 118.7, 112.6, 75.9, 70.3, 19.1; ESI HRMS Calcd for $[C_{10}H_{12}O_4 + Na]$+: 219.0628, Found: 219.0631.

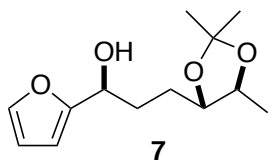
(4S,5S,2E)-4,5-Isopropylenedioxy-1-(2-furanyl)-hexa-2-en-1-one (**6**):



6

To a solution of diol **B** (196 mg, 1 mmol) in acetone (5 mL) was added PPTS (2%) and 2,2-DMP (312 mg, 3 mmol). The reaction mixture was stirred at room temperature for 2 h. Then acetone was removed at the reduced pressure. Flash chromatography (1:10 EtOAc/hexane) on silica gel afforded acetonide **(6)** (234 mg, 99%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.68; $[\alpha]^{25}_{D}$ = –17 (c 1.28, CH_2Cl_2); IR (thin film, cm^{-1}) 2984, 1671, 1629, 1467, 1227,1089; ^{1}H NMR (270 MHz, $CDCl_3$) δ 7.62 (dd, J = 1.5, 0.7 Hz, 1H), 7.27 (dd, J = 3.5, 0.7 Hz, 1H), 7.05 (d, J = 15.8 Hz, 1H), 7.03 (dd, J = 15.8, 4.2 Hz, 1H), 6.55 (dd, J = 3.5, 1.7 Hz, 1H), 4.16 (dd, J = 8.8, 4.2 Hz, 1H), 3.85 (dq, J = 8.9, 5.9 Hz, 1H), 1.45 (s, 3H), 1.42 (s, 3H), 1.33 (d, J = 5.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 177.4, 153.0, 146.9, 142.6, 125.2, 118.3, 112.5, 109.3, 82.0, 27.3, 26.6, 16.7; ESI HRMS Calcd for $[C_{13}H_{16}O_4 + Na]$+: 259.0947, Found: 259.0964.

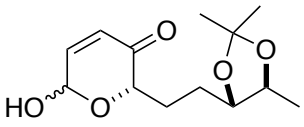
(S)-1-(furan-2-yl)-3-((4S,5S)-2,2,5-trimethyl-1,3-dioxolan-4-yl)propan-1-ol (7)



7

To a 10 mL flask was added enone **(6)** (236 mg, 1 mmol), formic acid-triethylamine (2:1, 2 mL) and Noyori asymmetric transfer hydrogenation catalyst (R)-Ru(η6-Mesitylene)-(S,S)-TsDPEN (I-33) (2.9 mg, 5 μmol). The resulting orange solution was stirred at room temperature for 24 h. The mixture was diluted with water (4 mL) and extracted with EtOAc (3 x 15 mL). The organic layers were combined, washed with sat. $NaHCO_3$ and brine, dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (2:8 EtOAc/hexane) on silica gel yielded alcohol **(7)** (228 mg, 95%) as a light yellow oil: R*f* (50% EtOAc/hexanes) = 0.67; $[\alpha]^{25}_D = -25$ (c 2.18, MeOH); IR (thin film, cm^{-1}) 3425, 2984, 2934, 1380, 1241, 1093, 1006; ^1H NMR (270 MHz, $CDCl_3$) δ 7.34 (d, J = 1.7 Hz, 1H), 6.31 (dd, J = 3.2, 1.7 Hz, 1H), 6.22 (d, J = 3.2 Hz, 1H), 4.71 (ddd, J = 7.7, 4.9, 4.7 Hz, 1H), 3.70 (dq, J = 8.4, 5.9 Hz, 1H), 3.55 (ddd, J = 8.2, 8.1, 3.7 Hz, 1H), 3.00 (d, J = 4.7 Hz, 1H), 1.96 (m, 2H), 1.62 (m, 2H), 1.35 (s, 3H), 1.34 (s, 3H), 1.21 (d, J = 5.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 156.6, 141.7, 110.0, 107.9, 105.6, 82.1, 76.6, 67.7, 32.4, 28.3, 27.2, 27.1, 17.3; ESI HRMS Calcd for $[C_{13}H_{20}O_4 + Na]+$: 263.1260, Found: 263.1261.

(2S)-2-[(3S,4S)-3,4-Isopropylenedioxypentanyl]-6-hydroxy-2H-pyran-3-(6H)-one (8):*

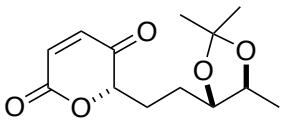


8

* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

Alcohol (**7**) (240 mg, 1 mmol), THF (3 mL), and H_2O (0.7 mL) were added to a 10 mL round bottom flask and cooled to 0 °C. $NaHCO_3$ (168 mg, 2 mmol), $NaOAc•3H_2O$ (136 mg, 1 mmol), and NBS (178 mg, 1 mmol) were added to the solution and the mixture was stirred for 1 h at 0 °C. The reaction was quenched with saturated aqueous $NaHCO_3$ (10 mL), extracted with EtOAc (3 x 15 mL), dried (Na_2SO_4), concentrated under reduced pressure. Flash chromatography (3:7 EtOAc/hexane) on silica gel yielded enone **(8)** (228 mg, 89%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.37; $[\alpha]^{25}_D$ = +5 (c 1.77, CH_2Cl_2); IR (thin film, cm^{-1}) 3376, 2982, 1694, 1372, 1244, 1086, 1034; ^1H NMR (270 MHz, $CDCl_3$) major isomer δ 6.87 (dd, J = 10.1, 3.5 Hz, 1H), 6.01 (d, J = 10.1 Hz, 1H), 5.61 (dd, J = 3.7, 3.7 Hz, 1H), 4.57 (dd, J = 7.4, 4.2 Hz, 1H), 4.08 (m, 1H), 3.71 (m, 1H), 1.96 (m, 2H), 1.61 (m, 2H), 1.35 (s, 3H), 1.34 (s, 3H), 1.22 (d, J = 5.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 196.3, 144.6, 127.4, 107.9, 87.5, 81.9, 78.4, 76.5, 73.6, 27.3, 27.2, 27.1, 26.0, 17.5; ESI HRMS Calcd for $[C_{13}H_{20}O_5 + Na]$+: 279.1203, Found: 279.1194.

(6S)-6-[(3S,4S)-3,4-Isopropylenedioxypentanyl]-pyran-2,5-dione (B):*

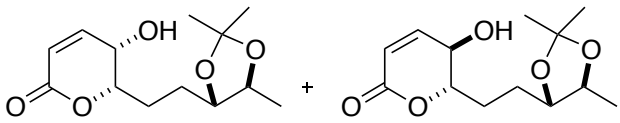


Pyranone **(8)** (90.5 mg, 0.35 mmol) was dissolved in 4 mL of acetone and cooled to 0 °C. Jones reagent (2.97 M, 120 μL, 0.35 mmol) was added dropwise into the solution. After 15 min the starting material was no longer visible by TLC and the solution was filtered through a pad of celite

* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

and washed with 50 mL of Et_2O. The organic layer was washed with saturated $NaHCO_3$ (30 mL) and brine (30 mL), dried (Na_2SO_4), and concentrated to afford dione **(B)**(88 mg, 98%) as a yellow oil: R*f* (50% EtOAc/hexanes) = 0.27; $[\alpha]^{25}_D = -54$ (c 1.05, CH_2Cl_2); IR (thin film, cm^{-1}) 2982, 2934, 1734, 1697, 1380, 1225, 1096; ^1H NMR (270 MHz, $CDCl_3$) δ 6.87 (d, J = 10.7 Hz, 1H), 6.75 (d, J = 10.7 Hz, 1H), 4.97 (dd, J = 6.7, 1.5 Hz, 1H), 3.67 (dq, J = 9.3, 5.9 Hz, 1H), 3.46 (m, 1H), 2.15 (m, 2H), 1.68 (m, 2H), 1.31 (s, 6H), 1.22 (d, J = 5.9, 1H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 192.7, 160.3, 138.2, 135.2, 108.1, 83.4, 81.3, 76.5, 29.8, 27.2, 27.1, 26.6, 17.3; ESI HRMS Calcd for $[C_{13}H_{18}O_5 + Na]+$: 277.1046, Found: 277.1045.

(6S)-6-[(3S,4S)-3,4-Isopropylenedioxypentanyl]-(5S)-5-hydroxy-5,6-dihydro-pyran-2-one (9a) and (6S)-6-[(3S,4S)-3,4-Isopropylenedioxypentanyl]-(5R)--5-hydroxy-5,6-dihydropyran-2-one (9b):*



9a **9b**

Pyrandione **(B)** (88 mg, 0.35 mmol) was dissolved in 2 mL of CH_2Cl_2, cooled to 0 °C, and 3 mL of a 0.4 M solution of $CeCl_3$ in MeOH was added to the solution. $NaBH_4$ (17 mg, 0.45 mmol) was added and the solution was stirred for 20 min. 15 mL of EtOAc and 30 mL of water were added. The phases were separated, and the aqueous layer was extracted with EtOAc (3 x 15 mL). The organic fractions were combined, washed with brine (30 mL), dried (Na_2SO_4) and concentrated.

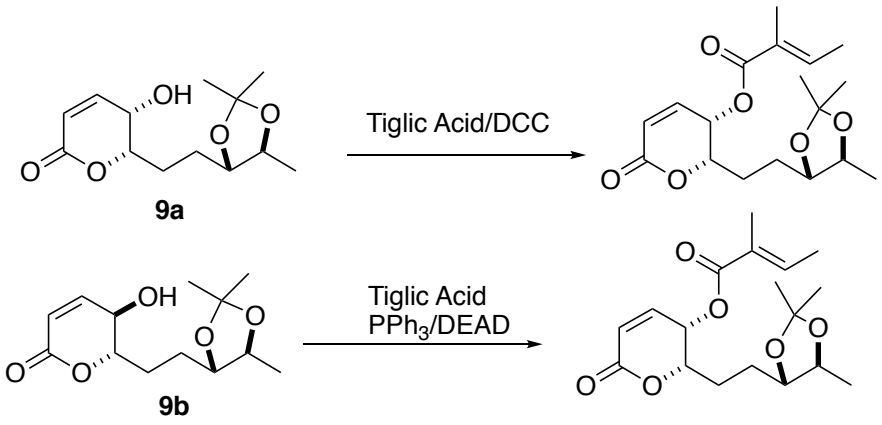
* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

Purification on silica gel (3:7 EtOAc/hexane) yielded pyranone **(9a)** (60.5 mg, 68%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.20; $[\alpha]^{25}_{D}$ = +60 (c 1.90, MeOH); IR (thin film, cm-1) 3416, 2982, 1708, 1380, 1257, 1096; ^{1}H NMR (270 MHz, $CDCl_3$) δ 6.99 (dd, J = 9.7, 5.9 Hz, 1H), 6.06 (d, J = 9.7 Hz, 1H), 4.37 (ddd, J = 7.9, 5.2, 2.5 Hz, 1H), 4.09 (m, 1H), 3.72 (dq, J = 8.4, 5.9 Hz, 1H), 3.54 (dd, J = 8.4, 6.4 Hz, 1H), 3.05 (br/s, 1H), 1.98 (m, 2H), 1.71 (m, 2H), 1.35 (s, 3H), 1.34 (s, 3H), 1.23 (d, J = 5.9 Hz); ^{13}C NMR (68 MHz, $CDCl_3$) δ 164.0, 144.4, 122.8, 108.0, 81.6, 80.4, 76.5, 61.6, 27.3, 27.1, 26.7, 26.3, 17.3; ESI HRMS Calcd for $[C_{13}H_{20}O_5 + Na]$+: 279.1208, Found: 279.1228.

Minor isomer (**9b)** (24.1 mg, 27%) is colorless oil: R*f* (50% EtOAc/hexanes) = 0.31; $[\alpha]^{25}_{D}$ = −53 (c 1.05, MeOH); IR (thin film, cm^{-1}) 3477, 2983, 2933, 1709, 1379, 1243, 1090; ^{1}H NMR (270 MHz, $CDCl_3$) δ 6.85 (dd, J = 9.9, 1.7 Hz, 1H), 5.94 (dd, J = 9.9, 1.7 Hz, 1H), 4.37 (ddd, J = 10.1, 1.7, 1.4 Hz, 1H), 4.28 (ddd, J = 10.1, 6.2, 3.7 Hz, 1H), 3.72 (dq, J = 8.2, 5.9 Hz, 1H), 3.54 (dd, J = 7.9, 4.7 Hz, 1H), 1.97 (m, 2H), 1.74 (m, 2H), 1.37 (s, 3H), 1.36 (s, 3H), 1.24 (d, J = 5.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 163.4, 149.9, 120.1, 108.1, 82.1, 81.9, 76.5, 65.6, 28.1, 27.3, 27.1, 26.0, 17.1; ESI HRMS Calcd for $[C_{13}H_{20}O_5 + Na]$+: 279.1208, Found: 279.1207.

2-Methylbut-2-enoic acid (2S)-2-[(3S,4S)-3,4-isopropylenedioxypentanyl]-6-oxo-3,6-dihydro-2H-pyran-(3S)-3-yl Ester (C):[*]

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

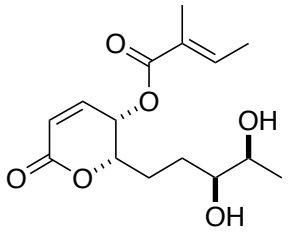


To a 10 mL round bottom flask was added alcohol **(9a)** (143.6 mg, 0.56 mmol), CH_2Cl_2 (9 mL), tiglic acid (112.2 mg, 1.12 mmol), dicyclohexylcarbodiimide (231.5 mg, 1.12 mmol), and DMAP (1%). The reaction mixture was stirred at room temperature for 6 h. Then it was filtered through a pad of celite and concentrated. The crude product was purified by silica gel chromatography (2:8 EtOAc/hexane) to yield ester **(C)** (155 mg, 82%) as a colorless oil.

Mitsunobu Reaction: Compound **(9b)** (97 mg, 0.38 mmol) was dissolved in 5 mL of benzene. The solution was cooled to 0 °C and triphenylphosphine (199 mg, 0.76 mmol), tiglic acid (76 mg, 0.76 mmol), and diethyl azodicarboxylate (132 mg, 0.76 mmol) were added to the solution. The solution was stirred for 12 h, quenched with saturated aqueous sodium bicarbonate (20 mL), and extracted with EtOAc (2 x 20 mL). The organic fractions were combined, washed with brine (30 mL), dried (Na_2SO_4) and concentrated. Purification on silica gel (3:7 EtOAc/hexane) yielded ester **(C)** (74 mg, 57%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.65; $[\alpha]^{25}_D$ = +160 (c 1.70, MeOH); IR (thin film, cm^{-1}) 2983, 2934, 1714, 1650, 1380, 1254, 1129, 1074; ^{1}H NMR (270 MHz, $CDCl_3$) δ 6.97 (dd, J = 9.7, 5.9 Hz, 1H), 6.84 (qq, J = 6.9, 1.0, 1H), 6.16 (d, J = 9.7 Hz, 1H), 5.24 (dd, J = 5.9, 2.7 Hz, 1H), 4.56 (ddd, J = 8.4, 5.4, 2.7 Hz, 1H), 3.67 (dq, J = 8.9, 5.9 Hz, 1H), 3.49 (ddd, J = 8.4, 5.9, 5.2 Hz, 1H), 1.99 (m, 2H), 1.78 (s, 3H), 1.75 (d, J = 6.9 Hz, 3H), 1.65 (m, 2H),

1.32 (s, 3H), 1.30 (s, 3H), 1.20 (d, J = 5.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 166.7, 162.9, 140.7, 139.6, 127.4, 124.7, 107.9, 81.4, 78.5, 76.4, 62.7, 27.2, 27.1, 26.9, 26.7, 17.3, 14.5, 12.0; ESI HRMS Calcd for $[C_{18}H_{26}O_6 + Na]$+: 361.1627, Found: 361.1609.

Phomopsolide D (1):

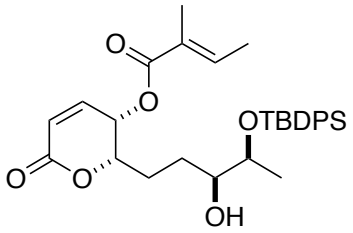


Phomopsolide D **(1)**

To a 10 mL round bottom flask was added ester **(C)** (75 mg, 0.22 mmol), MeOH (4 mL) and HCl (1 M, 1 mL). The reaction mixture was stirred at room temperature for 12 h. Then the solution was extracted with EtOAc (3 x 15 mL). The organic fractions were combined, washed with saturated $NaHCO_3$ (30 mL) and brine (30 mL), dried (Na_2SO_4) and concentrated. Purification on silica gel (7:3 EtOAc/hexane) yielded phomopsolide D **(1)** (63 mg, 95%) as a colorless oil: R*f* (100% EtOAc) = 0.32; $[\alpha]^{25}_D$ = +296 (c 1.25, MeOH); IR (thin film, cm^{-1}) 3450, 2968, 2928, 1711, 1649, 1257, 1132, 829, 733; 1H NMR (270 MHz, $CDCl_3$) δ 6.98 (dd, J = 9.7, 5.9 Hz, 1H), 6.87 (qq, J = 6.9, 1.0 Hz, 1H), 6.16 (d, J = 9.7 Hz, 1H), 5.24 (dd, J = 5.9, 2.7 Hz, 1H), 4.56 (ddd, J = 8.9, 4.5, 2.5 Hz, 1H), 3.56 (dq, J = 6.4, 6.2 Hz, 1H), 3.32 (ddd, J = 10.2, 6.0, 6.0 Hz, 1H), 2.83 (br/s, 1H), 2.66 (br/s, 1H), 2.04 (m, 2H), 1.80 (s, 3H), 1.78 (d, J = 6.7 Hz, 3H), 1.66 (m, 2H), 1.15 (d, J = 6.4 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 166.8, 163.2, 141.0, 139.7, 127.4, 124.6, 78.8, 75.1, 70.6,

62.9, 28.3, 26.3, 19.5, 14.5, 12.0; ESI HRMS Calcd for $[C_{15}H_{22}O_6 + Na]^+$: 321.1314, Found: 321.1322.

(5*S*,6*S*)-5-(2-Methyl-2-butenoyloxy)-6-[(3*S*,4*S*)-4-(*tert*-butyldiphenylsilanyloxy)-3-hydroxypentyl]-5,6-dihydropyran-2-one (D):*

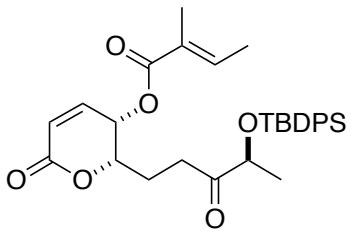


To a stirred solution of phomopsolide D (**1**) (0.263 g, 0.88 mmol) in CH_2Cl_2 (3 mL) were added TBDPSCl (0.267 g, 0.97 mmol), triethylamine (45 mg, 0.44 mmol), and DMAP (54 mg, 0.44 mmol). The reaction mixture was stirred at rt for 24 h and then diluted with Et_2O (50 mL). The organic layer was washed with diluted HCl (1 M, 20 mL), sat. aq. $NaHCO_3$ (20 mL), brine (100 mL) and dried over Na_2SO_4. After removal of the solvent *in vacuo*, flash chromatography (3:7 EtOAc/hexanes) on silica gel afforded TBDPS-ether **(D)** (0.360 g, 76%) as a colorless oil and the starting material phomopsolide D **(1)** (40 mg, 15%). *Rf* (30% EtOAc) = 0.40; $[\alpha]^{25}_D$ +120 (*c* 1.02, MeOH); IR (thin film, cm^{-1}) 3494, 3074, 2957, 2932, 2858, 1732, 1651, 1428, 1255, 1112, 824; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.68 (m, 4H), 7.40 (m, 6H), 7.01 (dd, *J* = 9.6, 6.0 Hz, 1H), 6.91 (qq, *J* = 7.2, 1.2 Hz, 1H), 6.20 (d, *J* = 9.6 Hz, 1H), 5.22 (dd, *J* = 6.0, 2.4 Hz, 1H), 4.54 (ddd, *J* = 9.0, 6.4, 3.2 Hz, 1H), 3.72 (dq, *J* = 6.0, 5.4 Hz, 1H), 3.43 (ddd, *J* = 8.4, 5.4, 5.4 Hz, 1H), 2.49 (d, *J* = 4.8 Hz, 1H), 2.04 (m, 1H), 1.82 (dd, *J* = 1.2, 1.2 Hz, 3H), 1.80 (dd, *J* = 6.6, 1.2 Hz, 3H), 1.74 (m, 1H), 1.58 (m, 2H), 1.07 (s, 9H), 1.03 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 166.7, 163.0, 140.8, 139.4, 135.8, 135.7, 133.9, 133.2, 129.8, 129.7, 127.7, 127.5, 127.4, 124.7, 78.5, 75.0, 72.9, 63.0, 27.8, 27.0, 26.4, 19.6, 19.2, 14.4, 11.9; ESI HRMS Calcd for $[C_{31}H_{40}O_6Si + Na]^+$:

* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

559.2486, Found: 559.2504.

