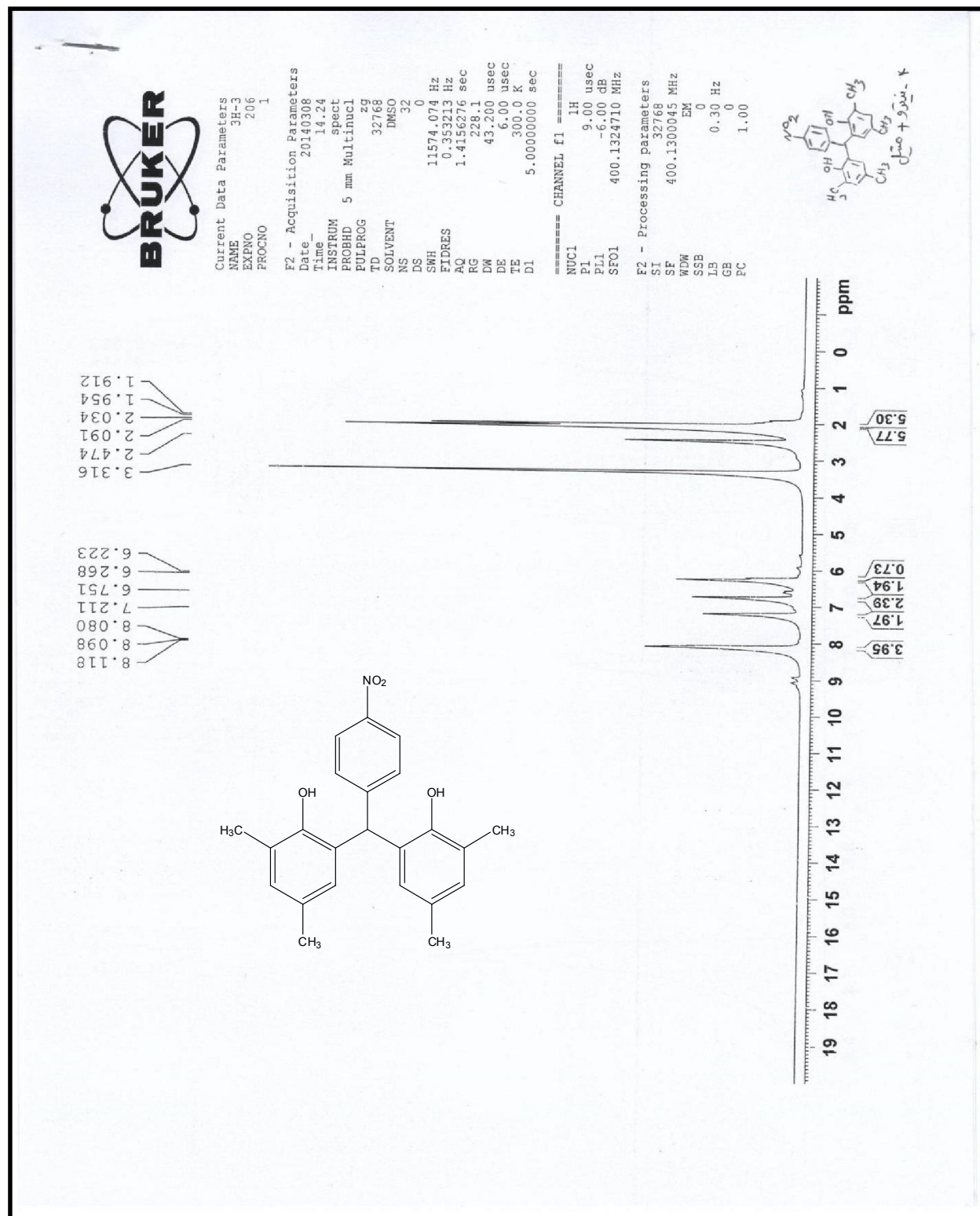**Supporting Information**

Microwave-assisted synthesis of 6,6′-(aryl(alkyl)methylene)bis(2,4-dialkylphenol) antioxidants catalyzed by multi sulfonated reduced graphene oxide nanosheets in water
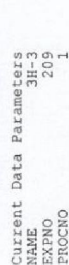
Hossein Naeimi*, Mohsen Golestanzadeh

Department of Organic Chemistry, Faculty of Chemistry, University of Kashan, Kashan, 8731751167, I. R. Iran