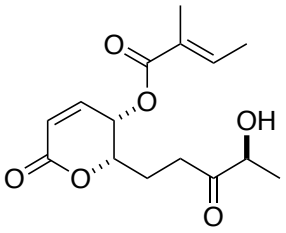
(5*S*,6*S*)-5-(2-Methyl-2-butenoyloxy)-6-[(4*S*)-4-(*tert*-butyldiphenylsilanyloxy)-3-oxopentyl]-5,6-dihydropyran-2-one (E):*



Alcohol (145 mg, 0.27 mmol) was dissolved in acetone (4 mL) and cooled to 0 °C. Jones reagent (2.97 M, 91 μL, 0.27 mmol) was added dropwise into the solution. After 15 min the starting material was no longer visible by TLC and the solution was filtered through a pad of celite and washed with Et_2O (50 mL). The organic layer was washed with sat. aq. $NaHCO_3$ (30 mL) and brine (30 mL), dried ($NaSO_4$), and concentrated to afford ketone **(E)** (134 mg, 95%) as a colorless oil: R_f (30% EtOAc/hexanes) = 0.48; $[\alpha]^{25}_D$ +124 (*c* 2.11, CH_2Cl_2); IR (thin film, cm^{-1}) 2930, 1717, 1428, 1253, 1111, 823, 740, 703; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.63 (m, 4H), 7.38 (m, 6H), 7.00 (dd, *J* = 9.6, 6.0 Hz, 1H), 6.91 (qq, *J* = 7.2, 1.2 Hz, 1H), 6.19 (d, *J* = 10.2 Hz, 1H), 5.18 (q, *J* = 6.0 Hz, 1H), 4.42 (ddd, *J* = 9.6, 3.6, 3.6 Hz, 1H), 4.24 (dd, *J* = 7.2, 7.2 Hz, 1H), 2.80 (m, 2H), 2.02 (m, 1H), 1.82 (m, 7H), 1.23 (d, *J* = 6.6 Hz, 3H), 1.12 (s); ^{13}C NMR (150 MHz, $CDCl_3$) δ 212.2, 166.6, 162.7, 140.7, 139.5, 135.7, 135.6, 135.3, 133.3, 132.8, 129.9, 129.8, 127.8, 127.6, 127.5, 124.7, 78.0, 75.4, 63.1, 32.1, 26.9, 23.8, 20.8, 19.1, 14.5, 12.0; ESI HRMS Calcd for $[C_{31}H_{38}O_6Si + Na]^+$: 557.2330, Found: 557.2325.

Phomopsolide E (2):

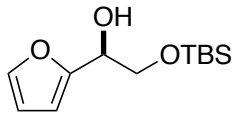
* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.



Phomopsolide E **(2)**

Ketone (126 mg, 0.24 mmol), MeCN (1 mL), and HF-Py (2:1) (2.5 M, 2 mL, ~4.9 mmol) were added to a plastic vial and stirred at rt for 12 h. The reaction was quenched with sat. aq. $NaHCO_3$ (5 mL), and the aqueous layer was extracted with EtOAc (2 x 60 mL). The organic layer was washed with HCl (1 M, 10 mL), dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (3:7 EtOAc/hexanes) on silica gel yielded 60 mg (0.20 mmol, 86%) of phomopsolide E (**2**) as a colorless oil: R_f (100% EtOAc) 0.63; $[\alpha]^{25}_D$ +246 (*c* 1.20, MeOH); IR (thin film, cm^{-1}) 3494, 2977, 2932, 1713, 1650, 1381, 1256, 1130, 1089, 829; ^1H NMR (600 MHz, $CDCl_3$) δ 7.00 (dd, *J* = 10.2, 6.0 Hz, 1H), 6.89 (qq, *J* = 6.6, 1.2 Hz, 1H), 6.18 (d, *J* = 9.6 Hz, 1H), 5.27 (dd, *J* = 6.0, 2.4 Hz, 1H), 4.57 (ddd, *J* = 10.2, 3.6, 3.6 Hz, 1H), 4.26 (dq, *J* = 6.6, 4.2 Hz, 1H), 3.43 (d, *J* = 4.8 Hz, 1H), 2.76 (m, 2H), 2.12 (m, 1H), 2.00 (m, 1H), 1.81 (dd, *J* = 1.2, 1.2 Hz, 3H), 1.79 (dd, *J* = 7.2, 1.2 Hz, 3 H), 1.38 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 211.6, 166.7, 162.6, 140.8, 139.7, 127.4, 124.6, 77.8, 72.7, 63.0, 32.4, 24.0, 19.8, 14.5, 12.0; ESI HRMS Calcd for $[C_{15}H_{20}O_6 + Na]^+$: 319.1152, Found: 319.1154.

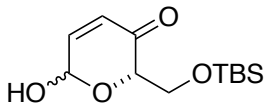
(*S*)-2-((*tert*-butyldimethylsilyl)oxy)-1-(furan-2-yl)ethan-1-ol (F):



To a 20 ml flask was added ketone **(11a)** (1.42 g, 5.9 mmol), formic acid-triethylamine (1:1, 6 mL), CH_2Cl_2 (3 mL), and Noyori asymmetric transfer hydrogenation catalyst (R)-Ru(η^6-Mesitylene)-(S,S)-TsDPEN (I-33) (18 mg, 0.5 mol%). The resulting solution was stirred at room temperature for 24 h. The mixture was diluted with water (20 ml) and extracted with EtOAc (3 x 15 mL). The organic layers were combined, washed with sat. $NaHCO_3$ and brine, dried over

Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (30% EtOAc/hexane) on silica gel yielded 1.20 g (5.0 mmol, 84%) of alcohol **(F)** as a light yellow oil: R*f* (30% EtOAc/hexanes) = 0.54; $[\alpha]^{25}_D$ = –15.4 (c 1.01, CH_2Cl_2); IR (thin film, cm^{-1}) 3447, 2954, 2930, 2884, 2857, 1471, 1473, 1361; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.35 (dd, J = 7.8, 1.2 Hz, 1H), 6.31 (dd, J = 3.6, 1.8 Hz, 1H), 6.28 (dd, J = 3.6, 1.2 Hz, 1H), 4.73 (dd, J = 7.2, 4.2 Hz, 1H), 3.85 (dd, J = 9.6, 4.8 Hz, 1H), 3.82 (dd, J = 9.6, 7.2 Hz, 1H), 2.81 (br, 1H), 0.88 (s, 9H), 0.05 (s, 3H), 0.04 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 153.9, 142.2, 110.4, 107.2, 68.6, 65.9, 26.0, 18.5, –5.2 (2C).

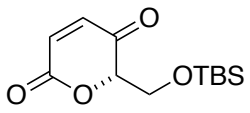
(2*S*)-2-(*tert*-Butyldimethylsilanyloxymethyl)-6-hydroxy-2*H*-pyran-3-(6*H*)-one (G):[*]



Alcohol **I-21** (290 mg, 1.2 mmol), THF (4 mL), and H_2O (1 mL) were added to a 10 mL round bottom flask and cooled to 0 °C. $NaHCO_3$ (202 mg, 2.4 mmol), $NaOAc•3H_2O$ (163 mg, 1.2 mmol), and NBS (213 mg, 1.2 mmol) were added to the solution and the mixture was stirred for 1h at 0 °C. The reaction was quenched with saturated aqueous $NaHCO_3$ (3 mL), extracted with EtOAc (3 x 15 mL), dried (Na_2SO_4) and concentrated. Flash chromatography (EtOAc/hexane, 3:7) on silica gel yielded enone **(G)** (280 mg, 92%) as a colorless oil. Major isomer: R_f (30% EtOAc/Hex) = 0.27; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.88 (dd, *J* = 10.2, 3.0 Hz, 1H), 6.08 (d, *J* = 10.2 Hz, 1H), 5.75 (dd, *J* = 6.0, 3.0 Hz, 1H), 4.53 (dd, *J* = 4.8, 2.4 Hz, 1H), 3.98 (dd, *J* = 11.4, 4.8 Hz, 1H), 3.88 (dd, *J* = 11.4, 2.4 Hz, 1H), 1.97 (br, 1H), 0.82 (s, 9H), 0.01 (s, 3H), –0.01 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 194.9, 145.8, 128.2, 88.1, 76.8, 63.5, 26.0, 18.5, –5.2, –5.3.

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

(6*S*)-6-*tert*-Butyldimethylsilanyloxymethylpyran-2,5-dione (12a):[*]

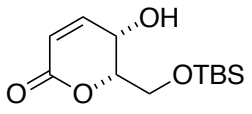


12a

Pyranone (270 mg, 1.05 mmol) was dissolved in 5 mL of acetone and cooled to 0 °C. Jones reagent (2.97 M, 354 μL, 1.05 mmol) was added dropwise into the solution. After 15 min the starting material was no longer visible by TLC and the solution was filtered through a pad of celite and washed with 50 mL of Et_2O. The organic layer was washed with saturated $NaHCO_3$ (30 mL) and brine (30 mL), dried ($NaSO_4$), and concentrated to afford dione **(12a)** (240 mg, 89%) as a white solid: mp = 71-73 °C; R_f (40% EtOAc/Hex) = 0.75; $[\alpha]^{25}_D$ = –60 (*c* 1.2, CH_2Cl_2); ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.87 (d, *J* = 10.2 Hz, 1H), 6.73 (d, *J* = 10.2 Hz, 1H), 4.83 (dd, *J* = 2.4, 1.8 Hz, 1H), 4.04 (dd, *J* = 10.2, 1.8 Hz, 1H), 3.99 (dd, *J* = 10.2, 2.4 Hz, 1H), 0.77 (s, 9H), -0.012 (s, 3H), -0.035 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 192.8, 160.7, 139.0, 136.5, 84.6, 65.4, 25.8, 18.3, –5.5, –5.7.

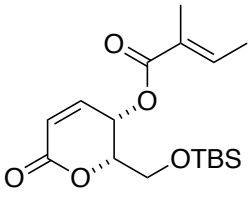
(5*S*,6*S*)-6-*tert*-Butyldimethylsilanyloxymethyl-5-hydroxy-5,6-dihydropyran-2-one (H):[*]

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.
[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.



Pyrandione (210 mg, 0.82 mmol) was dissolved in 4 mL of CH_2Cl_2, cooled to 0 °C, and 4 mL of a 0.4 M solution of $CeCl_3$ in MeOH was added to the solution. $NaBH_4$ (62 mg, 1.64 mmol) was added and the solution was stirred for 20 min. 15 mL of EtOAc and 30 mL of water were added. The phases were separated, and the aqueous layer was extracted with EtOAc (3 x 25 mL). The organic fractions were combined, washed with brine (30 mL), dried (Na_2SO_4) and concentrated. Purification on silica gel (EtOAc/hexane, 3:7) yielded alcohol **(H)** (196 mg, 93%) as a colorless oil: R_f (40% EtOAc/hexanes) = 0.35; $[\alpha]^{25}_D$ = +91 (*c* 1.2, CH_2Cl_2); ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (dd, *J* = 9.6, 6.0 Hz, 1H), 6.06 (d, *J* = 9.6 Hz, 1H), 4.33 (m, 2H), 4.04 (dd, *J* = 10.2, 6.6 Hz, 1H), 3.96 (dd, *J* = 10.2, 4.2 Hz, 1H), 3.29 (br, d, *J* = 6.0 Hz, 1H), 0.87 (s, 9H), 0.086 (s, 3H), 0.083 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 163.5, 144.5, 123.0, 79.4, 61.9, 61.0, 25.9, 18.3, –5.34, –5.35.

(5S, 6S)-5-(2-methyl-2-butenoyloxy)-6-(*tert*-Butyldimethylsilanyloxymethyl)-5,6-dihydropyran-2-one (13a):[*]

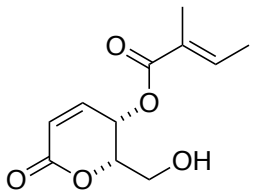


13a

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

Alcohol (136 mg, 0.53 mmol), tiglic acid (105 mg, 1.05 mmol), dicyclohexylcarbodiimide (217 g, 1.05 mmol), and dimethylaminopyridine (catalytic amount) were dissolved in 64 mL of CH_2Cl_2. The reaction mixture was stirred at room temperature for 5 h. The reaction mixture was then filtered through a pad of celite with excess Et_2O and concentrated. The crude product was purified by silica gel flash chromatography eluting with 10% EtOAc/Hexanes to yield 152mg (0.45 mmol, 85%) of **(13a)** as a clear oil: R_f (30% EtOAc/Hex) = 0.78; $[\alpha]^{25}_D$ = +250 (*c* 1.10, CH_2Cl_2); IR (thin film, cm^{-1}) 2955, 2930, 2857, 1715, 1253, 1134, 1096, 1068, 837; ^1H NMR (500 MHz, $CDCl_3$) δ 7.07 (dd, *J* = 10.0, 6.0 Hz, 1H), 6.86 (dd, *J* = 14.0, 6.0 Hz, 1H), 6.17 (d, *J* = 9.5 Hz, 1H), 5.33 (dd, *J* = 6.0 Hz, 2.5 Hz, 1H), 4.56 (ddd, *J* = 7.0, 7.0, 2.5 Hz, 1H), 3.88 (d, *J* = 7.0 Hz, 1H), 1.81-1.76 (m, 6H), 0.83 (s, 9H), 0.01 (d, *J* = 16.5 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 166.0, 162.4, 141.0, 139.3, 127.7, 124.9, 78.5, 60.9, 60.2, 25.7, 18.1, 14.5, 12.0, –5.5, –5.6; CI HRMS Calcd for $[C_{17}H_{28}O_5Si + H]^+$: 341.1784, Found: 341.1772.

(5*S*, 6*S*)-5-(2-Methyl-2-butenoyloxy)-6-hydroxymethyl-5,6-dihydropyran-2-one (I):[*]

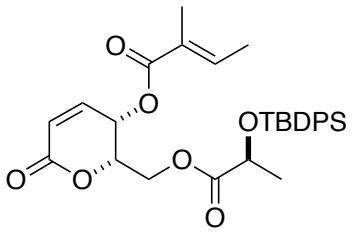


Ester **(13a)** (140 mg, 0.41 mmol), 1 mL of CH_3CN, and HF (5 %, 2 mL, ~5.0 mmol) were added to a plastic vial and stirred at rt for 10 h. The reaction was quenched with saturated $NaHCO_3$, the

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

aqueous layer was extracted with EtOAc (2 x 30 mL), and the organic layer was dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (60% EtOAc/hexane) on silica gel yielded 81 mg (0.36 mmol, 87%) of alcohol **(I)** as a colorless oil: R_f (50% EtOAc/hexanes) = 0.23; $[\alpha]^{25}_D$ = +285 (*c* 1.02, CH_2Cl_2); IR (thin film, cm^{-1}) 3446, 2934, 1712, 1649, 1382, 1256, 1131, 1066; ^1H NMR (270 MHz, $CDCl_3$) δ7.02 (dd, *J* = 9.6, 6.0 Hz, 1H), 6.95-6.85 (m, 1H), 6.24 (d, *J* = 9.6 Hz, 1H), 5.41 (dd, *J* = 6.0, 2.7 Hz, 1H), 4.64 (ddd, *J* = 6.5, 6.5, 2.7 Hz, 1H), 3.94 (dd, *J* = 12.0 Hz, 6.9 Hz, 1H), 3.75 (dd, *J* = 12.0 Hz, 6.3 Hz, 1H), 1.82-1.78 (m, 6H); ^{13}C NMR (68 MHz, $CDCl_3$) 167.1, 162.3, 140.2, 139.1, 127.1, 125.0, 79.1, 61.9, 60.3, 14.5, 11.9; ESI HRMS Calcd for $[C_{11}H_{14}O_5 + Na]^+$: 249.0739, Found: 249.0751.

(5*S*, 6*S*)-5-(2-Methyl-2-butenoyloxy)-6-[(2*S*)-2-(*tert*-butyldiphenylsilanyloxy)-propionyloxymethyl]-5,6-dihydropyran-2-one (J):[*]

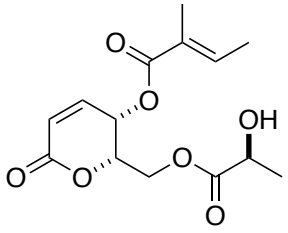


Alcohol (79 mg, 0.35 mmol), (2*S*)-(*tert*-butyldiphenylsilanoxy) propionic acid (228 mg, 0.70 mmol), dicyclohexylcarbodiimide (143 mg, 0.70 mmol), and dimethylaminopyridine (catalytic amount) were dissolved in 8 mL of CH_2Cl_2. The reaction mixture was stirred at room temperature for 6 h. The reaction mixture was then filtered through a pad of Celite with Et_2O (40 mL) and

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

concentrated. The crude product was purified by silica gel flash chromatography eluting with 20% EtOAc/Hexanes to yield 164 mg (0.31 mmol, 89%) of as a colorless oil **(J)**: R_f (30% EtOAc/hexanes) = 0.47; $[\alpha]^{25}_D$ = +108 (*c* 1.02, CH_2Cl_2); IR (thin film, cm^{-1}) 3069, 2962, 2936, 2860, 1750, 1717, 1651, 1428, 1248, 1135, 824; ^1H NMR (270 MHz, $CDCl_3$) δ 7.69-7.62 (m, 4H), 7.44 (m, 6H), 6.99 (dd, *J* = 9.7, 5.7 Hz, 1H), 6.87 (m, 1H), 6.20 (d, *J* = 9.7 Hz, 1H), 5.03 (dd, *J* = 5.7, 2.7 Hz, 1H), 4.46 (ddd, *J* = 6.4, 6.4, 2.7 Hz, 1H), 4.31 (q, *J* = 6.7 Hz, 1H), 4.20 (m, 2H), 1.83-1.79 (m, 6H), 1.38 (d, *J* = 6.7 Hz, 3H), 1.08 (s, 9H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 173.2, 166.3, 161.6, 140.3, 140.0, 135.9, 135.7, 133.2, 133.0, 129.9, 127.7, 127.6, 127.2, 124.8, 75.8, 68.6, 61.5, 61.0, 26.7, 21.2, 19.2, 14.6, 12.0; ESI HRMS Calcd for $[C_{30}H_{36}O_7Si + Na]^+$: 559.2123, Found: 559.2137.

7-Oxo-phomopsolide E (3):

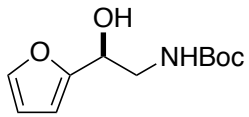


7-Oxa-phomopsolide E **(3)**

Ester (153 mg, 0.29 mmol), 2 mL of CH_3CN, and HF-Py (2:1) (2.5 M, 3 mL, ~7.5 mmol) were added to a plastic vial and stirred at rt for 24 h. The reaction was quenched with saturated $NaHCO_3$, and the aqueous layer was extracted with EtOAc (2 x 40 ml). The organic layer was washed with HCl (1 M, 10 mL), dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (60% EtOAc/hexane) on silica gel yielded 78 mg (0.26 mmol, 91%) of 7-oxo-phomopsolide **(3)** as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.21; $[\alpha]^{25}_D$ = +243

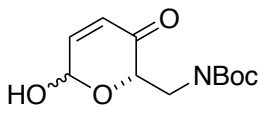
(c 1.20, CH2Cl2); IR (thin film, cm-1) 3468, 2933, 1715, 1648, 1450, 1381, 1254, 1132, 1099, 1068; ^{1}H NMR (270 MHz, $CDCl_3$) δ 7.05 (dd, J = 9.5, 5.9 Hz, 1H), 6.99-6.87 (m, 1H), 6.27 (d, J = 9.9 Hz, 1H), 5.40 (dd, J = 5.9, 3.0 Hz, 1H), 4.85 (ddd, J = 6.0, 3.0, 0.9 Hz, 1H), 4.47 (ddd, J = 11.7, 6.0, 6.0, 2H), 4.34 (q, J = 6.9 Hz, 1H), 1.87-1.79 (m, 6H), 1.43 (d, J = 6.9 Hz, 3H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 174.7, 166.2, 161.5, 140.4, 138.9, 127.0, 124.8, 76.6, 66.6, 62.3, 61.2, 20.0, 14.3, 11.9; ESI HRMS Calcd for $[C_{14}H_{18}O_7 + Na]$+: 321.0950, Found: 321.1188.