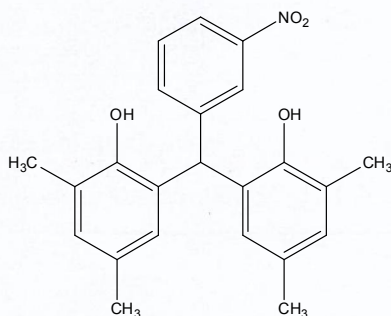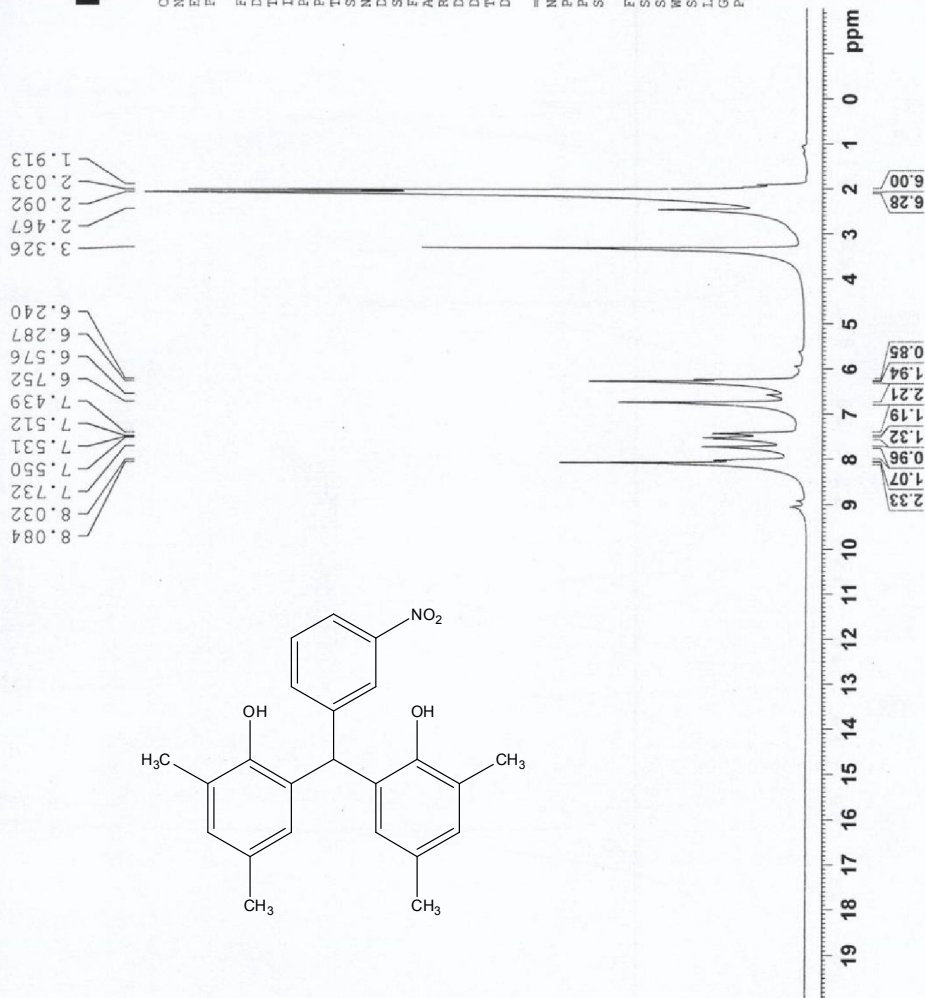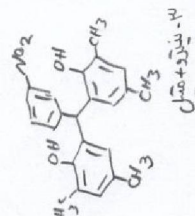E-mail: naeimi@kashanu.ac.ir

^{1}H NMR Spectra of prepared compounds.

Current Data Parameters
NAME   3H-3
EXPNO   206
PROCNO   1

F2 - Acquisition Parameters
Date_   20140308
Time   14.24
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   228.1
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.912
1.954
2.034
2.091
2.474
3.316

6.223
6.268
6.751
7.211
8.080
8.098
8.118

5.30
5.77

0.73
1.94
2.39
1.97
3.95

Current Data Parameters
NAME   3H-3
EXPNO   209
PROCNO   1

F2 - Acquisition Parameters
Date_   20140308
Time   15.02
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   16
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   101.6
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

Peaks: 1.913, 2.033, 2.092, 2.467, 3.326, 6.240, 6.287, 6.576, 6.752, 7.439, 7.512, 7.531, 7.550, 7.732, 8.032, 8.084

Integrals: 6.00, 6.28, 0.85, 1.94, 2.21, 1.19, 1.32, 0.96, 1.07, 2.33
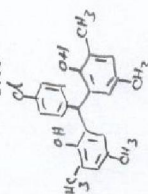
Current Data Parameters
NAME   3H-3
EXPNO   234
PROCNO   1

F2 - Acquisition Parameters
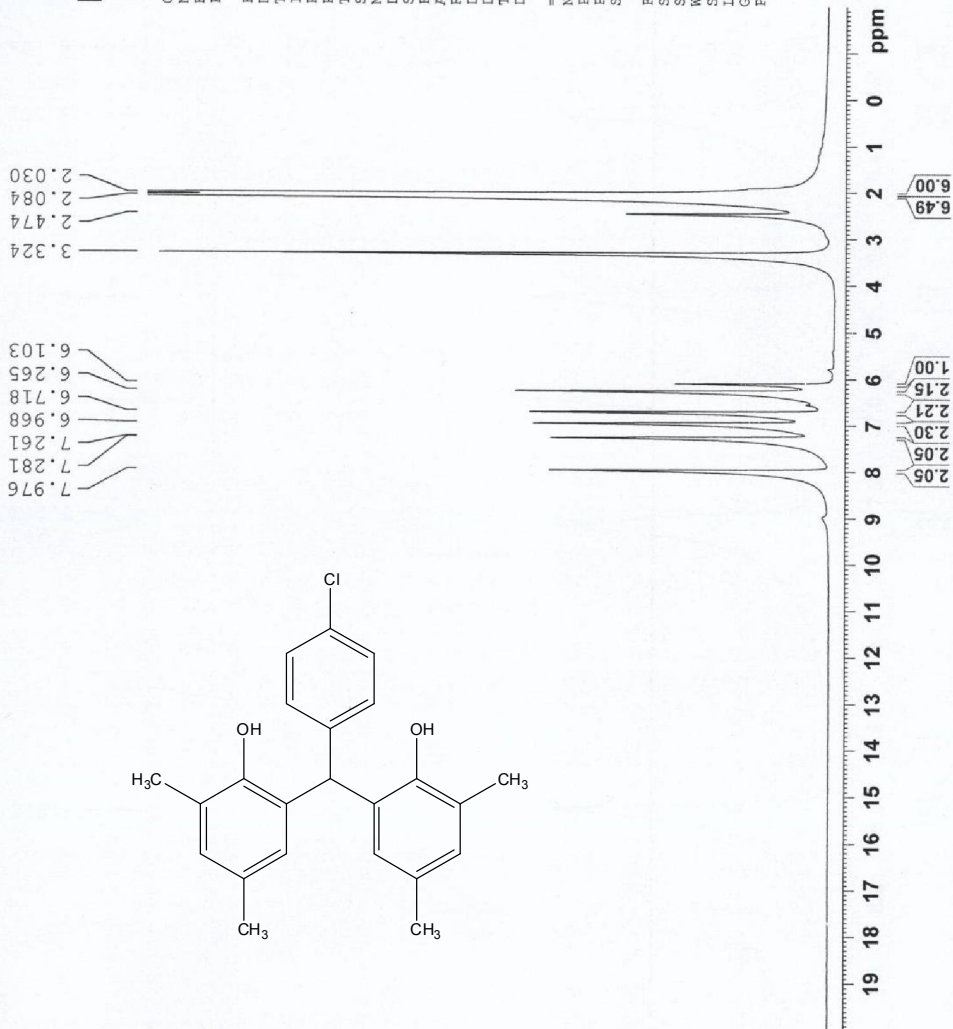Date_   20140312
Time   8.16
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074   Hz
FIDRES   0.353213   Hz
AQ   1.4156276   sec
RG   161.3
DW   43.200   usec
DE   6.00   usec
TE   300.0   K
D1   5.00000000   sec