(2S)-(2-Furan-2-yl-2-hydroxy-ethyl)-carbamic acid tert-butyl ester (K):



To a 10 mL flask was added ketone **(11b)** (0.27 g, 1.2 mmol), formic acid-triethylamine (1:1, 3 mL), CH_2Cl_2 (1 mL), and Noyori asymmetric transfer hydrogenation catalyst (R)-Ru(η6-Mesitylene)-(S,S)-TsDPEN·HCl (I-33) (3.5 mg, 0.5%mol). The resulting solution was stirred at room temperature for 24 h. The mixture was diluted with water (20 mL) and extracted with EtOAc (3 x 15 mL). The organic layers were combined, washed with sat. $NaHCO_3$ and brine, dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (30% EtOAc/hexane) on silica gel yielded 0.25 g (1.1 mmol, 92%) of alcohol **(K)** as a light yellow oil: R*f* (30% EtOAc/hexanes) = 0.62; $[\alpha]^{25}_{D}$ = –14 (c 1.02, MeOH); IR (thin film, cm-1) 3356, 2980, 2940, 1695, 1520, 1367, 1252, 1172, 739; *1*H NMR (270 MHz, $CDCl_3$) δ 7.37 (d, J = 1.7 Hz, 1H), 6.33 (dd, J = 3.0, 2.0 Hz, 1H), 6.29 (d, J = 3.2 Hz, 1H), 5.02 (s, br, 1H), 4.80 (ddd, J = 8.2, 4.2, 4.2 Hz, 1H), 3.62-3.37 (m, 2H), 3.31 (d, J = 4.2 Hz, 1H), 1.43 (s, 9H); ^{13}C NMR (68 MHz, $CDCl_3$) δ 156.8, 154.3, 142.2, 110.2, 106.7, 79.9, 67.6, 45.2, 28.3;

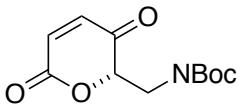
(2S)-2-(tert-Butyloxycarbonylaminomethyl)-6-hydroxy-2H-pyran-3-(6H)-one (L):[*]



Alcohol (913 mg, 4.04 mmol), THF (12 mL), and H_2O (3 mL) were added to a 50 mL round bottom flask and cooled to 0 °C. $NaHCO_3$ (680 mg, 8.09 mmol), $NaOAc•3H_2O$ (550 mg, 4.04 mmol), and NBS (720 mg, 4.04 mmol) were added to the solution and the mixture was stirred for 1h at 0 °C. The reaction was quenched with saturated aqueous $NaHCO_3$ (20mL), extracted with EtOAc (3 x 50 mL), dried (Na_2SO_4), concentrated under reduced pressure. Flash chromatography (EtOAc/hexane, 3:7) on silica gel yielded enone **(L)** (873 mg, 89%) as colorless oils: R*f* (50% EtOAc/hexanes) = 0.35; $[\alpha]^{25}_D$ = –12 (c 1.25, CH_2Cl_2); IR (thin film, cm-1) 3356, 2979, 2931, 1692, 1523, 1368, 1251, 1168, 1035; ^{1}H NMR (600 MHz, $CDCl_3$) major isomer δ 6.92 (dd, J = 10.2, 3.0 Hz, 1H), 6.10 (d, J = 10.4 Hz, 1H), 5.66 (dd, J = 4.2, 4.2 Hz, 1H), 5.07 (br/s, 1H), 4.66 (dd, J = 5.4, 5.4 Hz, 1H), 4.33 (br/s, 1H), 4.19 (dd, J = 7.2, 4.8 Hz, 1H), 3.56 (dd, J = 6.6, 6.6 Hz, 2H), 1.44 (s, 9H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 195.5, 156.5, 145.2, 127.3, 90.2, 87.8, 77.7, 72.5, 28.4; ESI HRMS Calcd for $[C_{11}H_{17}NO_5 + Na]$+: 266.0999, Found: 266.1000.

(6S)-6-(tert-Butyloxycarbonylaminomethyl)-pyran-2,5-dione (12b):[*]

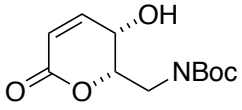
[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.
[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.



12b

Pyranone **(L)** (872.8 mg, 3.6 mmol) was dissolved in 15 mL of acetone and cooled to 0 °C. Jones reagent (2.97 M, 1.21 mL, 3.6 mmol) was added dropwise into the solution. After 15 min the starting material was no longer visible by TLC and the solution was filtered through a pad of celite and washed with 100 ml of Et_2O. The organic layer was washed with saturated $NaHCO_3$ (50 mL) and brine (50 ml), dried ($NaSO_4$), and concentrated to afford dione **(12b)** (730 mg, 84%) as light yellow solid: mp 106-108 °C; Rf (50% EtOAc/hexanes) = 0.42; $[\alpha]^{25}_D = -51$ (c 1.23, CH_2Cl_2); IR (thin film, cm^{-1}) 3367, 2976, 1738, 1699, 1618, 1524, 1368, 1252, 1167, 1113; ^1H NMR (600 MHz, $CDCl_3$) δ 6.85 (d, J = 9.6 Hz, 1H), 6.80 (d, J = 10.2 Hz, 1H), 5.05 (br/s, 1H), 4.96 (dd, J = 4.2, 4.2 Hz, 1H), 3.65 (m, 2H), 1.39 (s, 9H); 13C NMR (150 MHz, $CDCl_3$) δ 191.1, 160.1, 155.6, 139.1, 134.6, 82.5, 80.3, 43.4, 28.2; ESI HRMS Calcd for $[C_{11}H_{15}NO_5 + Na]+$: 264.0842, Found: 266.0844.

(5S, 6S)-5-Hydroxy-6-(tert-butyloxycarbonylaminomethyl)-5,6-dihydropyran-2-one (M):[*]



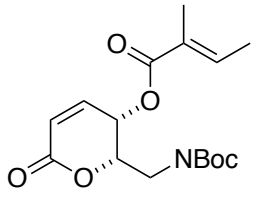
[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

Pyrandione **(12b)** (692 mg, 2.87 mmol) was dissolved in 9 mL of CH_2Cl_2, cooled to 0 ºC, and 9 mL of a 0.4 M solution of $CeCl_3$ in MeOH was added to the solution. $NaBH_4$ (136 mg, 3.58 mmol) was added and the solution was stirred for 20 min 80 mL of EtOAc and 100 mL of water were added. The phases were separated, and the aqueous layer was extracted with EtOAc (3 x 50 mL). The organic fractions were combined, washed with brine (30 ml), dried (Na_2SO_4) and concentrated. Purification on silica gel (EtOAc/hexane, 3:7) yielded pyranone **(M)** (391.2 mg, 56%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.19; $[\alpha]^{25}_D$ = +43 (c 1.20, MeOH); IR (thin film, cm^{-1}) 3372, 2980, 2933, 1712, 1523, 1455, 1368, 1253, 1169, 1060; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (dd, J = 9.0, 5.7 Hz, 1H), 6.08 (d, J = 9.6 Hz, 1H), 5.20 (dd, J = 5.4, 5.4 Hz, 1H), 4.68 (br/s, 1H), 4.29 (m, 1H), 3.73 (ddd, J = 15.0, 8.4, 8.4 Hz, 1H), 3.37 (ddd, J = 14.4, 10.8, 5.4 Hz, 1H), 1.43 (s, 9H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 163.1, 157.4, 144.1, 122.7, 80.8, 78.9, 59.8, 39.7, 28.2; ESI HRMS Calcd for $[C_{11}H_{17}NO_5 + Na]$+: 264.0999, Found: 266.0981.

Minor isomer **(N)** (122.3 mg, 18%) is a colorless oil: R*f* (50% EtOAc/hexanes) = 0.32; $[\alpha]^{25}_D$ = –34 (c 1.10, MeOH); IR (thin film, cm^{-1}) 3380, 2979, 2930, 1714, 1526, 1368, 1251, 1167, 1062; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (d, J = 10.2 Hz, 1H), 5.92 (dd, J = 10.2, 2.4 Hz, 1H), 5.20 (br, 1H), 4.61 (d, J = 4.8 Hz, 1H), 4.35 (ddd, J = 7.8, 4.8, 2.4 Hz, 1H), 4.17 (ddd, J = 10.8, 2.4, 2.4 Hz, 1H), 3.28 (ddd, J = 15.6, 5.4, 2.4 Hz, 1H), 3.83 (ddd, J = 15.6, 7.8, 2.4 Hz, 1H), 1.45 (s, 9H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 163.3, 158.1, 151.2, 119.4, 81.9, 81.0, 63.1, 40.3, 28.2; ESI HRMS Calcd for $[C_{11}H_{17}NO_5 + Na]$+: 264.0999, Found: 266.0984.

(5S, 6S)-5-(2-Methyl-2-butenoyloxy)-6-(tert-butyloxycarbonylaminomethyl)-

5,6-dihydropyran-2-one (13b):*



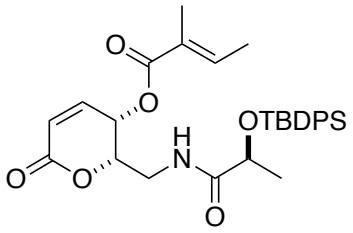
13b

To a 10 mL round bottom flask was added alcohol (358 mg, 1.47 mmol), CH_2Cl_2 (5 mL), tiglic acid (294 mg, 2.94 mmol), dicyclohexylcarbodiimide (608 mg, 2.94 mmol), and DMAP (1%). The reaction mixture was stirred at room temperature for 6 h. Then it was filtered through a pad of celite and concentrated. The crude product was purified by silica gel chromatography (EtOAc/hexane, 2:8) to yield ester **(13b)** (396 mg, 83%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.51; $[\alpha]^{25}_D$ = +229 (c 2.30, CH_2Cl_2); IR (thin film, cm-1) 3376, 2979, 2928, 1717, 1653, 1521, 1368, 1251, 1171, 1066; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.96 (dd, J = 9.6, 5.4 Hz, 1H), 6.82 (qq, J = 7.2, 1.2 Hz, 1H), 6.15 (d, J = 10.2 Hz, 1H), 5.27 (dd, J = 6.0, 3.0 Hz, 1H), 5.17 (br, 1H), 4.60 (dd, J = 3.0, 3.0 Hz, 1H), 3.47 (ddd, J = 13.2, 7.2, 4.8 Hz, 1H), 3.35 (ddd, J = 13.8, 7.8, 4.8 Hz, 1H), 1.74 (d, J = 1.2 Hz, 3H), 1.72 (d, J = 7.2 Hz, 3H), 1.35 (s, 9H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 166.5, 162.2, 155.6, 140.4, 139.6, 127.3, 124.7, 79.6, 77.5, 61.7, 40.4, 28.1, 14.3, 14.0; ESI HRMS Calcd for $[C_{16}H_{23}NO_6 + Na]$+: 348.1418, Found: 348.1409.

(5S, 6S)-5-(2-Methyl-2-butenoyloxy)-6-[(2S)-2-(tert-butyldiphenylsilanyloxy)

* The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

propionylaminomethyl]-5,6-dihydropyran-2-one (P):[*]

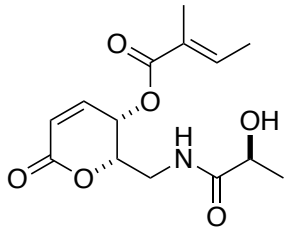


To a 25 mL round bottom flask was added ester **(13b)** (102.7 mg, 0.316 mmol), dioxane (5 mL) and HCl (2 mL, 4 M). The reaction mixture was stirred at room temperature for 4 h. Then it was concentrated under reduced pressure to afford the crude ammonium salt which was then dissolved in water (3 mL) and dioxane (7 mL). $NaHCO_3$ (106 mg, 1.26 mmol) and then acid chloride (219.0 mg, 0.632 mmol) were added. The reaction mixture was stirred at room temperature for 2 h then extracted with EtOAc (3 x 50 mL). The organic fractions were combined, washed with brine (30 mL), dried (Na_2SO_4) and concentrated. Purification on silica gel (EtOAc/hexane, 2:8) yielded amide **(P)** (128 mg, 76%) as a colorless oil: R*f* (50% EtOAc/hexanes) = 0.59; $[\alpha]^{25}_D$ = +101 (c 0.91, CH_2Cl_2); IR (thin film, cm^{-1}) 3420, 2932, 2858, 1742, 1716, 1682, 1651, 1522, 1251, 1113; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.62 (m, 4H), 7.39 (m, 6H), 7.27 (dd, J = 7.8, 3.6 Hz, 1H), 7.01 (dd, J = 10.2, 6.0 Hz, 1H), 6.91 (qq, J = 7.2, 1.2 Hz, 1H), 6.24 (d, J = 10.2 Hz, 1H), 5.25 (dd, J = 6.0, 3.0 Hz, 1H), 4.37 (ddd, J = 8.4, 4.2, 2.4 Hz, 1H), 4.28 (q, J = 6.6 Hz, 1H), 3.74 (ddd, J = 14.4, 7.8, 4.2 Hz, 1H), 3.46 (ddd, J = 13.8, 9.0, 4.2 Hz, 1H), 1.82 (s, 3H), 1.80 (d, J = 7.2 Hz, 3H), 1.27 (d, J = 6.6 Hz, 3H), 1.13 (s, 9H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 197.5, 174.7, 166.5, 161.8, 140.2,

[*] The pyranone based numbering for this compound is different to the lactone/carboxylic acid (C-1 to C-10) based numbering used for the phomopsolide natural product in the text.

139.9, 135.7, 135.6, 132.8, 132.3, 130.1, 130.0, 127.9, 127.7, 127.3, 125.0, 77.3, 70.8, 61.8, 38.9, 26.9, 21.7, 19.0, 14.5, 12.0; ESI HRMS Calcd for $[C_{30}H_{37}NO_6Si+ Na]^+$: 558.2282, Found: 558.2254.

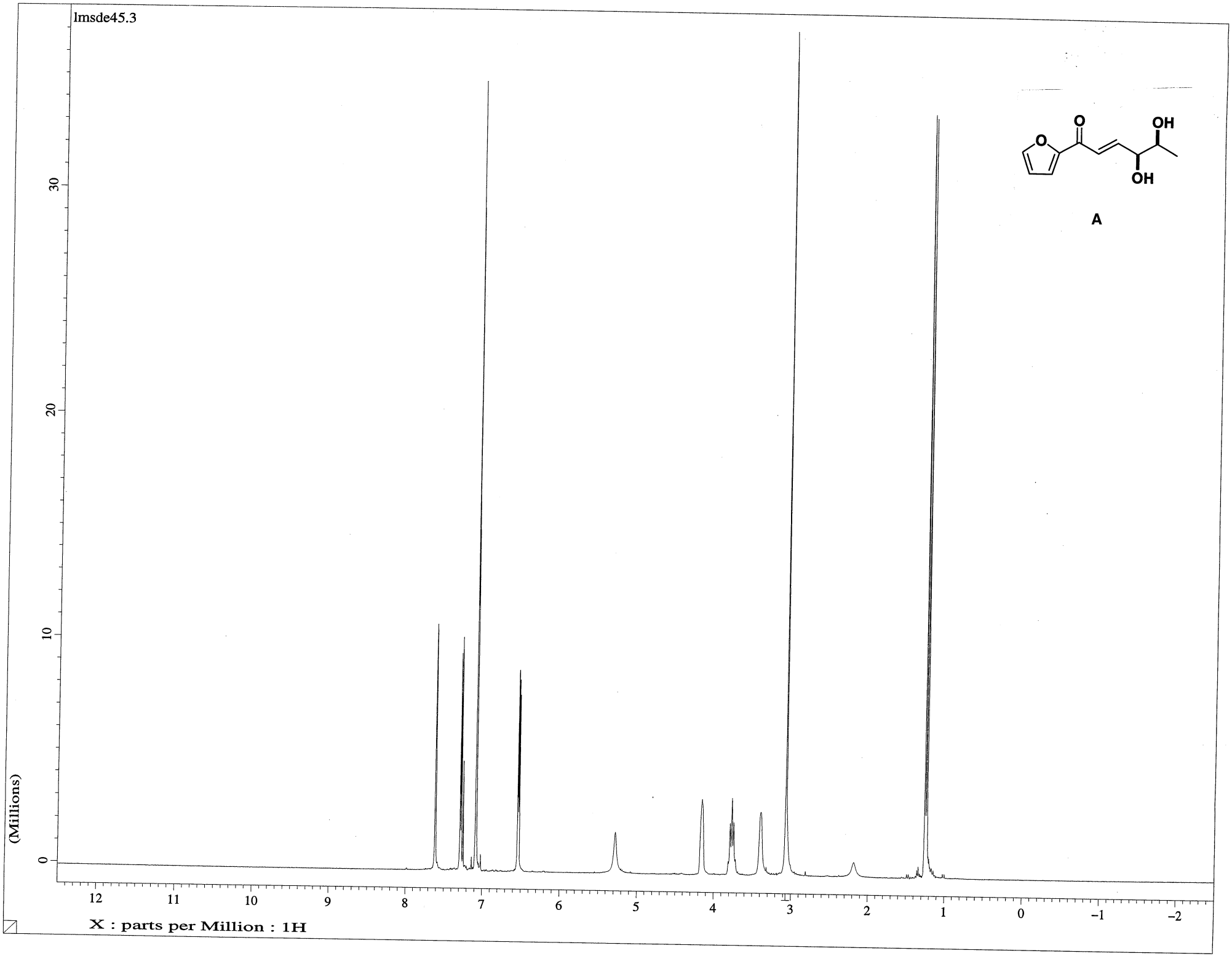
7-Aza-phomopsolide E (4):

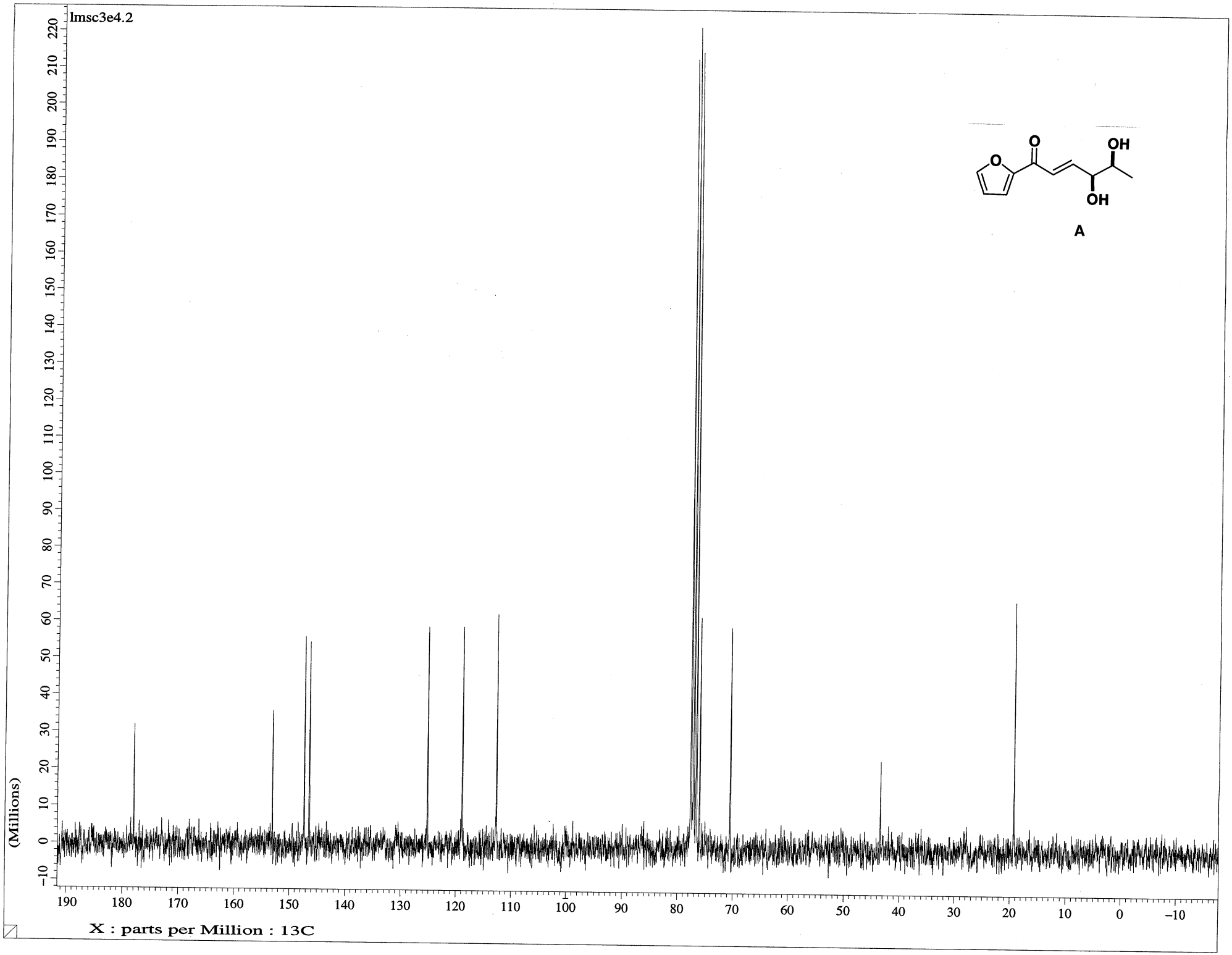


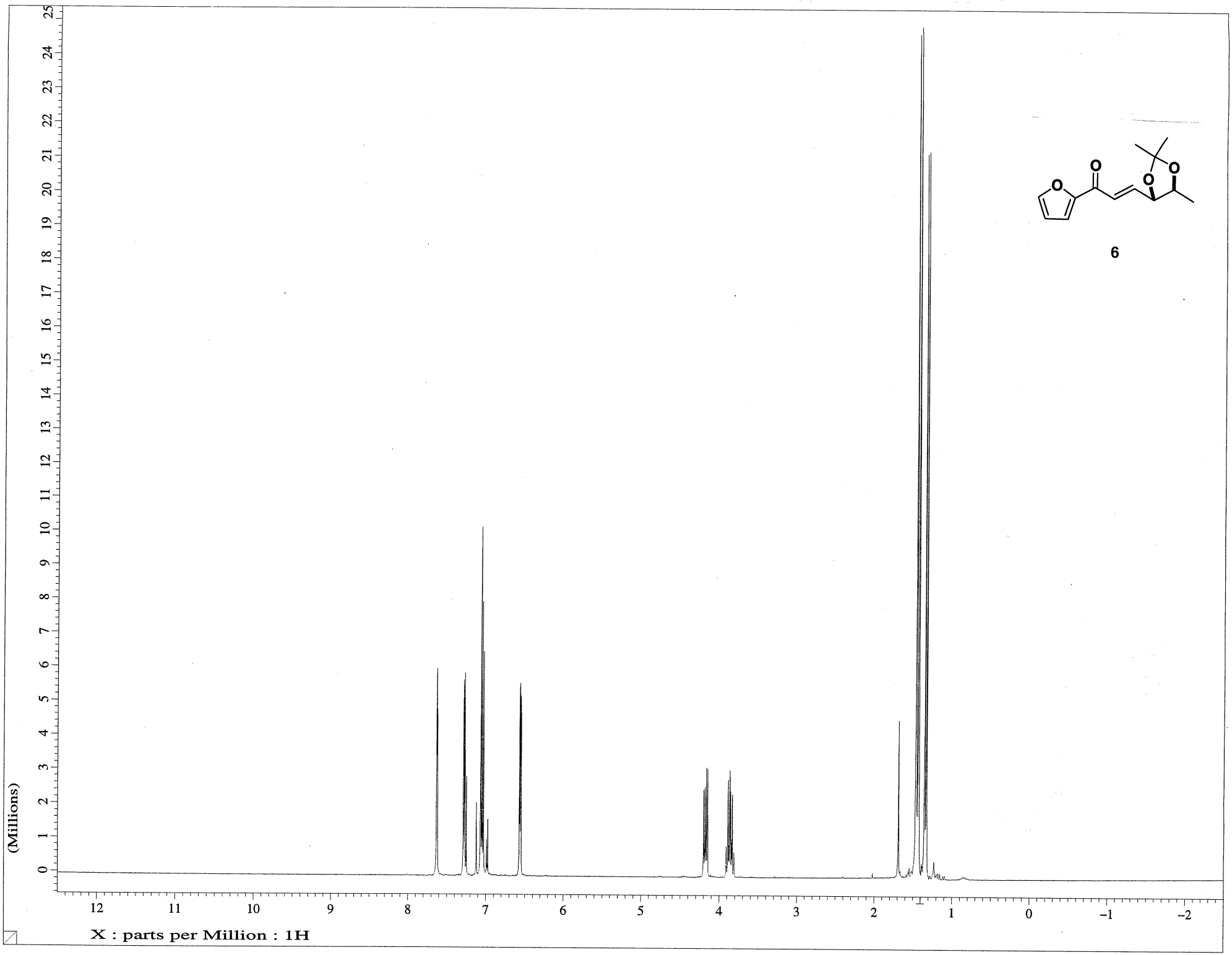
7-Aza-phomopsolide E **(4)**

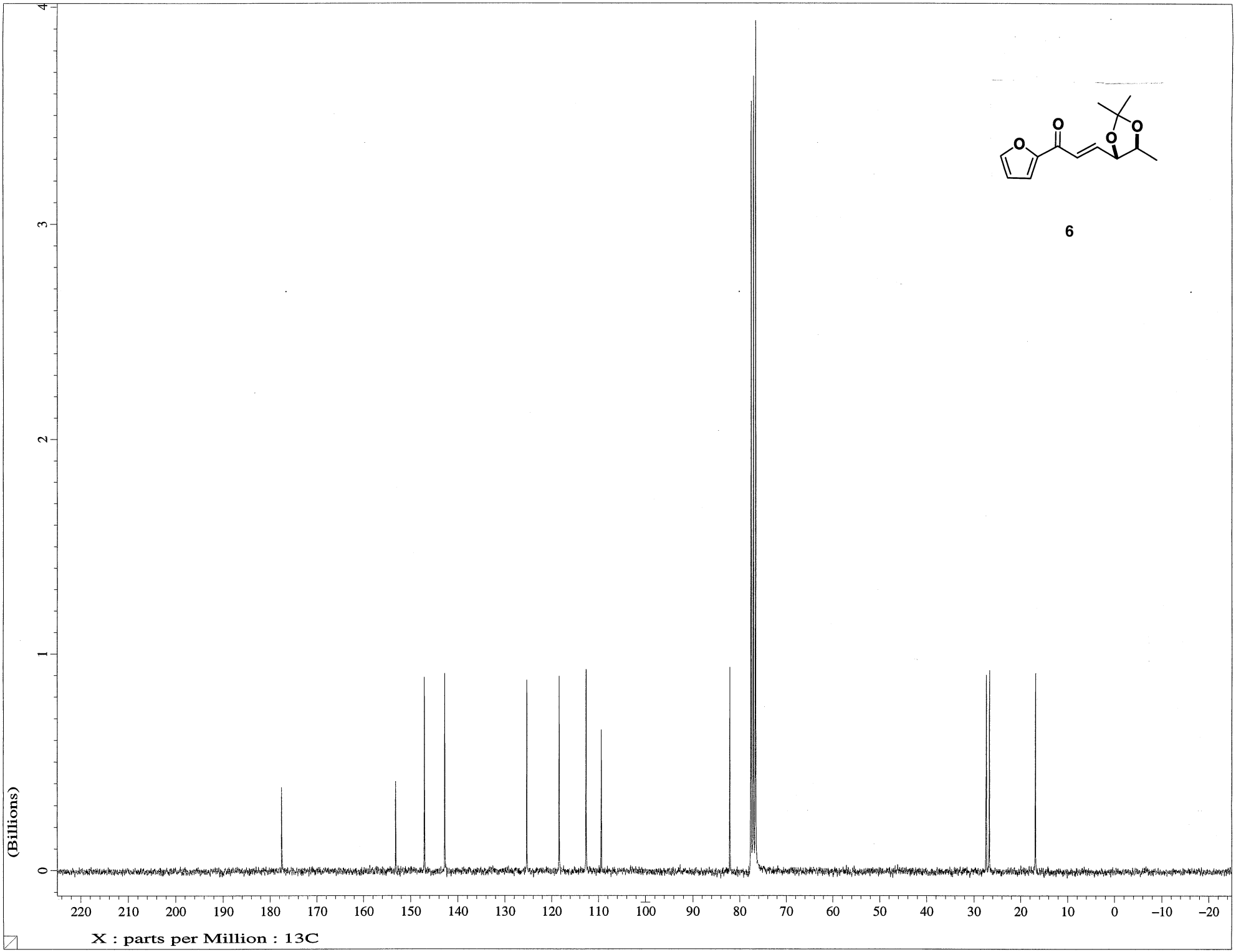
Ester (113 mg, 0.21 mmol), 1 mL of CH_3CN, and HF-Py (2:1) (2.5 M, 1.5 mL, ~3.7 mmol) were added to a plastic vial and stirred at rt for 24 h. The reaction was quenched with saturated $NaHCO_3$ (5 mL), and the aqueous layer was extracted with EtOAc (2 x 40 mL). The organic layer was washed with HCl (1 M, 10 mL), dried over Na_2SO_4, and concentrated under reduced pressure to afford the crude alcohol. Flash chromatography (70% EtOAc/hexane) on silica gel yielded 56 mg (0.19 mmol, 90%) of 7-aza-phomopsolide E **(4)** as a colorless solid: mp 156-158 °C; R*f* (100% EtOAc) = 0.35; $[\alpha]^{25}_D$ = +231 (c 1.02, MeOH); IR (thin film, cm^{-1}) 3434, 3388, 2767, 1733, 1706, 1647, 1533, 1263, 1127; ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.92 (dd, J = 6.0, 6.0 Hz, 1H), 7.12 (dd, J = 9.6, 5.4 Hz, 1H), 6.81 (qq, J = 7.2, 1.8 Hz, 1H), 6.22 (d, J =9.0 Hz, 1H), 5.55 (d, J = 4.8 Hz, 1H), 5.26 (dd, J = 6.0, 2.4 Hz, 1H), 4.74 (m, 1H), 3.97 (q, J = 7.2 Hz, 1H), 3.51 (ddd, J = 13.2, 6.0, 6.0 Hz, 1H), 3.39 (ddd, J = 13.2, 7.2, 5.4 Hz, 1H), 1.79 (d, J = 6.0 Hz, 3H), 1.78 (s, 3H), 1.21 (d, J = 7.2 Hz, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 174.9, 165.9, 162.2, 141.4, 138.8, 127.3,

124.2, 76.6, 67.2, 61.8, 38.0, 21.0, 14.2, 11.9; ESI HRMS Calcd for $[C_{14}H_{19}NO_6 + Na]^+$: 320.1104, Found: 340.1094.

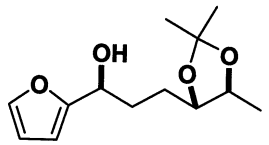

lmsde45.3
O
OH
O
OH
A
(Millions)
0
10
20
30
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
X : parts per Million : 1H


lmsc3e4.2
O
OH
OH
A
(Millions)
X : parts per Million : 13C


(Millions)
X : parts per Million : 1H
6


(Billions)
4
3
2
1
0
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
X : parts per Million : 13C
O
O
O
O

6



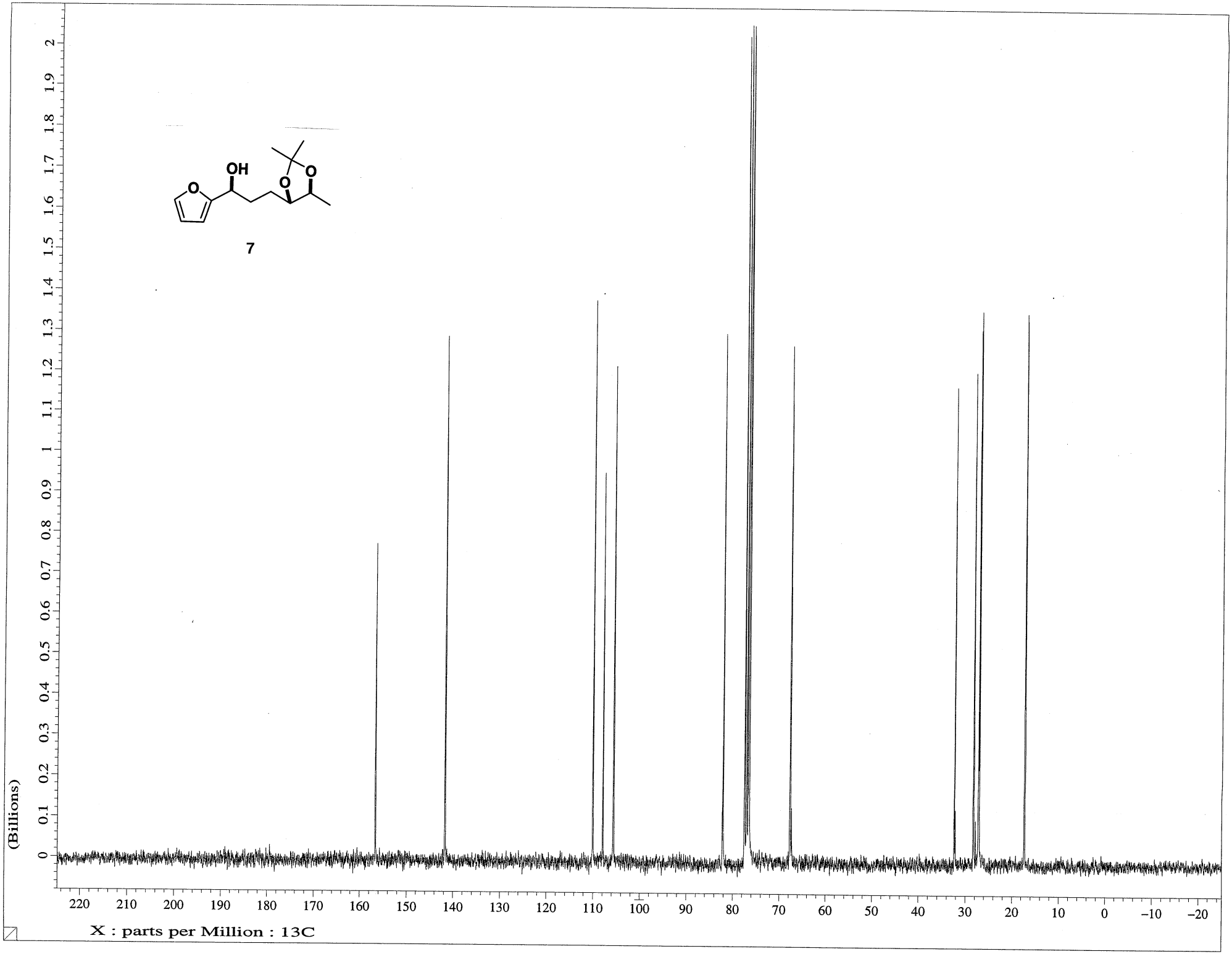
7

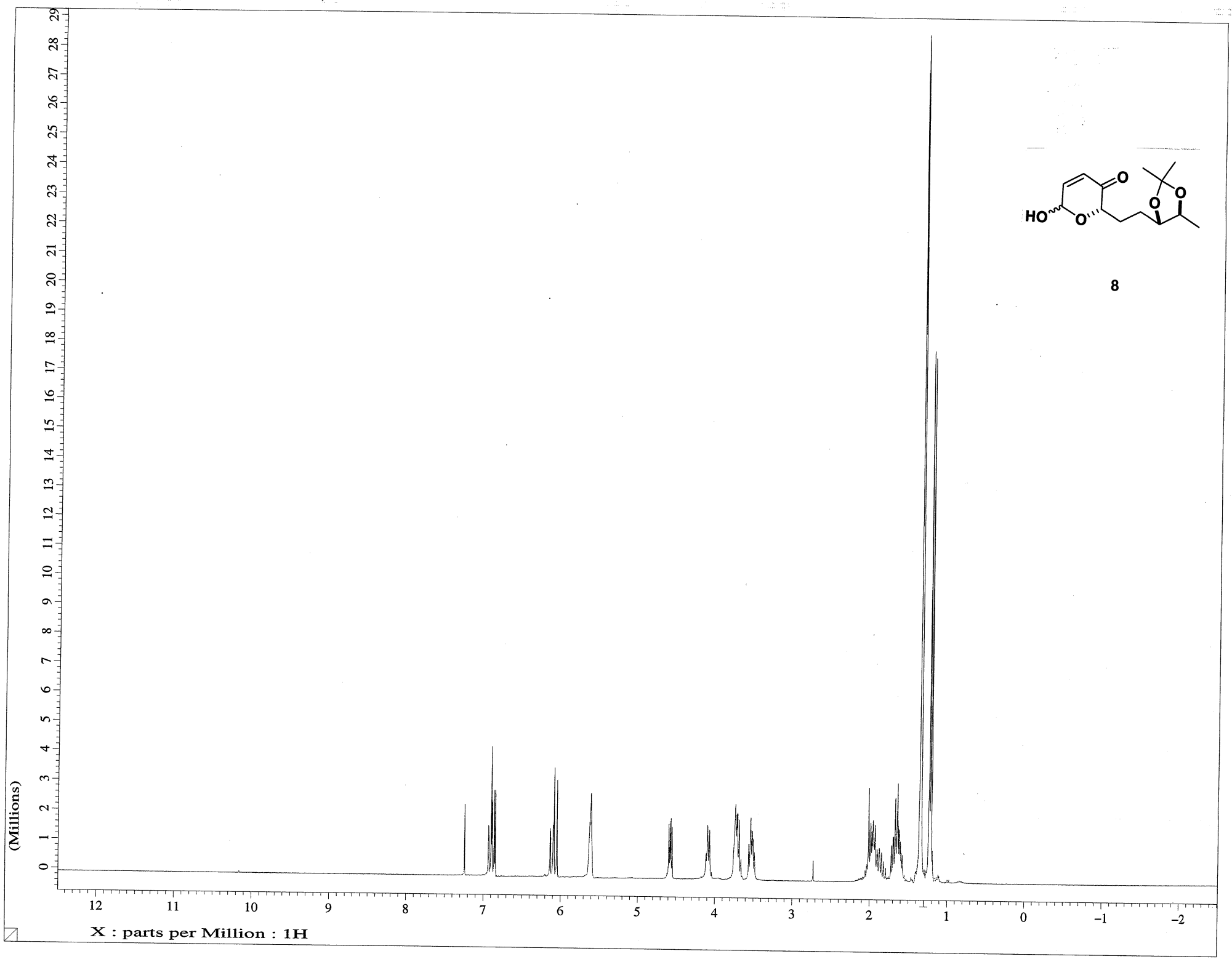
(Millions)

30
20
10
0

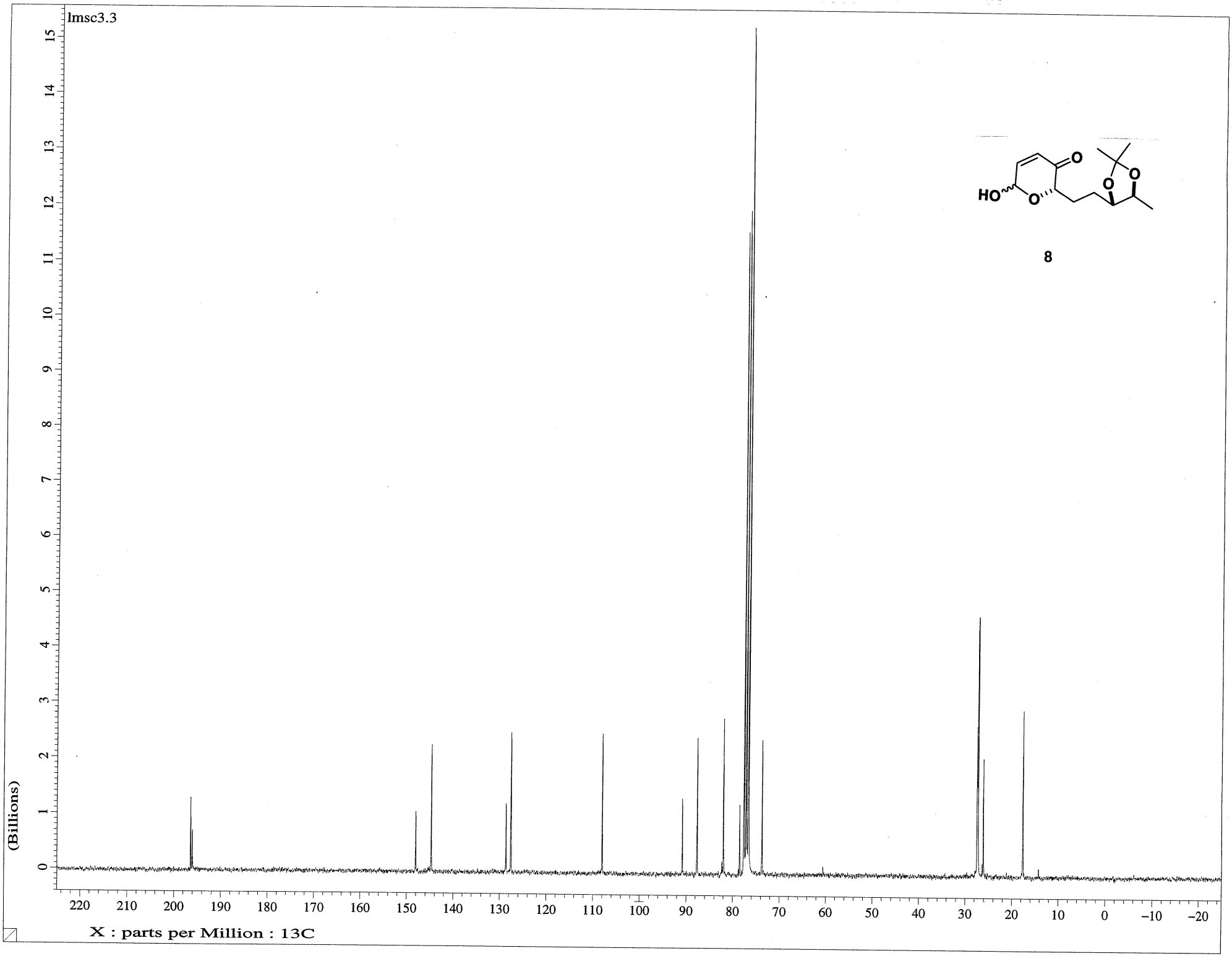
12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2