======= CHANNEL f1 =======
NUC1   1H
P1   9.00   usec
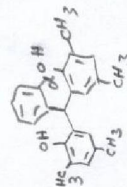PL1   -6.00   dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30   Hz
GB   0
PC   1.00

Peaks:
2.030
2.084
2.474
3.324
6.103
6.265
6.718
6.968
7.261
7.281
7.976

Integrals: 6.00, 6.49, 1.00, 2.15, 2.21, 2.30, 2.05, 2.05

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Current Data Parameters
NAME   3H-3
EXPNO   171
PROCNO   1

F2 - Acquisition Parameters
Date_   20140304
Time_   8.37
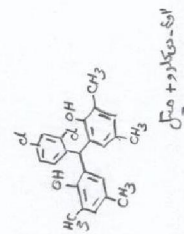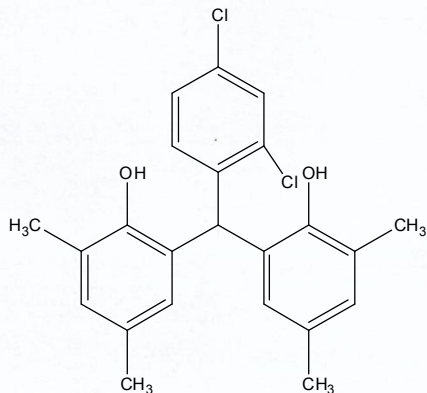INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   64
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.913
1.936
1.968
2.018
2.086
2.473
3.337

6.195
6.403
6.719
6.835
7.181
7.359
7.964

5.02
6.18

2.23
1.15
1.94
1.15
2.29
1.28
1.90

ppm
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

BRUKER

Current Data Parameters
NAME   3H-3
EXPNO   241
PROCNO   1

F2 - Acquisition Parameters
Date_   20140315
Time   8.57
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   161.3
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

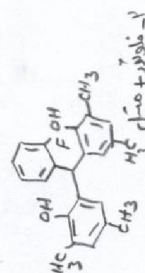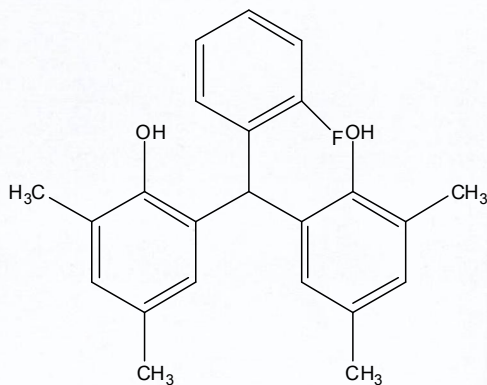======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.926
2.027
2.034
2.082
2.478
3.326
3.334

6.177
6.330
6.736
6.786
6.807
7.299
7.502
8.005
8.012

6.00
6.34

2.13
1.23
2.01
1.92
1.36
1.07
1.24

ppm
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

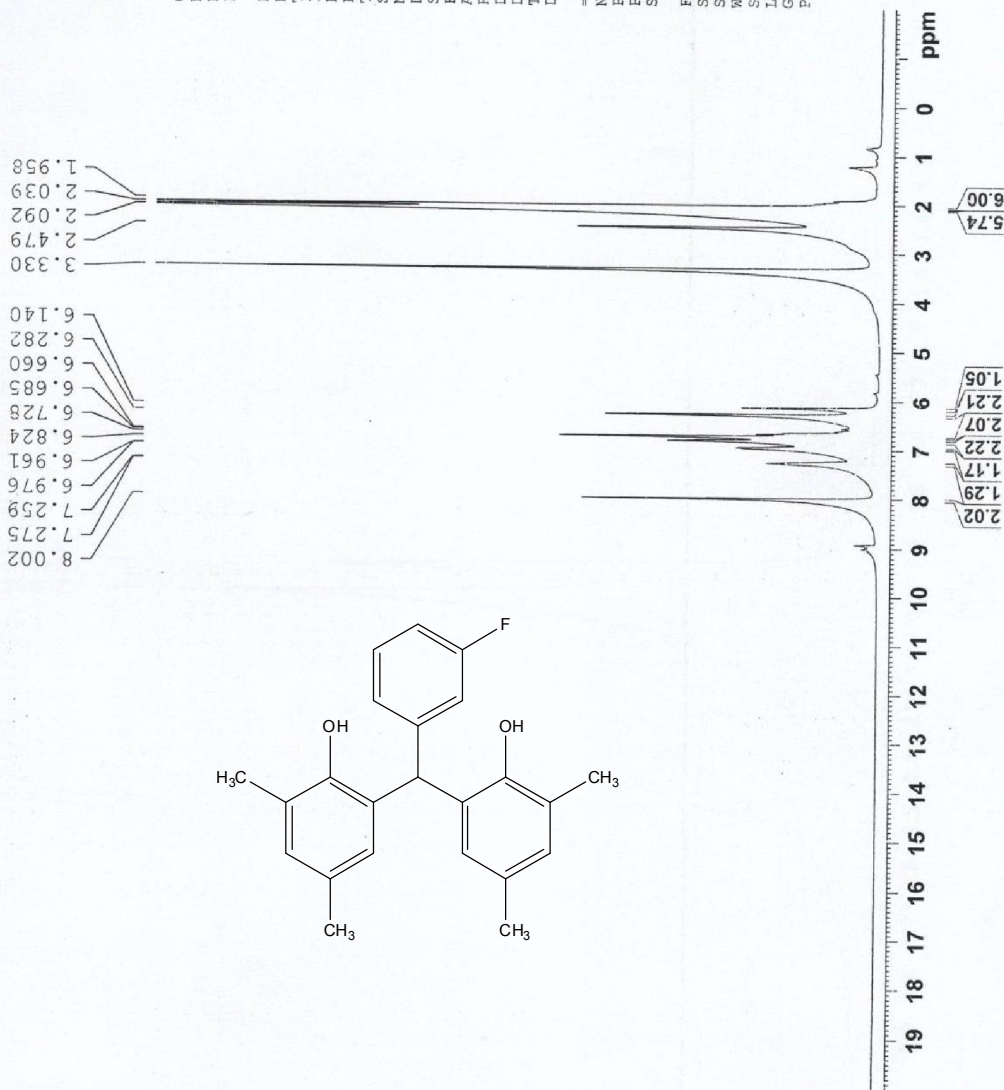BRUKER

Current Data Parameters
NAME   3H-3
EXPNO   185
PROCNO   1

F2 - Acquisition Parameters
Date_   20140305
Time   8.09
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   71.8
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

ppm

1.951
2.027
2.095
2.477
3.347

6.263
6.350
6.728
6.779
7.064
7.202
7.984

6.00
5.72

2.17
1.39
3.38
2.17
1.30
2.07

Peak labels: 1.958, 2.039, 2.092, 2.479, 3.330, 6.140, 6.282, 6.660, 6.685, 6.728, 6.824, 6.961, 6.976, 7.259, 7.275, 8.002

Integrations: 6.00, 5.74, 1.05, 2.21, 2.07, 2.22, 1.17, 1.29, 2.02

BRUKER

Current Data Parameters
NAME   3H-3
EXPNO   186
PROCNO   1

F2 - Acquisition Parameters
Date_   20140305
Time   8.18
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   114
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
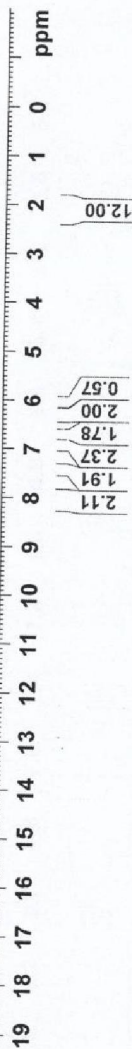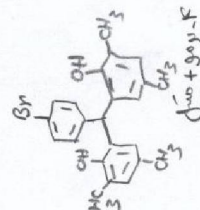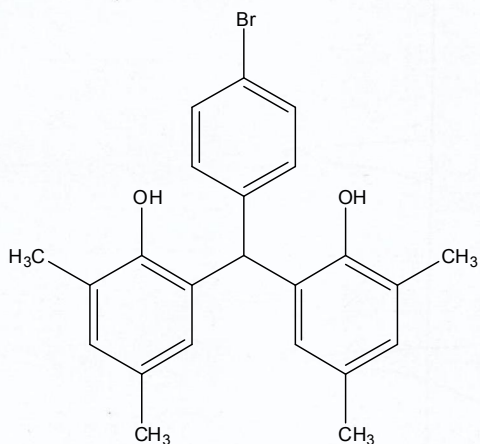P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