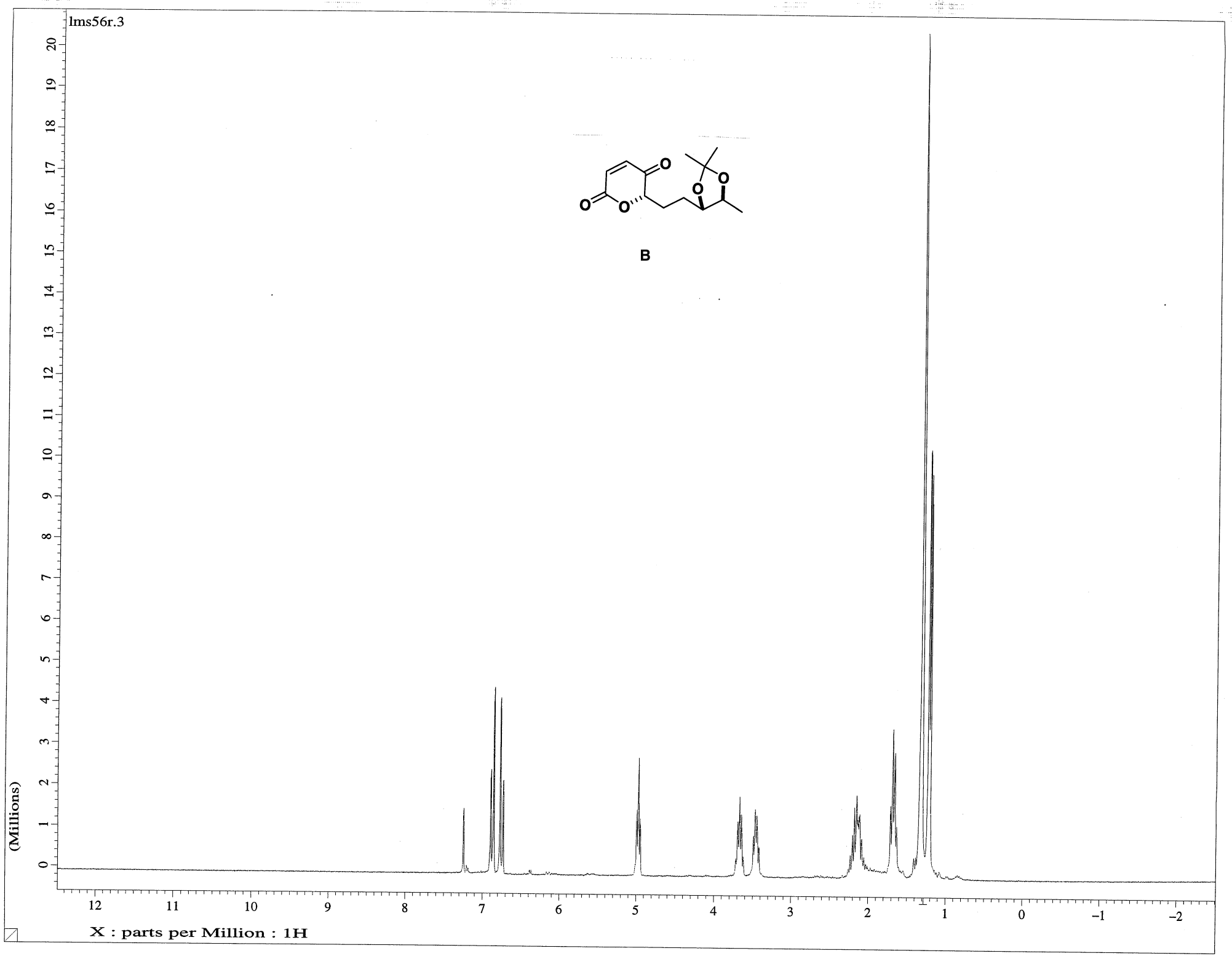
X : parts per Million : 1H

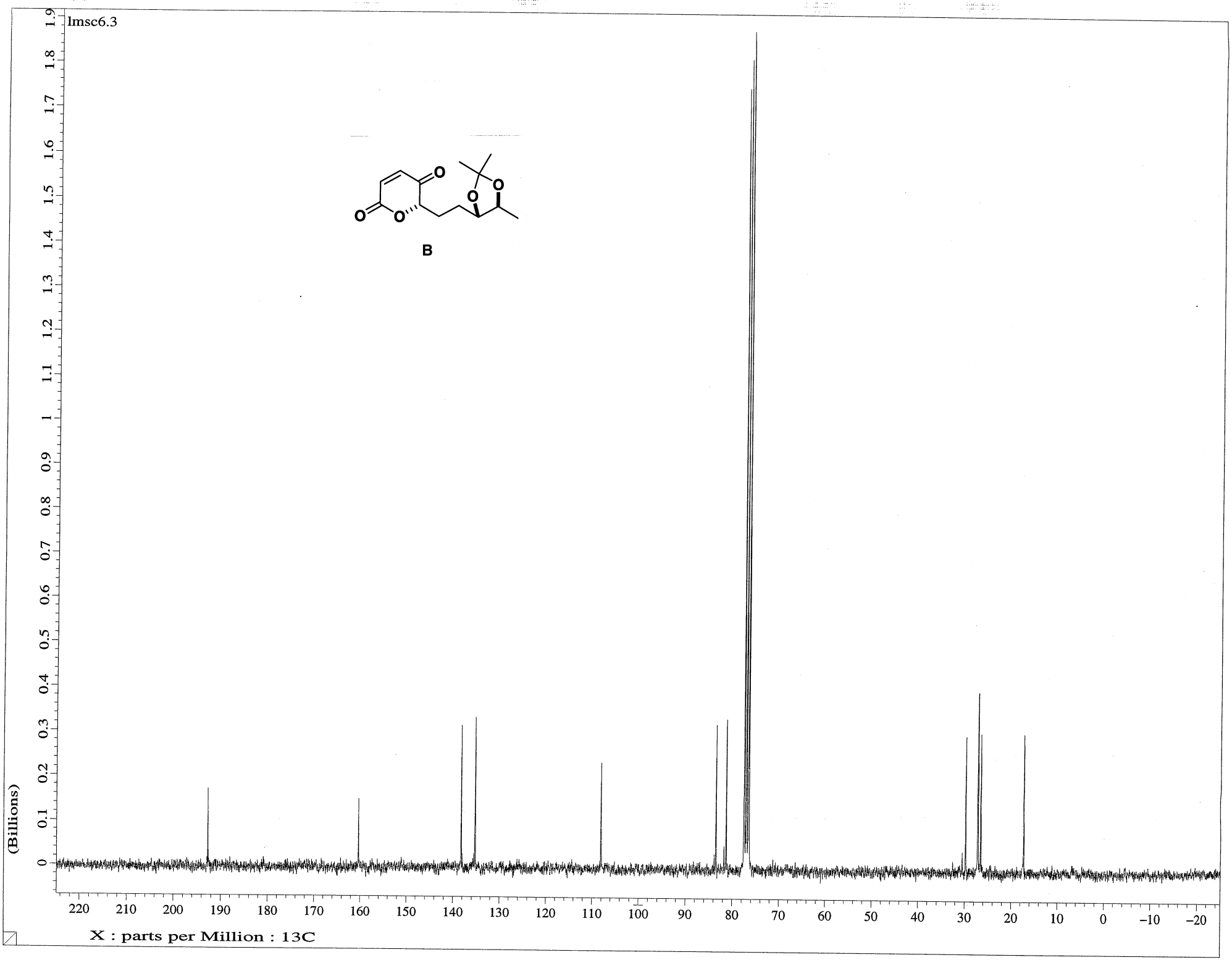

OH
O
O
O
7
(Billions)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
X : parts per Million : 13C