2.069
2.459

3.318

6.072
6.251
6.704
6.886
7.388
7.965

12.00

0.57
2.00
1.78
2.37
1.91
2.11

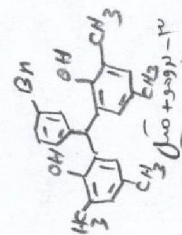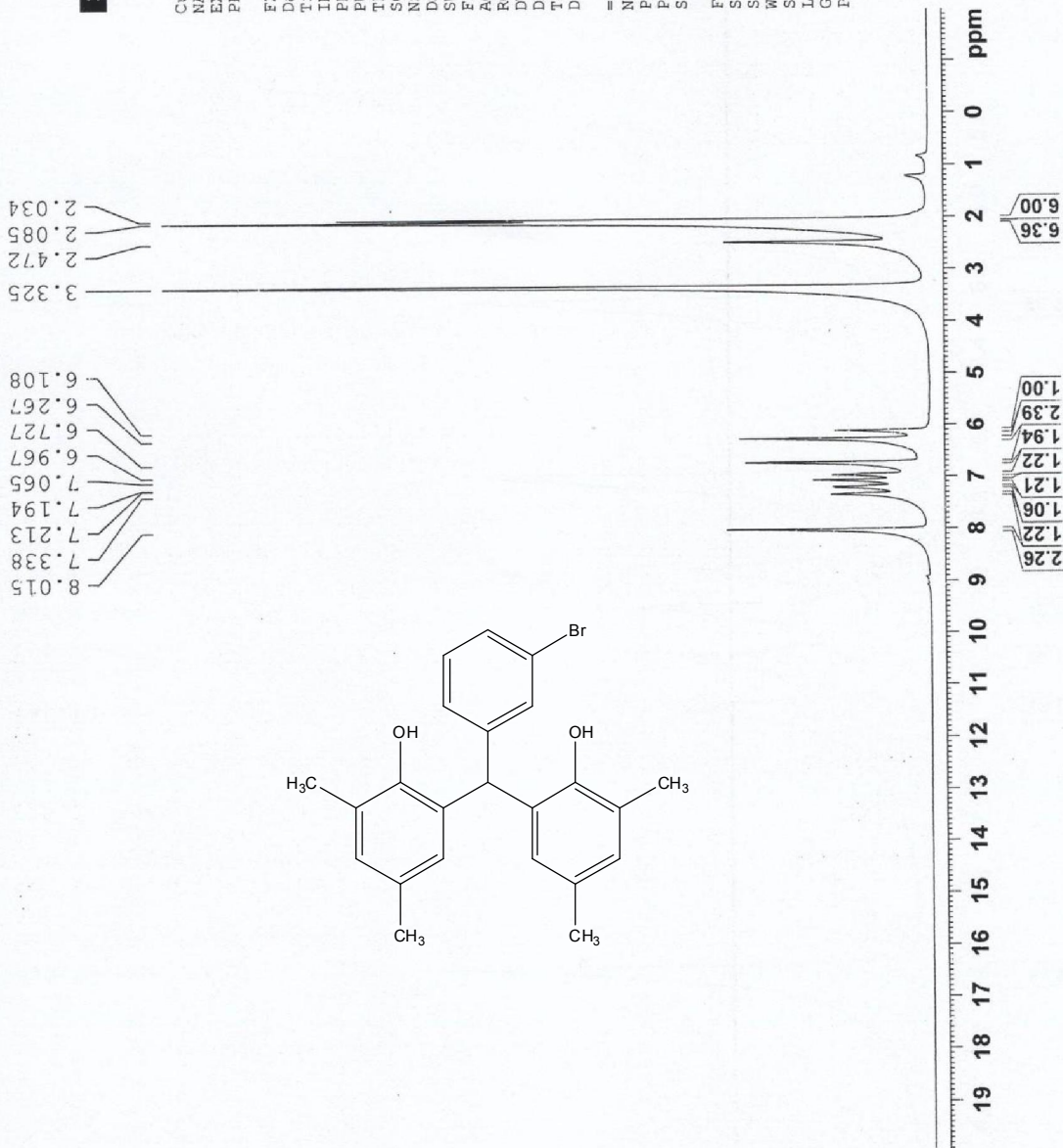Current Data Parameters
NAME   3H-3
EXPNO   215
PROCNO   1

F2 - Acquisition Parameters
Date_   20140309
Time   14.00
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   143.7
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

2.034
2.085
2.472
3.325

6.108
6.267
6.727
6.967
7.065
7.194
7.213
7.338
8.015

ppm

6.00
6.36

1.00
2.39
1.94
1.22
1.21
1.06
1.22
2.26

Current Data Parameters
NAME   3H-3
EXPNO   170
PROCNO   1

F2 - Acquisition Parameters
Date_   20140304
Time   8.19
INSTRUM   spect
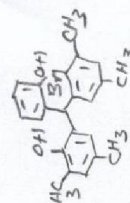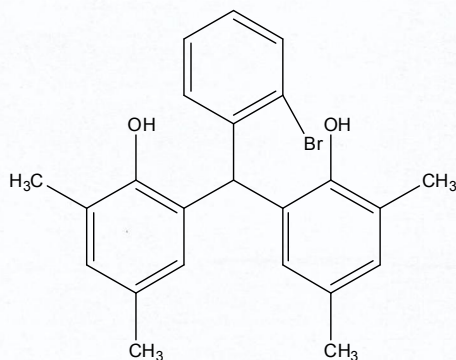PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   64
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
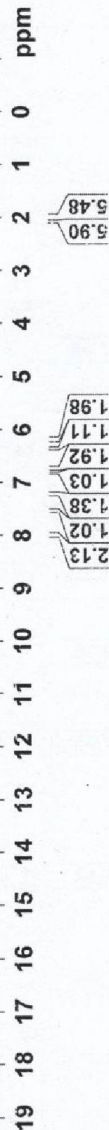PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.944
2.020
2.091
2.478
3.349

6.184
6.356
6.722
6.836
7.087
7.103
7.218
7.538
7.970

5.48
5.90

1.98
1.11
1.92
1.03
1.38
1.02
2.13

ppm

2.026
2.087
2.480
3.334

6.133
6.291
6.705
6.979
7.119
7.136
7.216
7.232
7.934

6.00
6.23

1.02
2.02
2.29
2.16
1.39
2.37
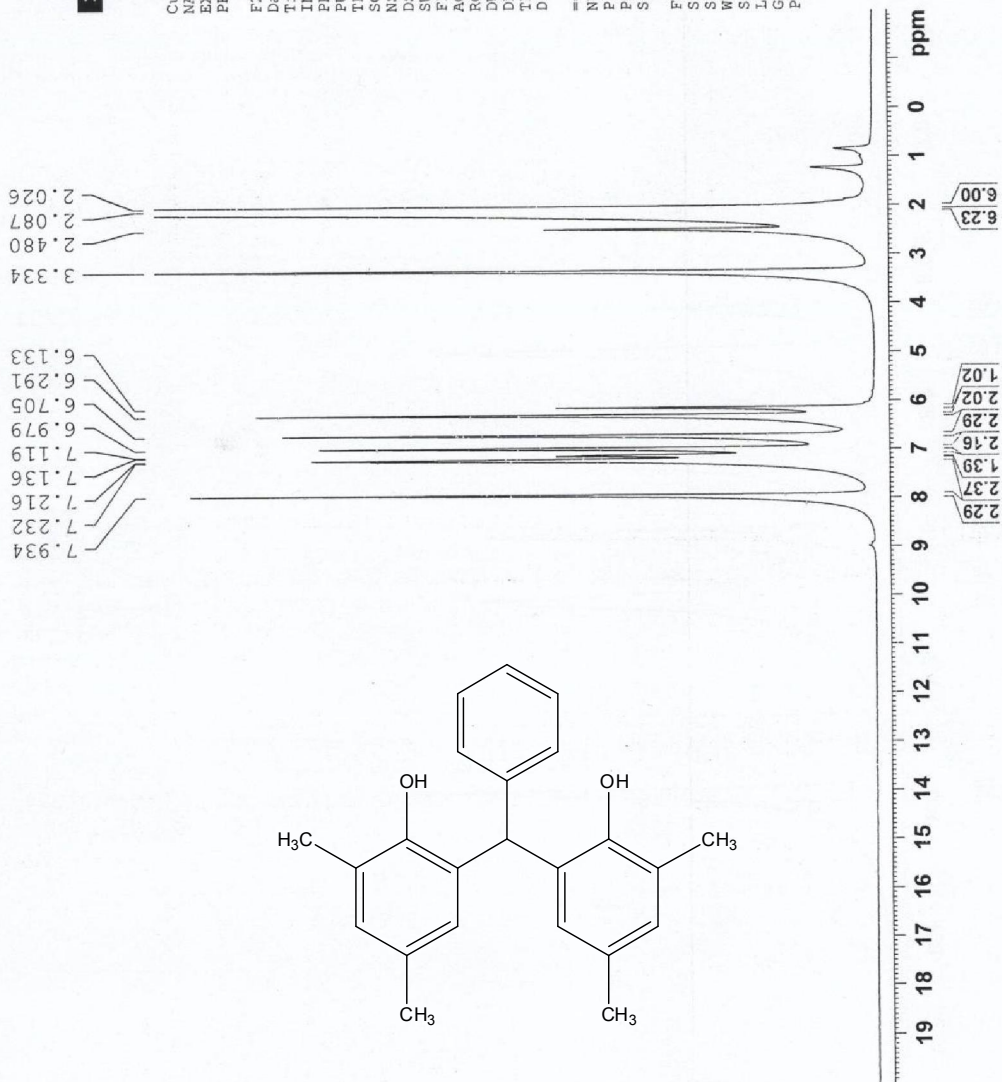2.29

Current Data Parameters
NAME   3H-3
EXPNO   207
PROCNO   1

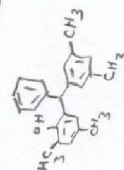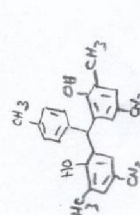F2 - Acquisition Parameters
Date_   20140308
Time   14.33
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   161.3
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======= CHANNEL f1 =======
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

2.019
2.071
2.219
2.472
3.319

6.064
6.282
6.687
6.848
7.001
7.019
7.884

6.00
6.39
3.21

1.06
1.91
2.12
2.32
2.35
2.38

ppm 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Current Data Parameters
NAME   3H-3
EXPNO   238
PROCNO   1

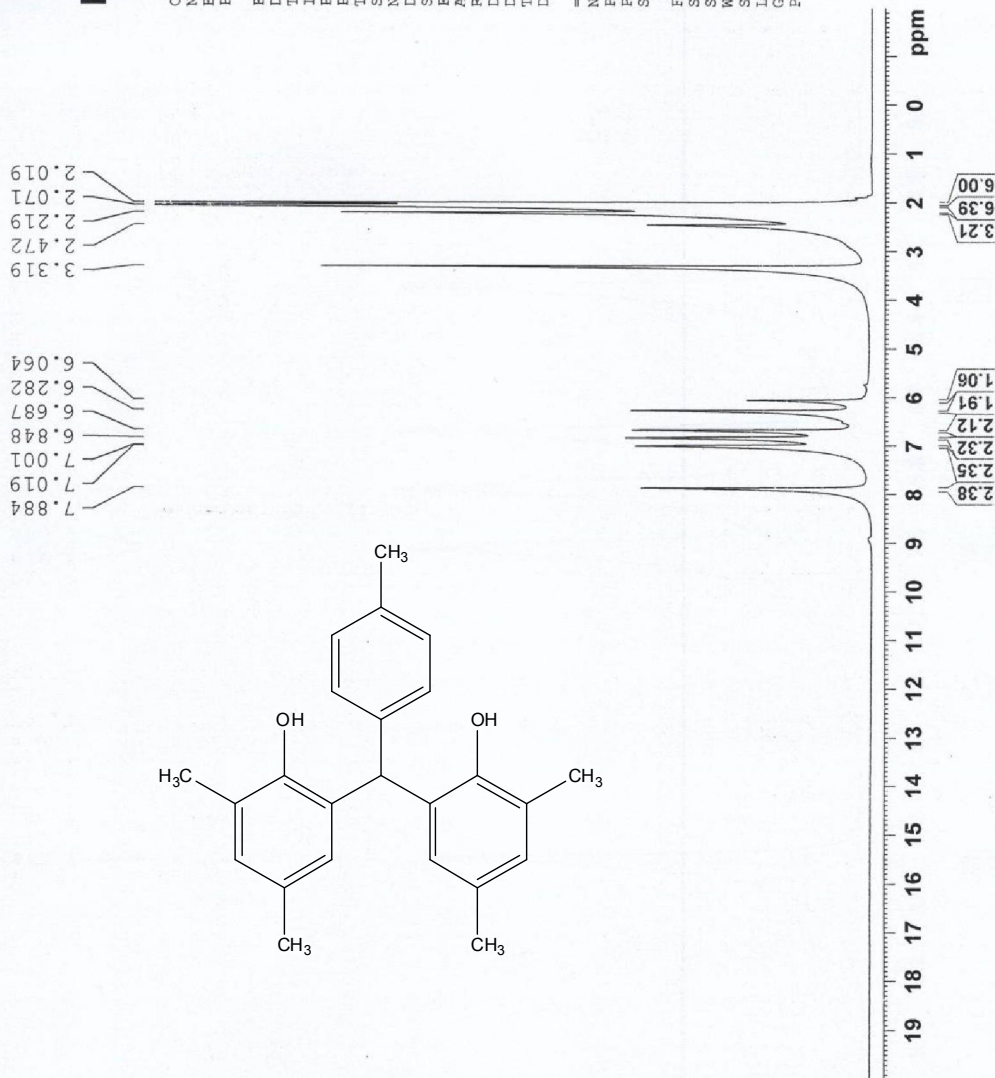F2 - Acquisition Parameters
Date_   20140312
Time   13.40
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   71.8
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======= CHANNEL f1 =======
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.908
2.018
2.031
2.069
2.107
2.466
3.489
6.070
6.257
6.525
6.598
6.618
6.680
6.729
6.826
7.181
7.779
7.944