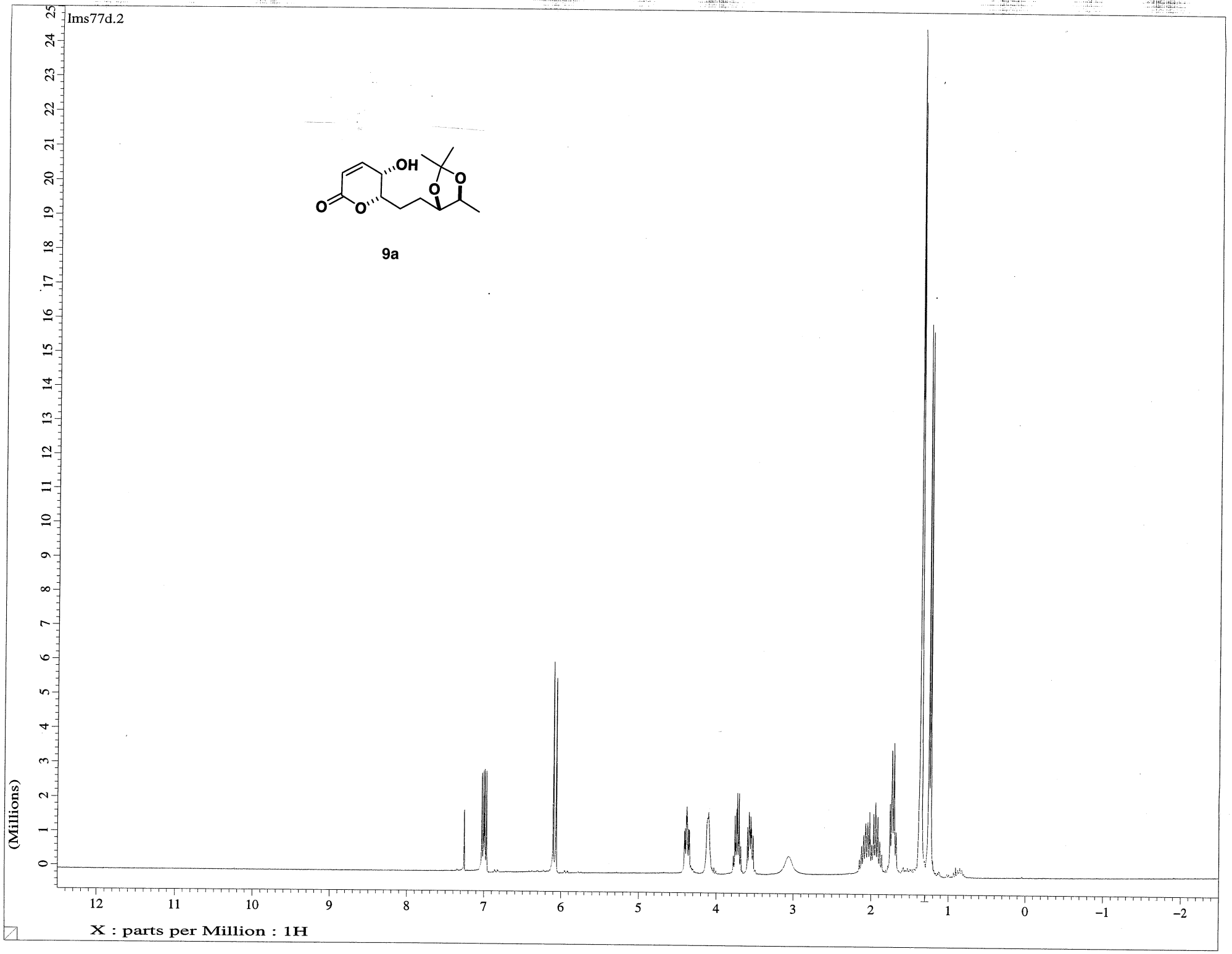


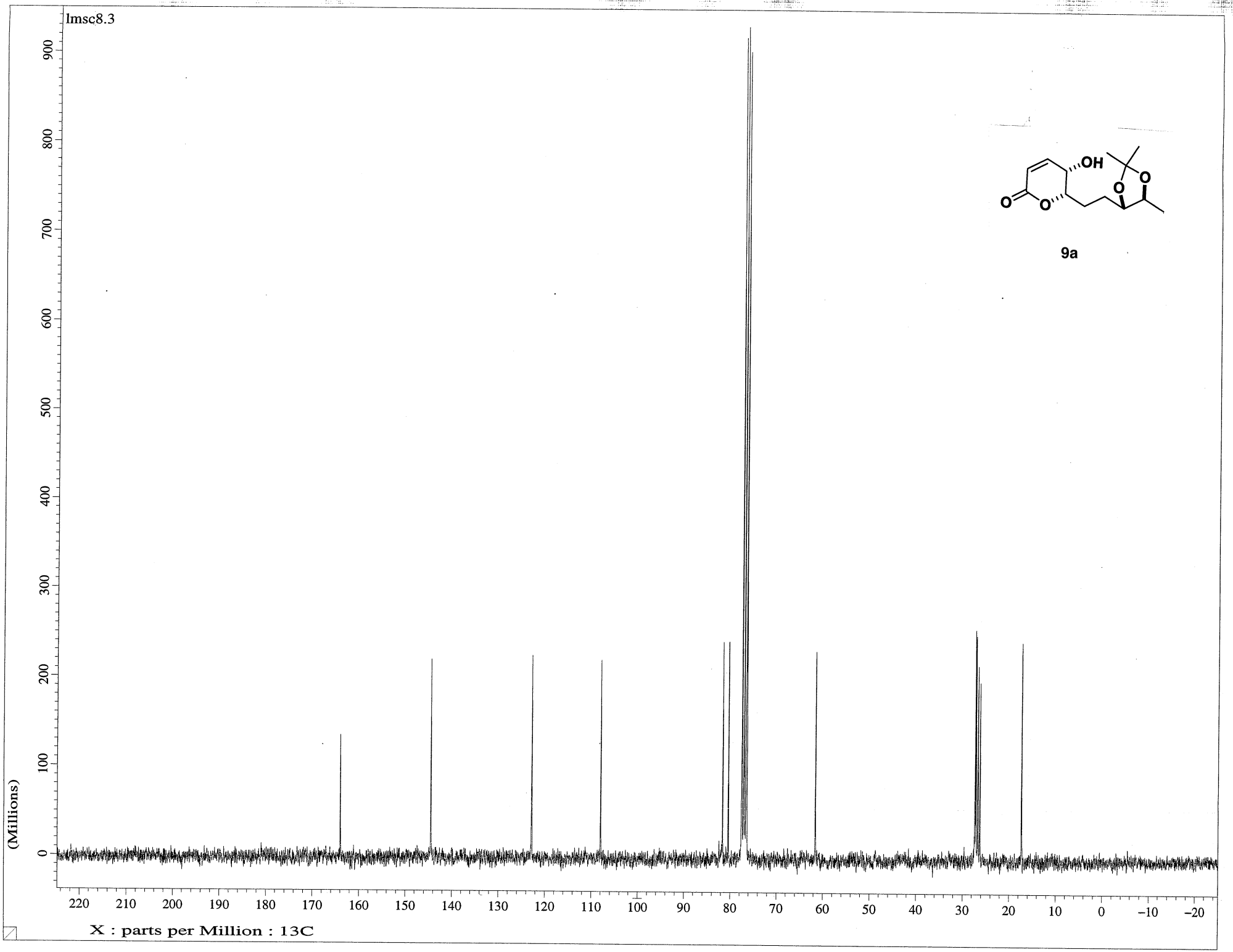
8

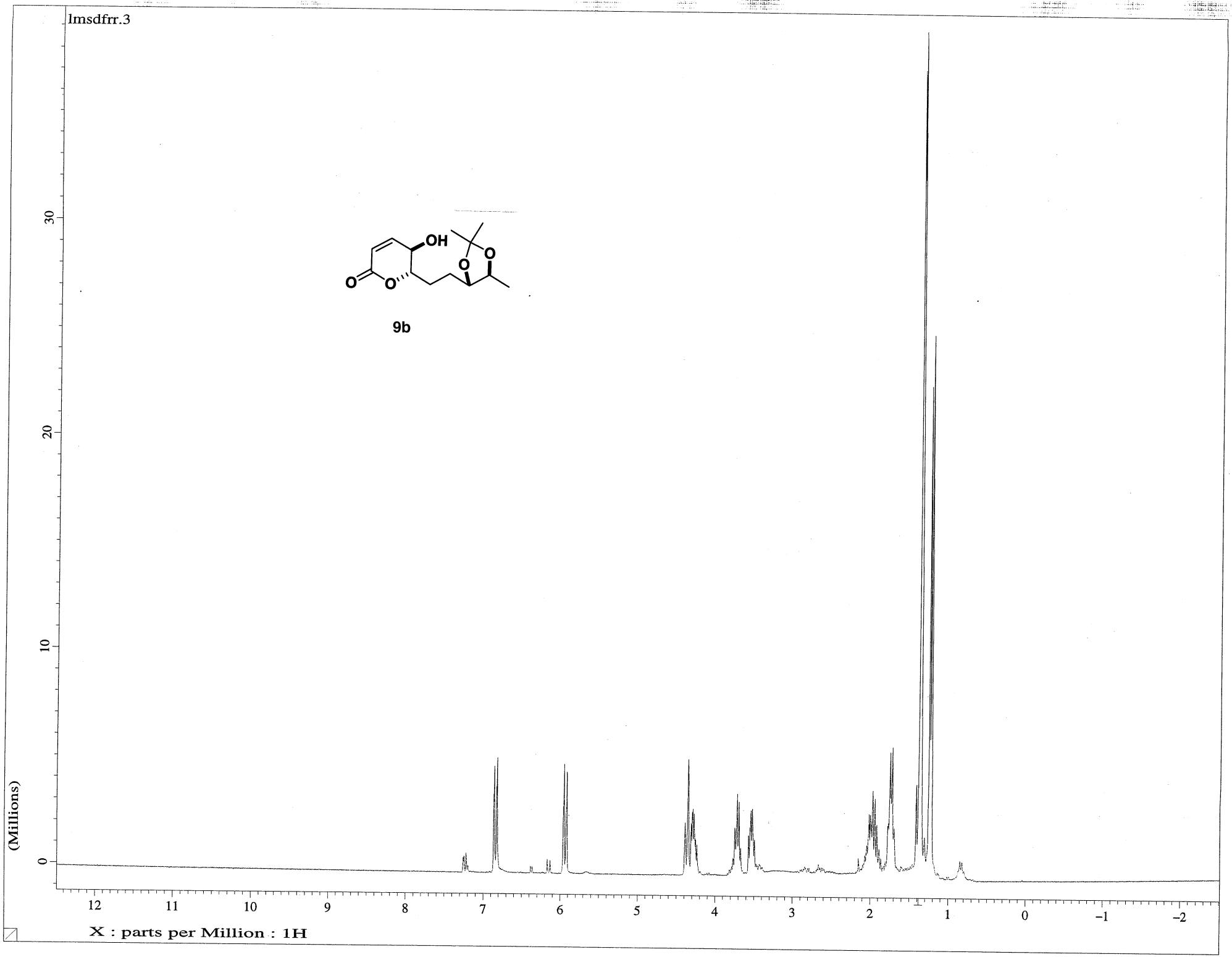

lmsc3.3
(Billions)
X : parts per Million : 13C
HO
O
O
O
O
8

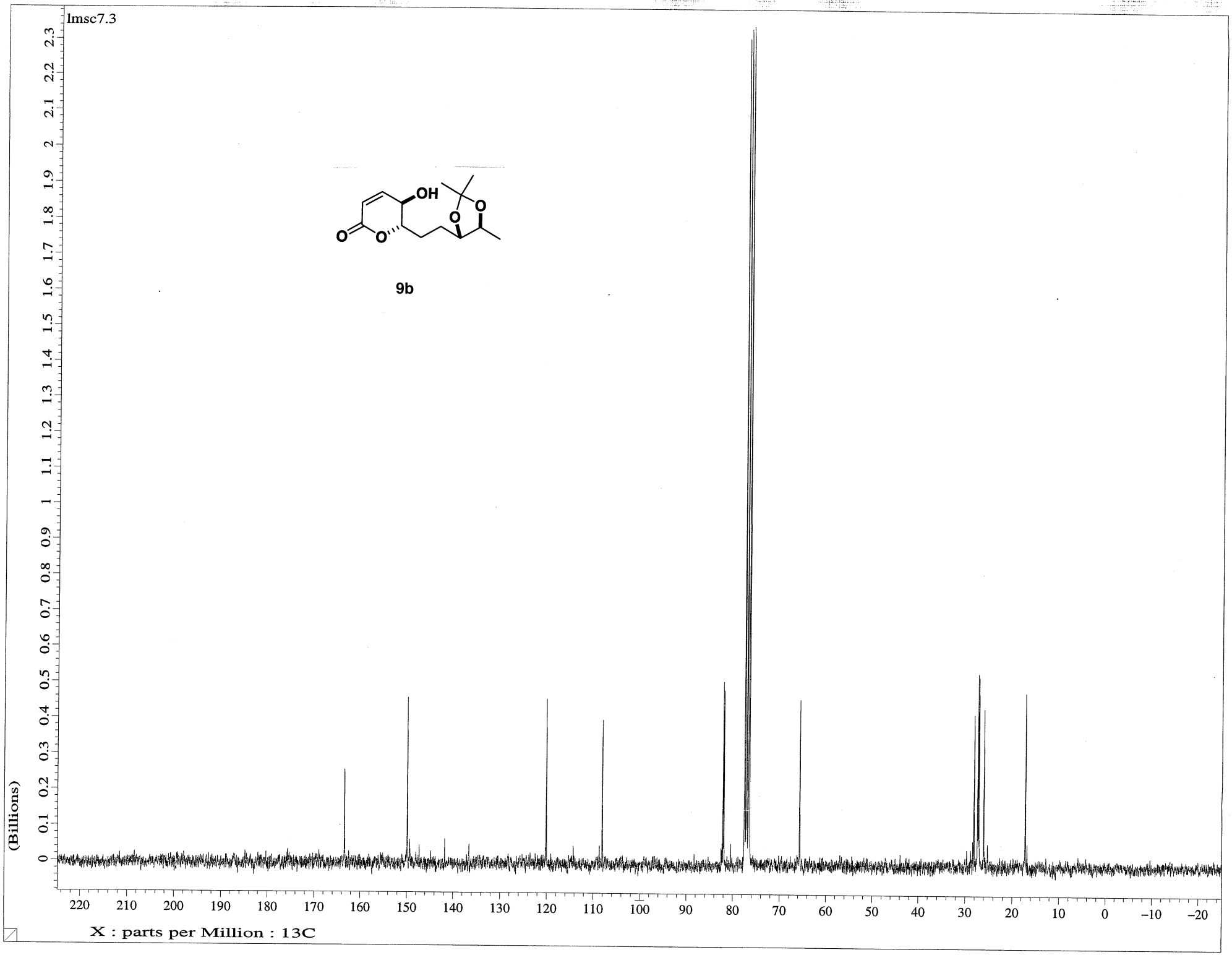

lms56r.3
B
(Millions)
X : parts per Million : 1H


lmsc6.3
O
O
O
O
O
B
(Billions)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
X : parts per Million : 13C

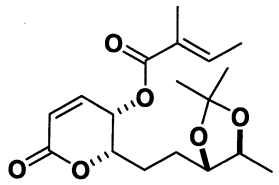

lms77d.2
OH
O
O
O
9a
(Millions)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
X : parts per Million : 1H


lmsc8.3
OH
O
O
O
O
9a
(Millions)
900
800
700
600
500
400
300
200
100
0
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
X : parts per Million : 13C


1msdfrr.3
OH
O
O
O
9b
30
20
10
0
(Millions)
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
X : parts per Million : 1H


lmsc7.3
OH
O
O
O
O
9b
(Billions)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10 −20
X : parts per Million : 13C

lmscgt54.3



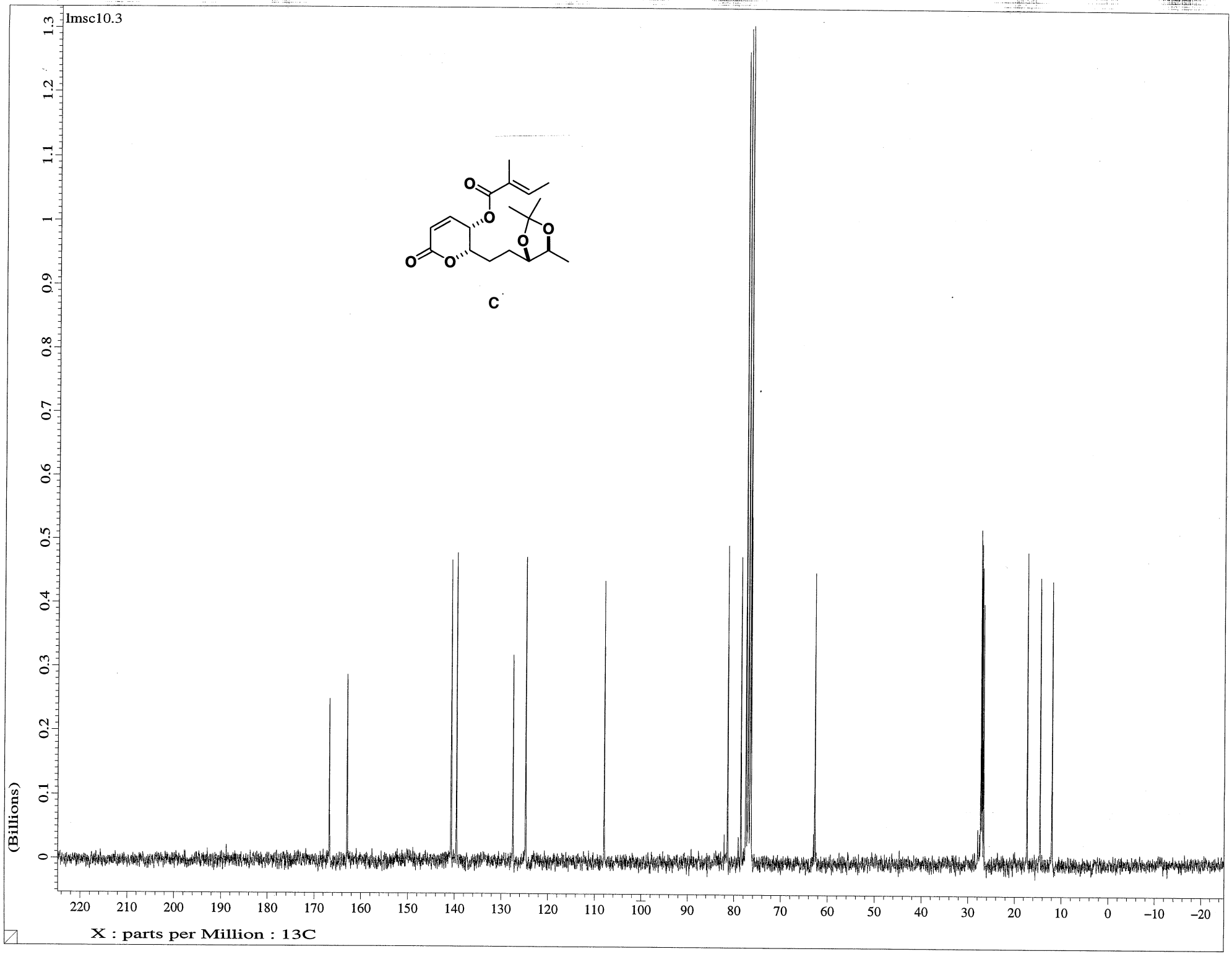
C

(Millions)

30
20
10
0

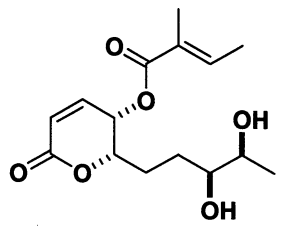
12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2

X : parts per Million : 1H



C

lms65d4fe.3



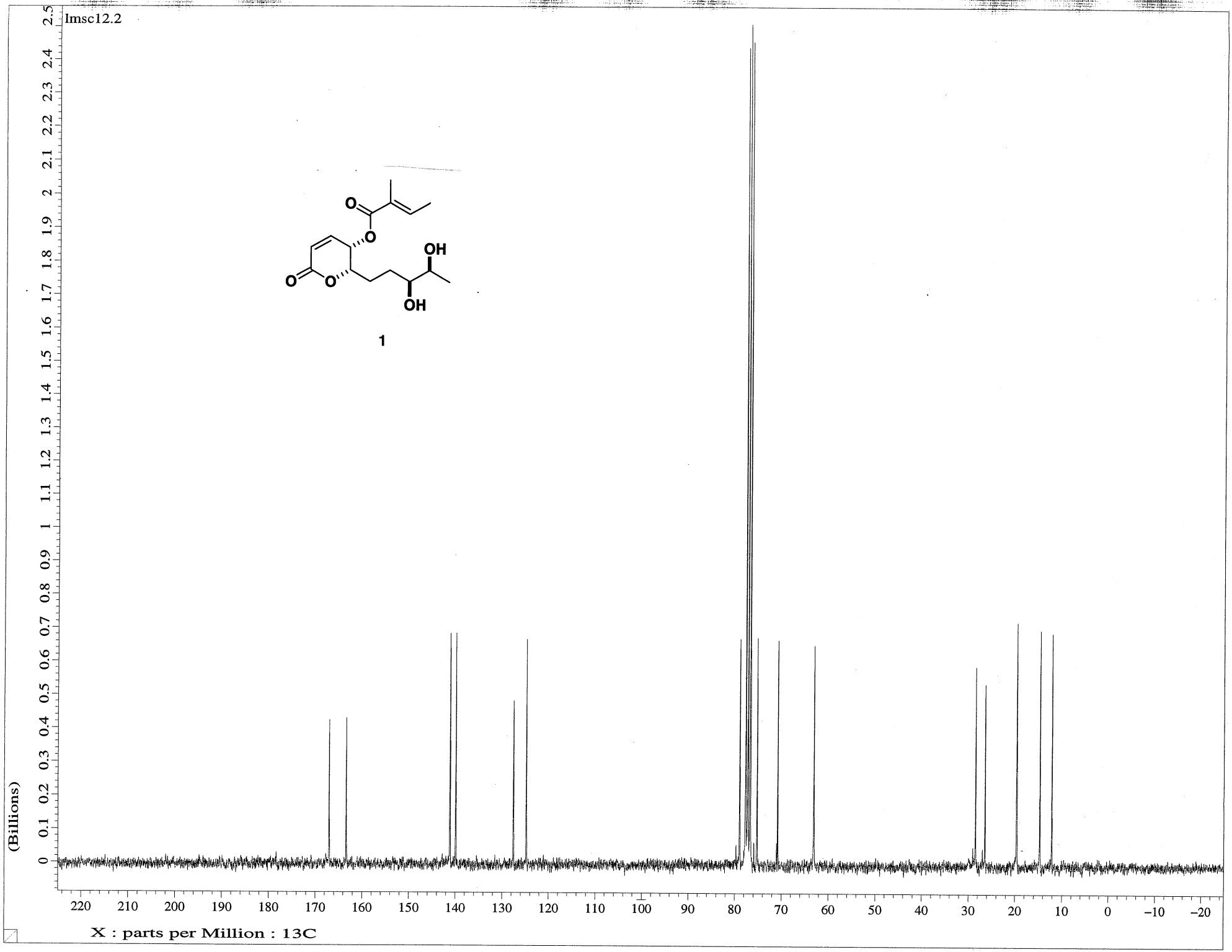
1

(Millions)

60
50
40
30
20
10
0

12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2

X : parts per Million : 1H

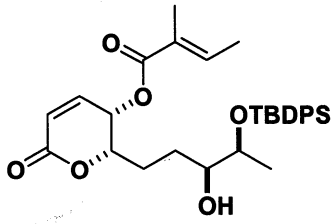

lmsc12.2
O
O
O
O
OH
OH
1
(Billions)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10 −20
X : parts per Million : 13C

STANDARD PROTON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 44.2 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669885 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



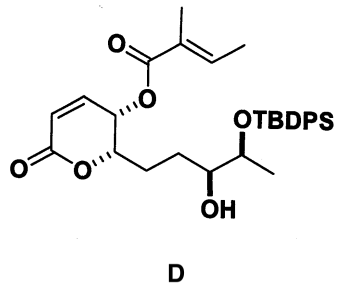
D

STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 34.9 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
384 repetitions
OBSERVE C13, 150.7863984 MHz
DECOUPLE H1, 599.6700024 MHz
Power 41 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 24 min, 0 sec



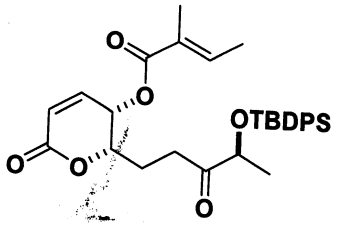
D

STANDARD PROTON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 44.2 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669895 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



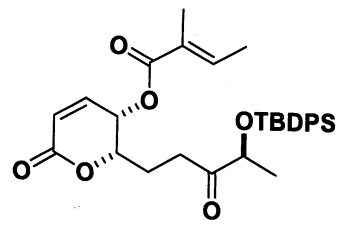
E

STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 34.9 degrees
Acq. time 1.300 sec
Width 38498.6 Hz
444 repetitions
OBSERVE C13, 150.7863962 MHz
DECOUPLE H1, 599.6700024 MHz
Power 41 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 3 hr, 38 min, 13 sec



E

212.206
166.644
162.685
140.717
139.501
135.710
135.660
133.315
132.789
129.929
129.855
127.767
127.638
127.482
124.701
78.017
77.210
77.000
76.786
75.399
63.123
32.096
26.860
23.779
20.767
19.092
14.464
11.951

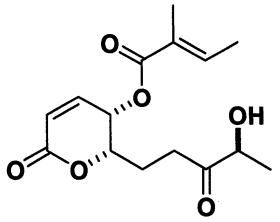
200 180 160 140 120 100 80 60 40 20 0 -20 ppm

STANDARD PROTON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 44.2 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669890 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



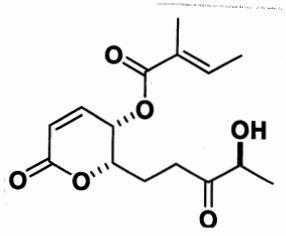
2

STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 34.9 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
348 repetitions
OBSERVE C13, 150.7863932 MHz
DECOUPLE H1, 599.6700024 MHz
Power 41 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 3 hr, 38 min, 13 sec



2

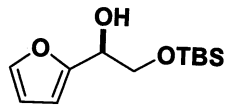
STANDARD PROTON PARAMETERS

Archive directory: /export/home/vnmr1/vnmrsys/data
Sample directory:
File: PROTON

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
INOVA-600 "inova600"

Relax. delay 1.000 sec
Pulse 30.0 degrees
Acq. time 4.000 sec
Width 9594.6 Hz
8 repetitions
OBSERVE H1, 599.6670066 MHz
DATA PROCESSING
Line broadening 0.2 Hz
FT size 131072
Total time 0 min, 40 sec



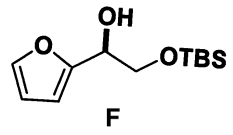
F

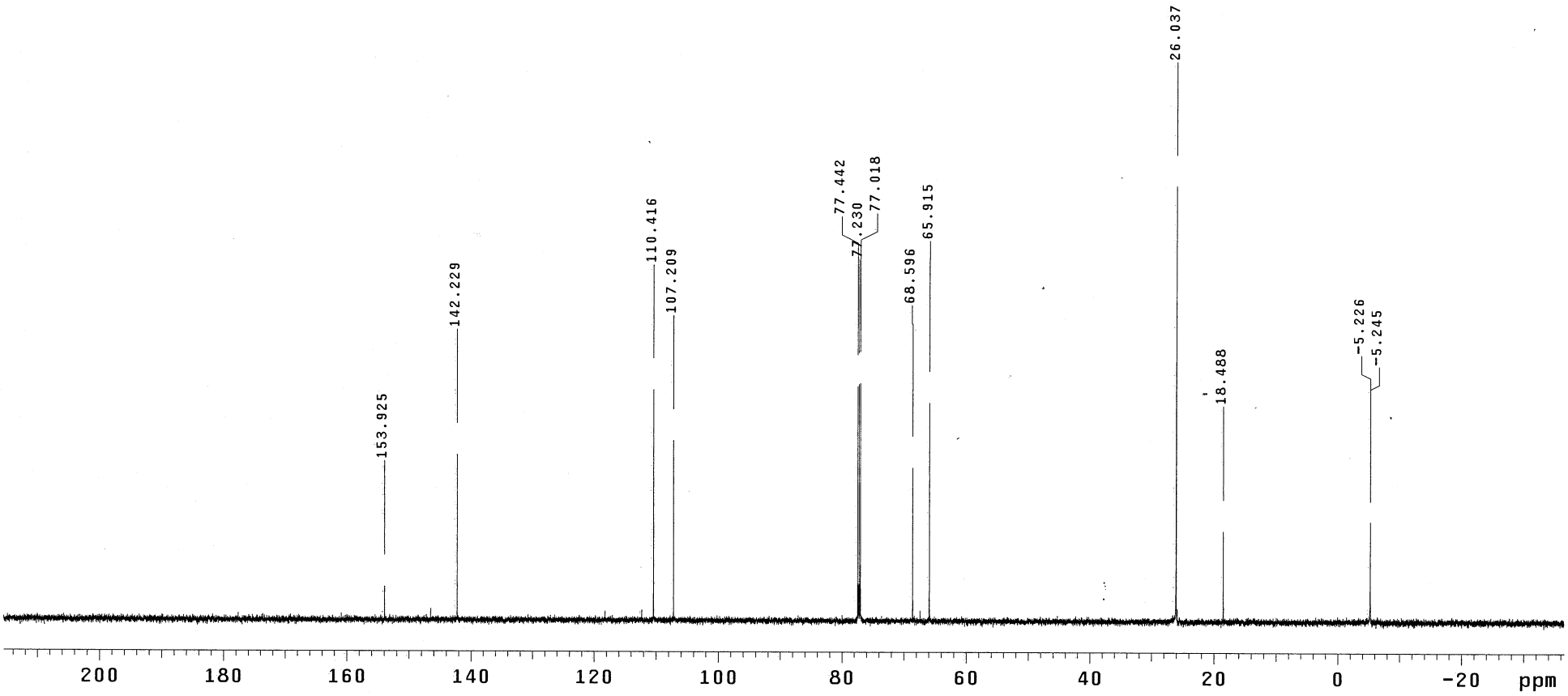
STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
User: 1-14-87
INOVA-600 "inova600"

Relax. delay 0.500 sec
Pulse 29.9 degrees
Acq. time 1.400 sec
Width 38004.8 Hz
224 repetitions
OBSERVE C13, 150.7863503 MHz
DECOUPLE H1, 599.6700024 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 32 min, 34 sec





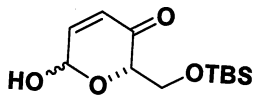
STANDARD PROTON PARAMETERS

Archive directory: /export/home/vnmr1/vnmrsys/data
Sample directory:
File: PROTON

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
INOVA-600 "inova600"

Relax. delay 1.000 sec
Pulse 30.0 degrees
Acq. time 4.000 sec
Width 9594.6 Hz
4 repetitions
OBSERVE H1, 599.6670057 MHz
DATA PROCESSING
Line broadening 0.2 Hz
FT size 131072
Total time 0 min, 20 sec