12.00
11.77

1.98
4.06
2.44
2.40
3.97
1.95
2.08

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Current Data Parameters
NAME   3H
EXPNO   1904
PROCNO   1

F2 - Acquisition Parameters
Date_   20131222
Time   10.12
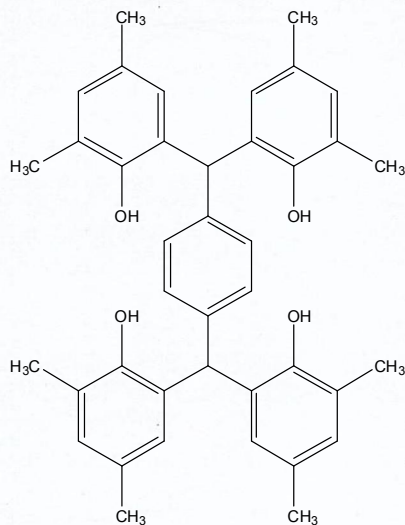INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   16
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   256
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
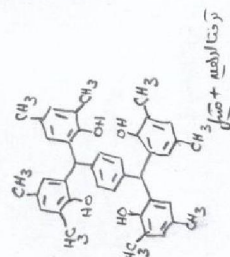SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

1.050
1.330
2.475
3.317
6.281
6.471
7.104
7.139
7.159
7.706
8.114
8.134

18.00 18.17   1.15 2.01 4.07 2.05 2.16

ppm 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Current Data Parameters
NAME   3H-3
EXPNO   214
PROCNO   1

F2 - Acquisition Parameters
Date_   20140309
Time   13.31
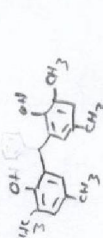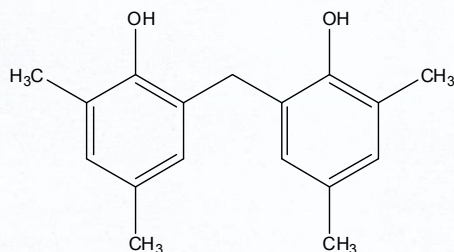INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   32
DS   0
SWH   11574.074 Hz
FIDRES   0.353213 Hz
AQ   1.4156276 sec
RG   40.3
DW   43.200 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
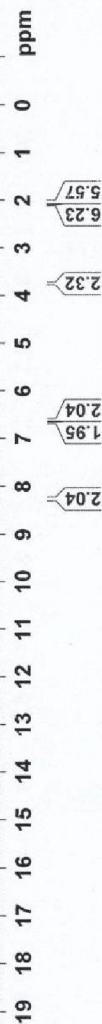PL1   -6.00 dB
SFO1   400.1324710 MHz

F2 - Processing parameters
SI   32768
SF   400.1300045 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

Peak labels:
2.000
2.066
2.102
2.465
3.387
3.742
3.877
6.628
6.681
8.254

Integration labels: 5.57, 6.23, 2.32, 2.04, 1.95, 2.04

ppm axis: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
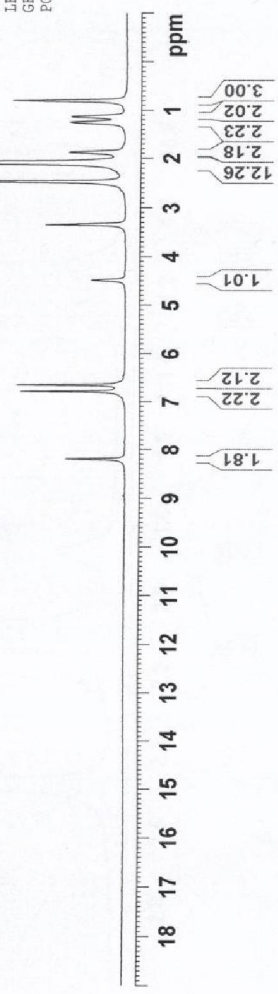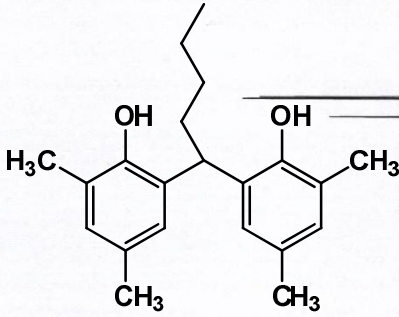
Current Data Parameters
NAME   3H-3
EXPNO   2382
PROCNO   1

F2 - Acquisition Parameters
Date_   20150114
Time   9.52
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zg
TD   32768
SOLVENT   DMSO
NS   16
DS   0
SWH   8012.820 Hz
FIDRES   0.244532 Hz
AQ   2.0447731 sec
RG   406.4
DW   62.400 usec
DE   6.00 usec
TE   300.0 K
D1   5.00000000 sec

======== CHANNEL f1 ========
NUC1   1H
P1   9.00 usec
PL1   -6.00 dB
SFO1   400.1336012 MHz