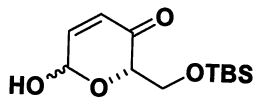
G

STANDARD CARBON PARAMETERS

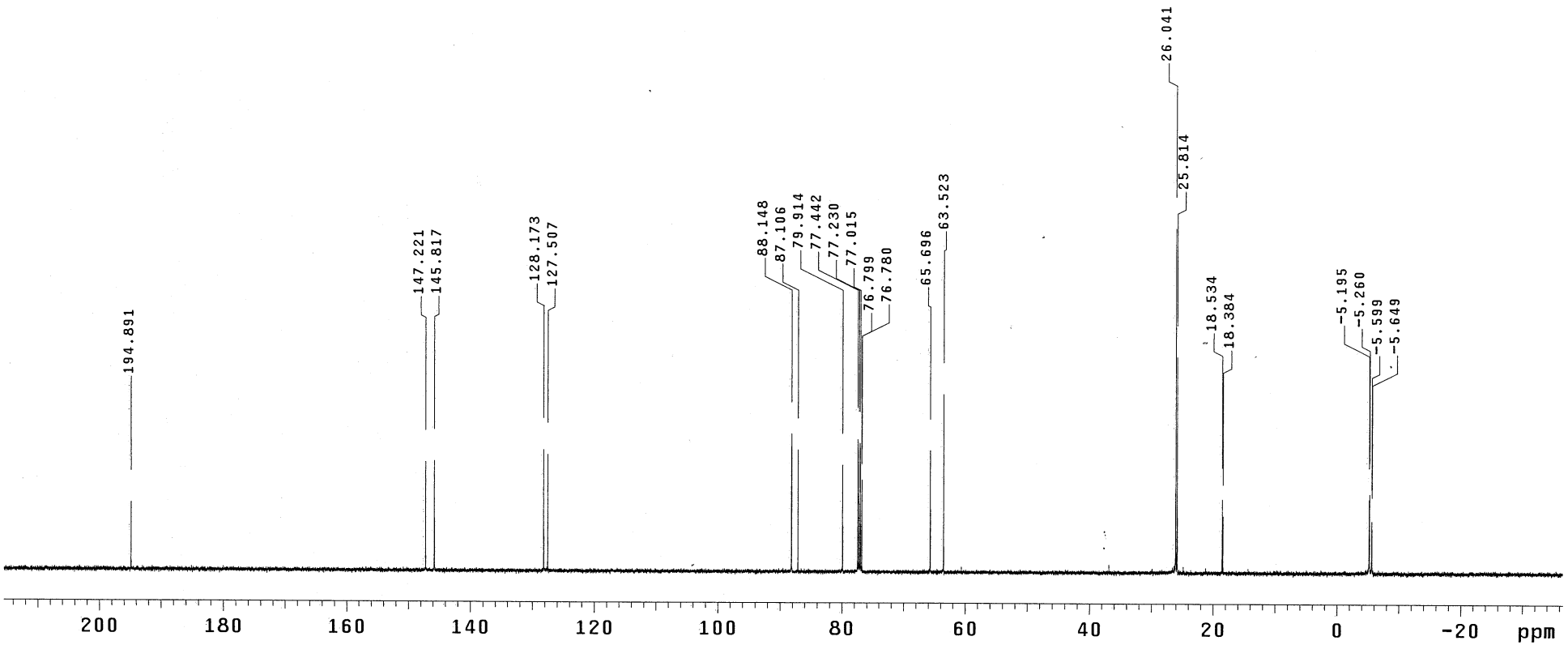
Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
User: 1-14-87
INOVA-600 "inova600"

Relax. delay 0.500 sec
Pulse 29.9 degrees
Acq. time 1.400 sec
Width 38004.8 Hz
1024 repetitions
OBSERVE C13, 150.7863543 MHz
DECOUPLE H1, 599.6700024 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 32 min, 34 sec



G



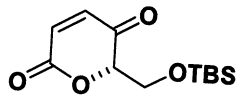
STANDARD PROTON PARAMETERS

Archive directory: /export/home/vnmr1/vnmrsys/data
Sample directory:
File: PROTON

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
INOVA-600 "inova600"

Relax. delay 1.000 sec
Pulse 30.0 degrees
Acq. time 4.000 sec
Width 9594.6 Hz
8 repetitions
OBSERVE H1, 599.6670057 MHz
DATA PROCESSING
Line broadening 0.2 Hz
FT size 131072
Total time 0 min, 40 sec



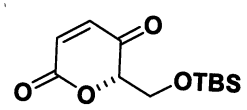
12a

STANDARD CARBON PARAMETERS

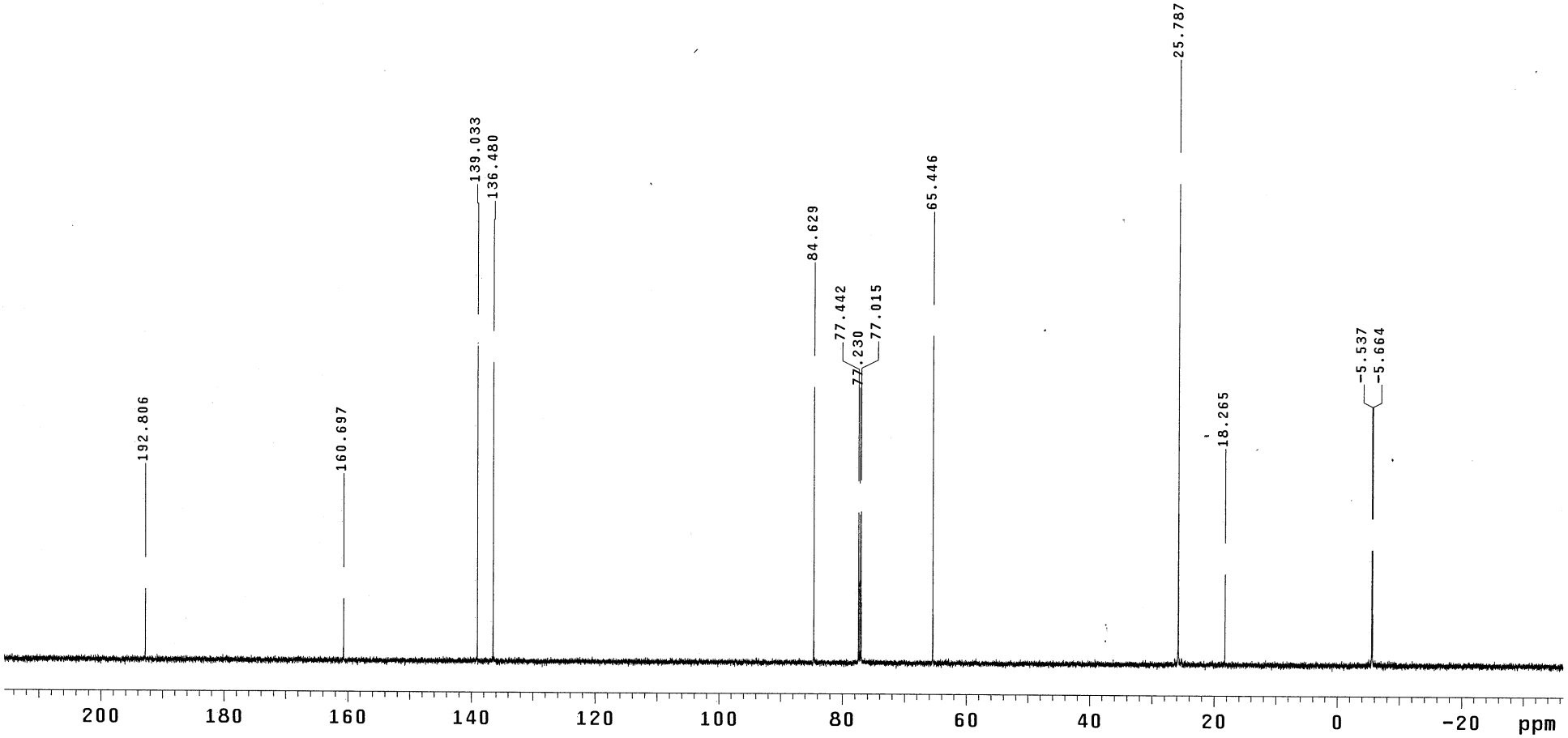
Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
User: 1-14-87
INOVA-600 "inova600"

Relax. delay 0.500 sec
Pulse 29.9 degrees
Acq. time 1.400 sec
Width 38004.8 Hz
1024 repetitions
OBSERVE C13, 150.7863543 MHz
DECOUPLE H1, 599.6700024 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 32 min, 34 sec



12a



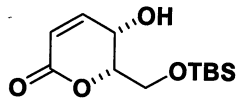
STANDARD PROTON PARAMETERS

Archive directory: /export/home/vnmr1/vnmrsys/data
Sample directory:
File: PROTON

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
INOVA-600 "inova600"

Relax. delay 1.000 sec
Pulse 30.0 degrees
Acq. time 4.000 sec
Width 9594.6 Hz
8 repetitions
OBSERVE H1, 599.6670059 MHz
DATA PROCESSING
Line broadening 0.2 Hz
FT size 131072
Total time 0 min, 40 sec



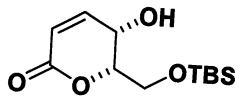
H

STANDARD CARBON PARAMETERS

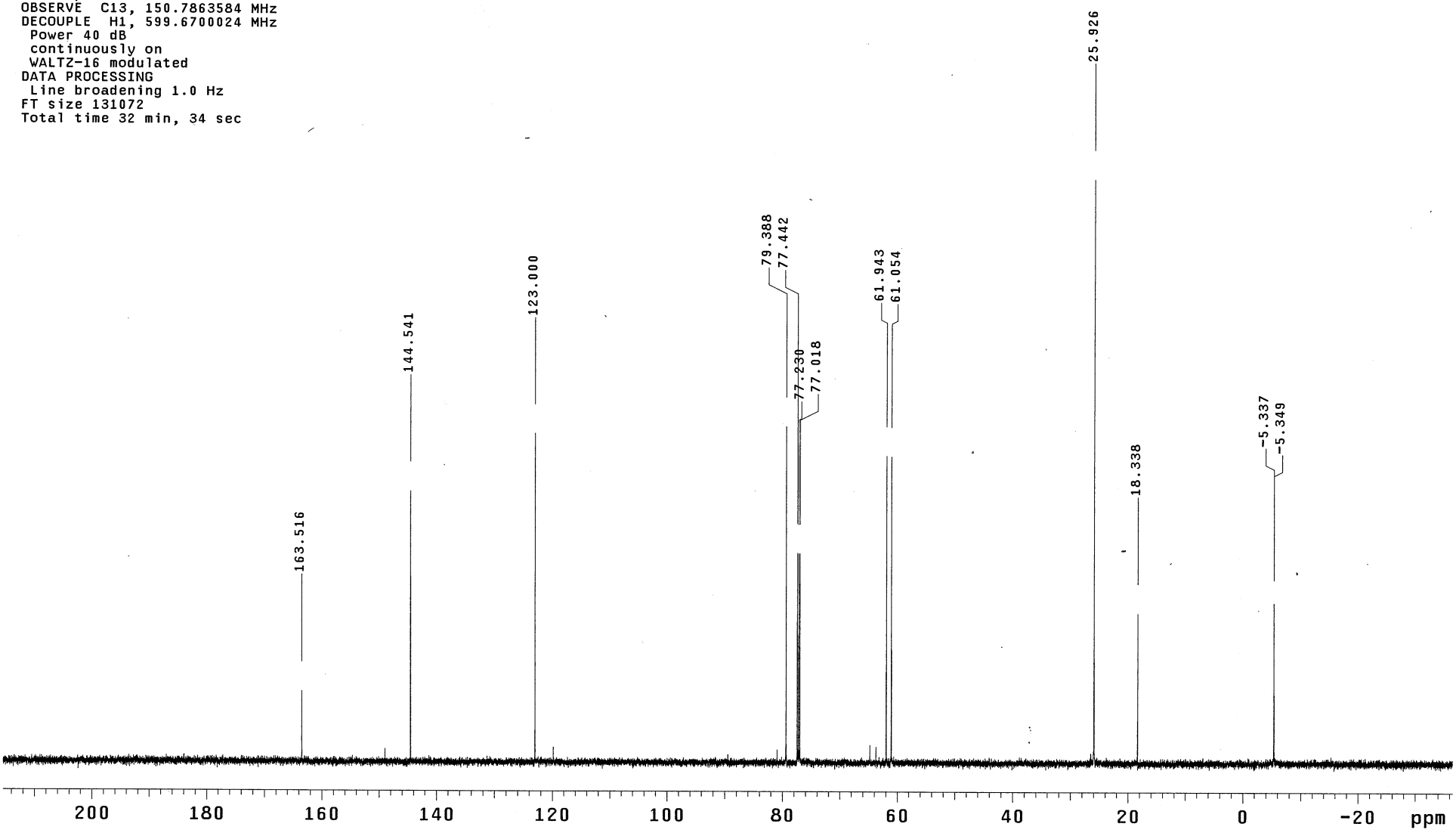
Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 28.0 C / 301.1 K
User: 1-14-87
INOVA-600 "inova600"

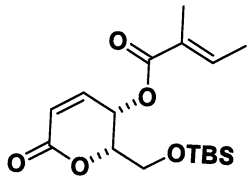
Relax. delay 0.500 sec
Pulse 29.9 degrees
Acq. time 1.400 sec
Width 38004.8 Hz
64 repetitions
OBSERVE C13, 150.7863584 MHz
DECOUPLE H1, 599.6700024 MHz
Power 40 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 1.0 Hz
FT size 131072
Total time 32 min, 34 sec



H



lms1014–3.2



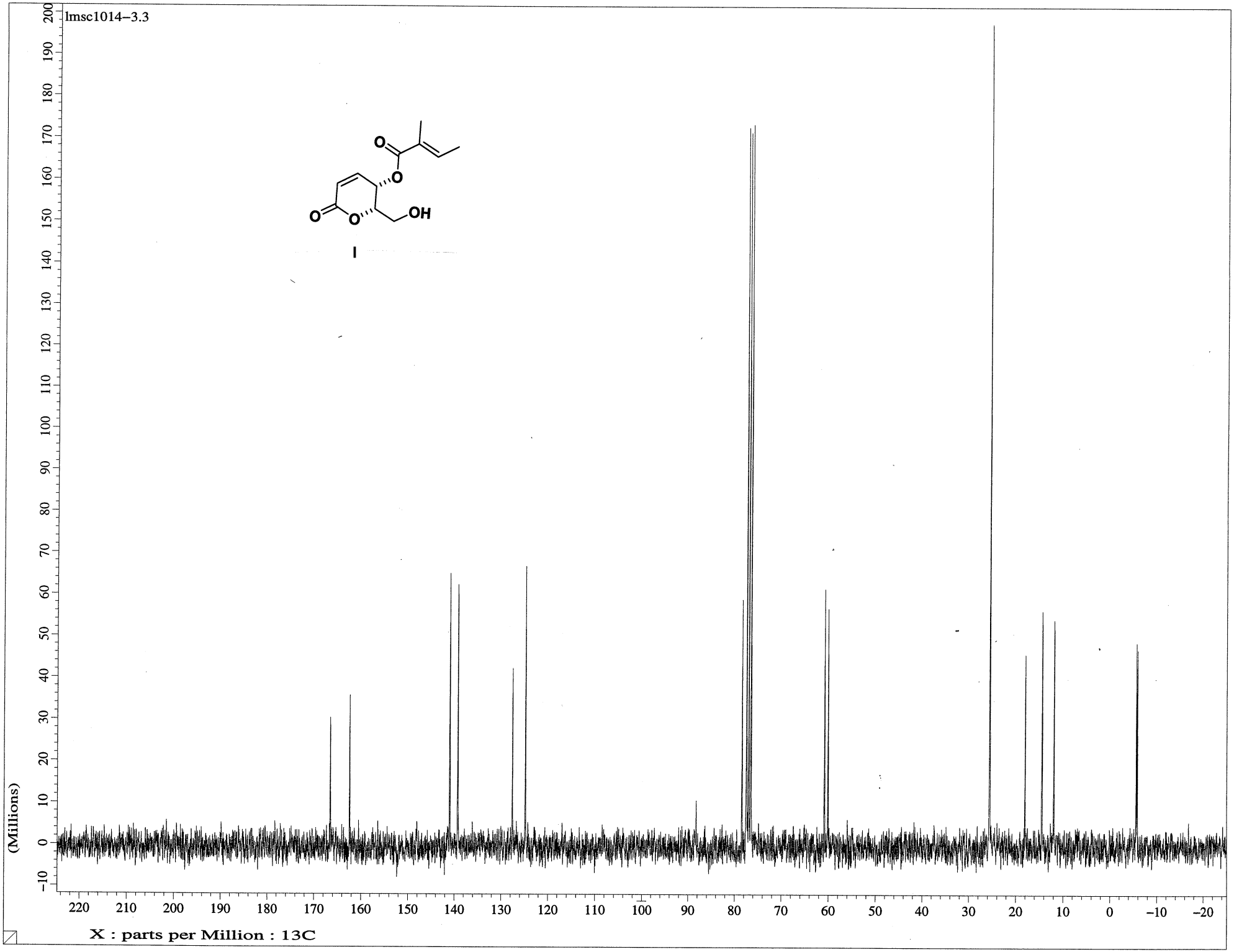
13a

(Millions)

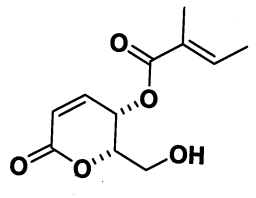
0 10 20 30 40 50 60 70

12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2

X : parts per Million : 1H


lmsc1014–3.3
O
O
O
O
OH
I
(Millions)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
X : parts per Million : 13C

lms1015–1.2



I

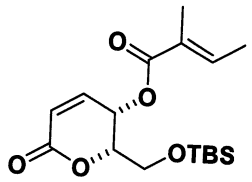
(Millions)

0
10
20
30

12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2

X : parts per Million : 1H

lmsc1015–1.2

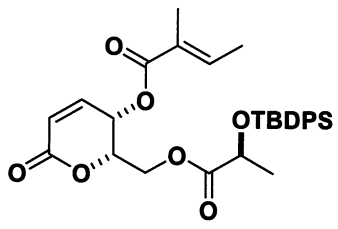


13a

(Millions)

X : parts per Million : 13C

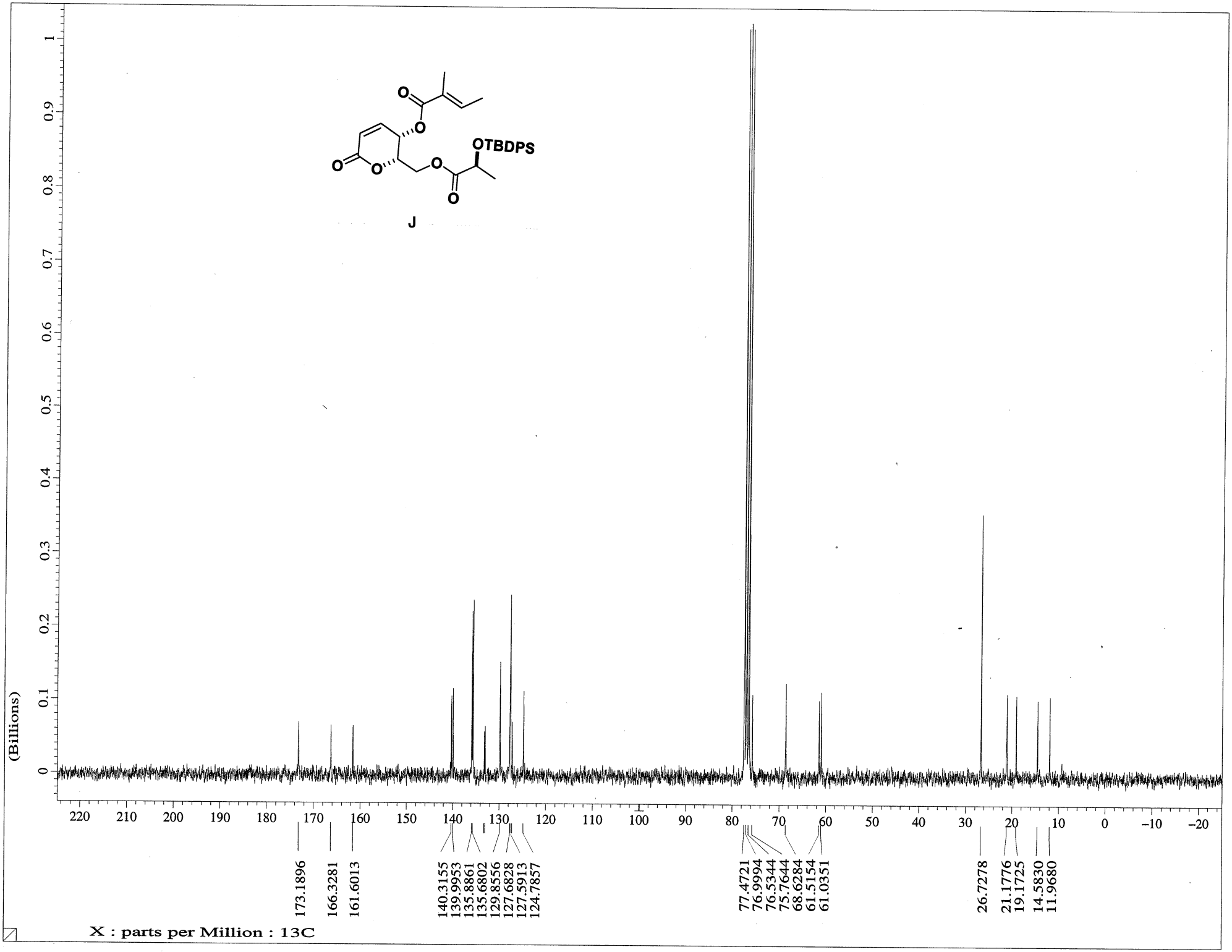
lms1016–1.3



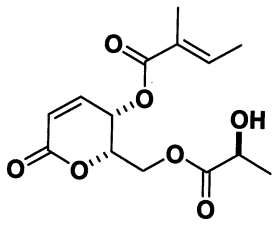
J

(Millions)

X : parts per Million : 1H


OTBDPS
J
(Billions)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
173.1896
166.3281
161.6013
140.3155
139.9953
135.8861
135.6802
129.8556
127.6828
127.5913
124.7857
77.4721
76.9994
76.5344
75.7644
68.6284
61.5154
61.0351
26.7278
21.1776
19.1725
14.5830
11.9680
X : parts per Million : 13C

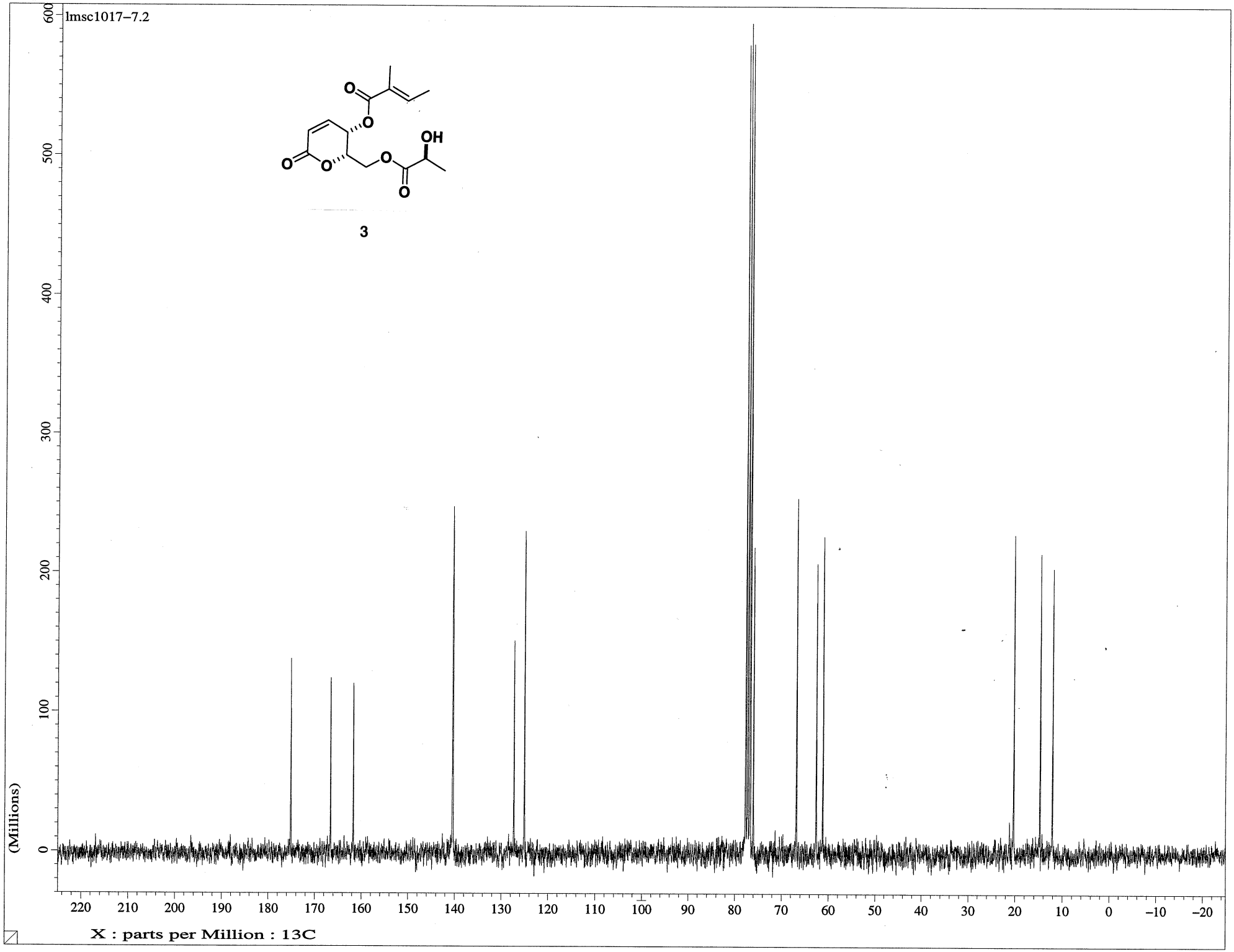
lms1017–5.2

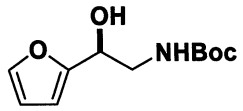


3

(Millions)

X : parts per Million : 1H


lmsc1017–7.2
OH
3
(Millions)
600
500
400
300
200
100
0
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 –10 –20
X : parts per Million : 13C

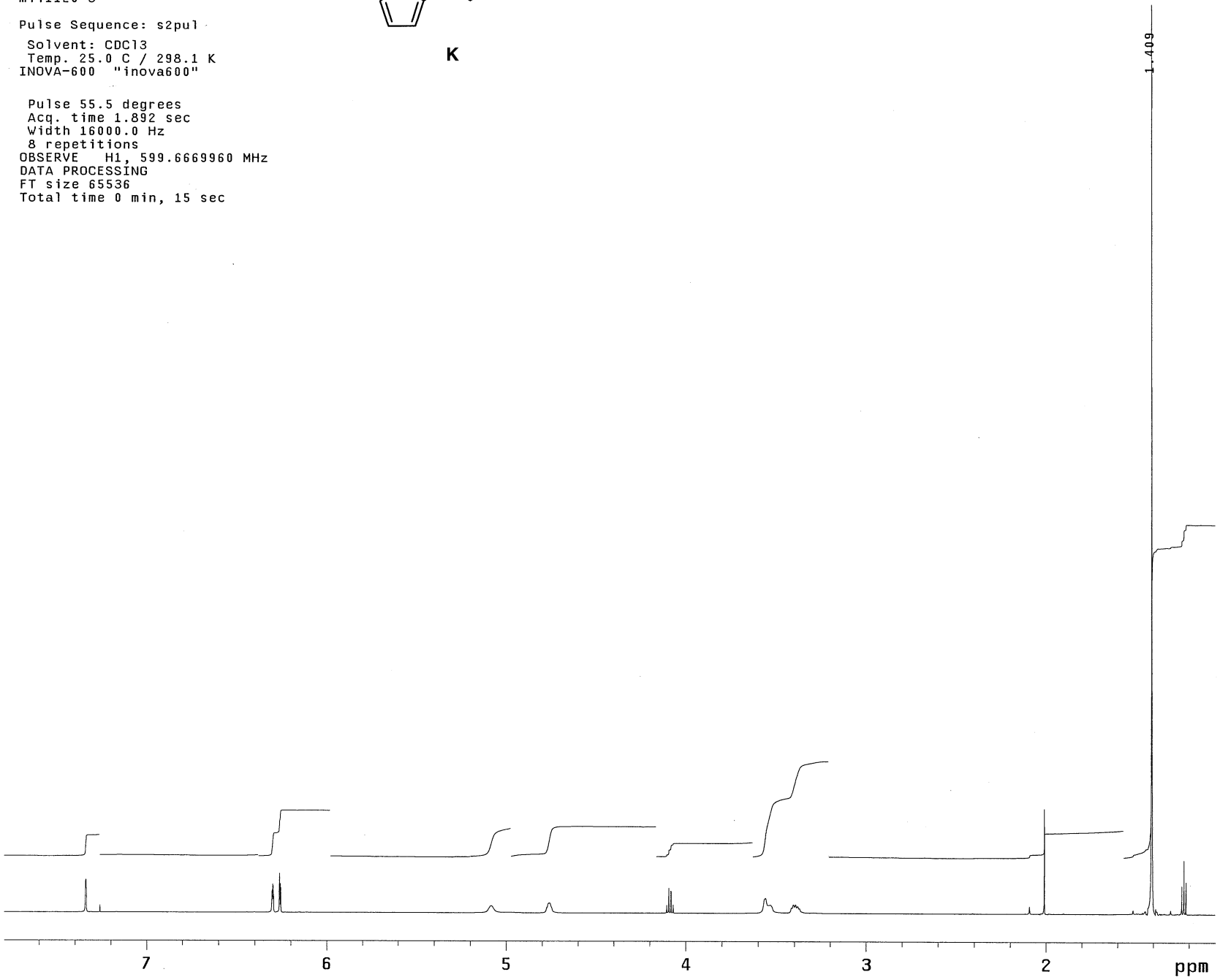


K

mli1120-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 16000.0 Hz
8 repetitions
OBSERVE H1, 599.6669960 MHz
DATA PROCESSING
FT size 65536
Total time 0 min, 15 sec

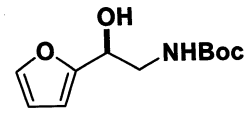


mlic1120-3

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
432 repetitions
OBSERVE C13, 150.7863938 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 3 hr, 38 min, 13 sec



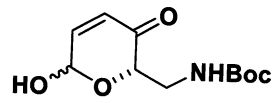
K

mli1120-1

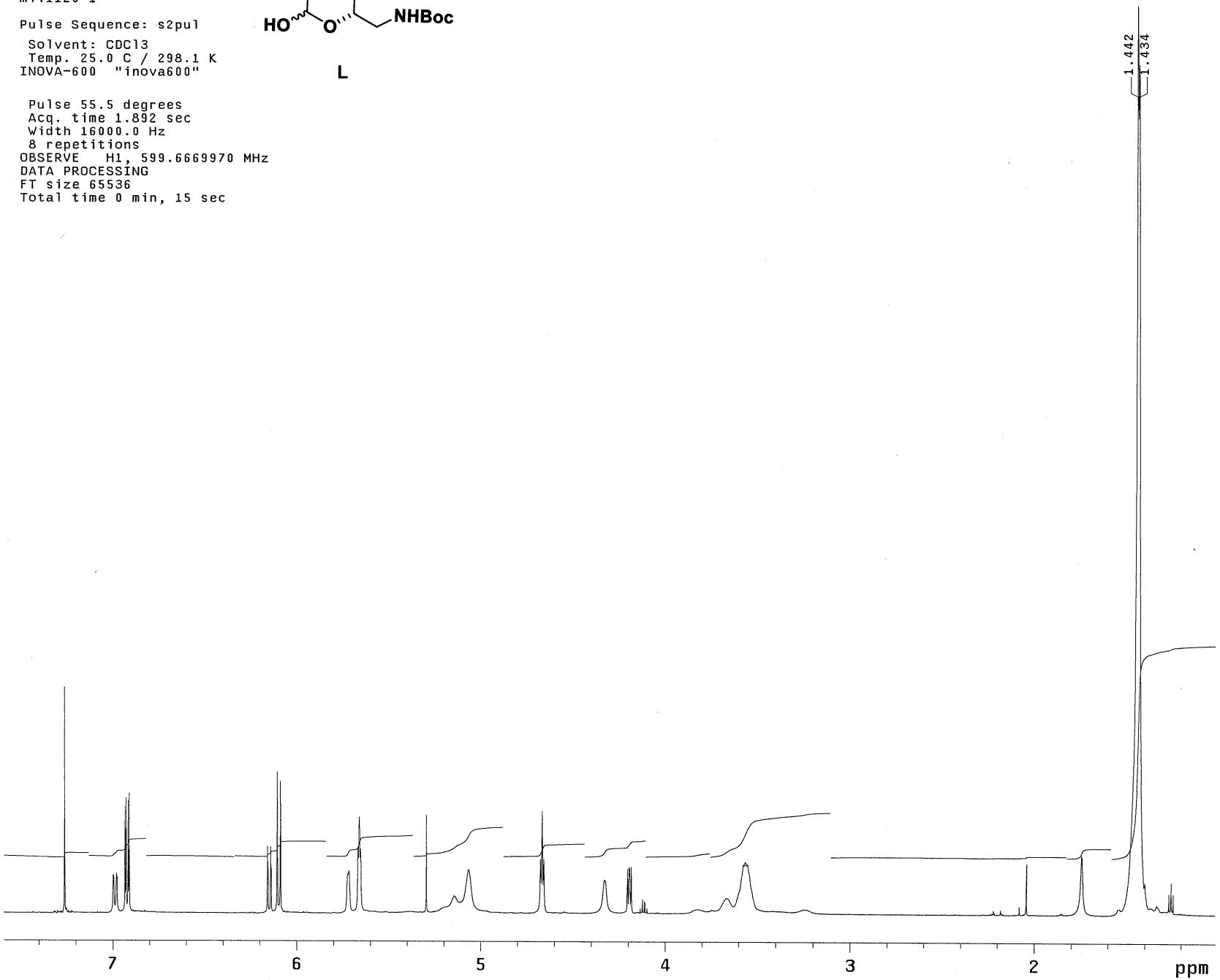
Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 16000.0 Hz
8 repetitions
OBSERVE H1, 599.6669970 MHz
DATA PROCESSING
FT size 65536
Total time 0 min, 15 sec



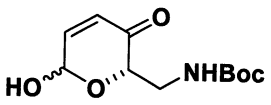
L



mlic1121

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
32672 repetitions
OBSERVE C13, 150.7863864 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 36 hr, 22 min, 19 sec

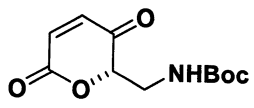


L

mli1120-2

Pulse Sequence: s2pul
 Solvent: CDCl3
 Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

 Pulse 55.5 degrees
 Acq. time 1.892 sec
 Width 16000.0 Hz
 8 repetitions
OBSERVE   H1, 599.6669960 MHz
DATA PROCESSING
FT size 65536
Total time 0 min, 15 sec

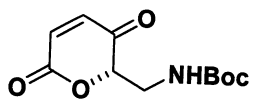


12b

mlic1120-4

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
6080 repetitions
OBSERVE C13, 150.7863909 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 3 hr, 38 min, 13 sec



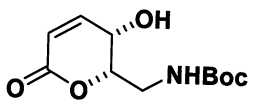
12b

STANDARD PROTON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669906 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



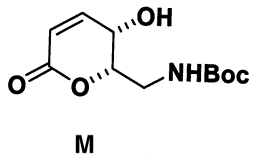
M

STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
608 repetitions
OBSERVE C13, 150.7863898 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec

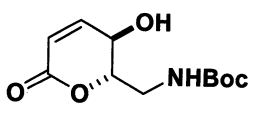


M

mli1108-21

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669935 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



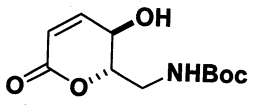
N

mlic1108-2

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
1000 repetitions
OBSERVE C13, 150.7863887 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec



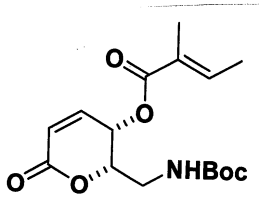
N

cis

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669921 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec



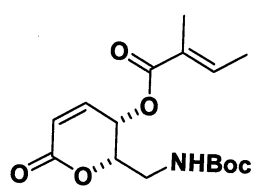
13b

STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
288 repetitions
OBSERVE C13, 150.7864030 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec



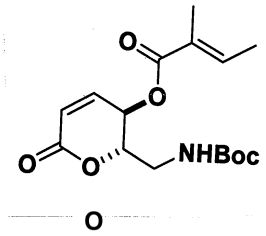
13b

STANDARD PROTON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 8000.0 Hz
8 repetitions
OBSERVE H1, 599.6669931 MHz
DATA PROCESSING
FT size 32768
Total time 0 min, 15 sec

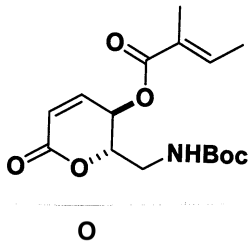


STANDARD CARBON PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

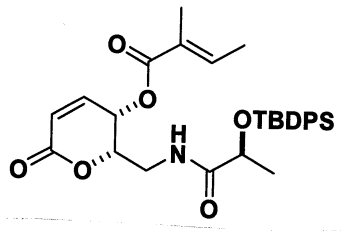
Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
2000 repetitions
OBSERVE C13, 150.7863887 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 43 min, 38 sec



mli1114-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 16000.0 Hz
8 repetitions
OBSERVE H1, 599.6669950 MHz
DATA PROCESSING
FT size 65536
Total time 0 min, 15 sec

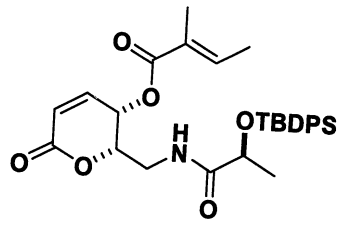


P

mlic1114-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
512 repetitions
OBSERVE C13, 150.7863938 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec

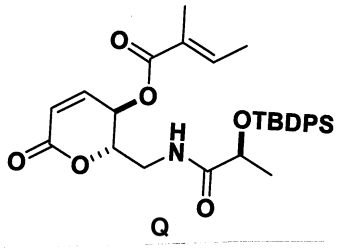


P

mli1117-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
INOVA-600 "inova600"

Pulse 55.5 degrees
Acq. time 1.892 sec
Width 16000.0 Hz
8 repetitions
OBSERVE H1, 599.6669955 MHz
DATA PROCESSING
FT size 65536
Total time 0 min, 15 sec

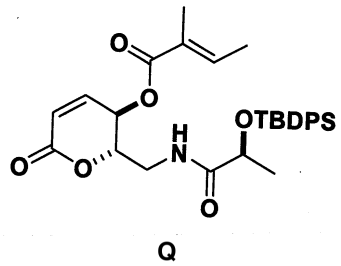


Q

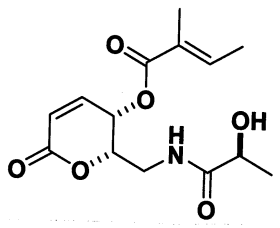
mlic1117-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
528 repetitions
OBSERVE C13, 150.7863887 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec



Q


O
O
O
H
N
OH
O
O

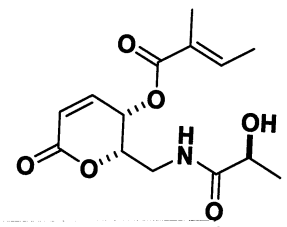
4

7.917
7.127
7.118
7.111
7.101
6.805
6.221
6.206
5.550
5.542
5.265
5.261
5.255
5.251
4.738
3.981
3.972
3.970
3.962
3.519
3.507
3.497
3.410
3.401
3.398
3.388
3.320
1.787
1.777
1.208
1.196
8
7
6
5
4
3
2
1
ppm
6.23
4.64
5.51
5.97
16.25
61.41

mlic1113-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 25.0 C / 298.1 K
User: 1-14-87
INOVA-600 "inova600"

Pulse 25.0 degrees
Acq. time 1.300 sec
Width 37505.9 Hz
592 repetitions
OBSERVE C13, 150.7871725 MHz
DECOUPLE H1, 599.6700024 MHz
Power 37 dB
continuously on
WALTZ-16 modulated
DATA PROCESSING
Line broadening 0.5 Hz
FT size 131072
Total time 21 min, 49 sec



4