F2 - Processing parameters
SI   32768
SF   400.1300065 MHz
WDW   EM
SSB   0
LB   0.30 Hz
GB   0
PC   1.00

0.803
1.138
1.254
1.881
2.076
2.108
2.479
3.354

4.491

6.654
6.793

8.201

0.854
1.326
1.342
1.358
1.763
1.780
1.798
2.085
2.115
2.484
3.336
3.359
4.625
4.643
4.662
6.659
6.815
8.256

6.00
1.02
2.01
6.01
6.13
1.00
2.09
2.24
1.87

ppm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
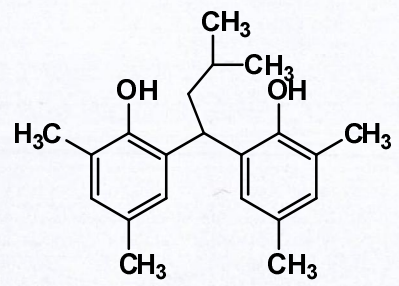
^{13}C NMR Spectra of selected compounds.

BRUKER

Current Data Parameters
NAME   Carbon13-3
EXPNO   128
PROCNO   1

F2 - Acquisition Parameters
Date_   20140521
Time   10.35
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zgpg30
TD   65536
SOLVENT   DMSO
NS   2500
DS   4
SWH   40404.039 Hz
FIDRES   0.616517 Hz
AQ   0.8110580 sec
RG   32768
DW   12.375 usec
DE   6.00 usec
TE   300.0 K
D1   1.00000000 sec
d11   0.03000000 sec
d12   0.00002000 sec

======== CHANNEL f1 ========
NUC1   13C
P1   7.50 usec
PL1   -2.00 dB
SFO1   100.6204965 MHz

======== CHANNEL f2 ========
CPDPRG2   waltz16
NUC2   1H
PCPD2   80.00 usec
PL2   -4.00 dB
PL12   18.50 dB
PL13   18.50 dB
SFO2   400.1316005 MHz
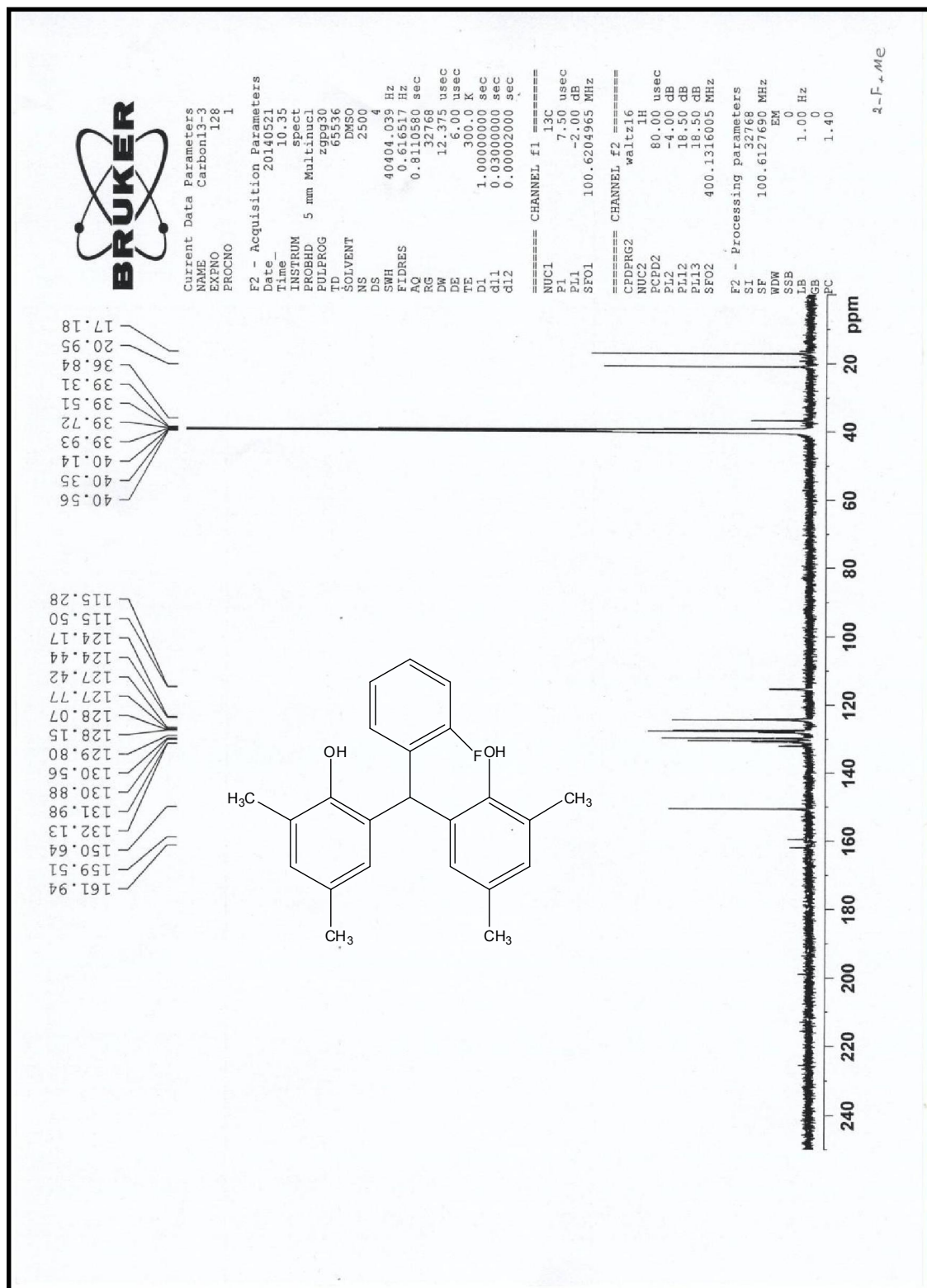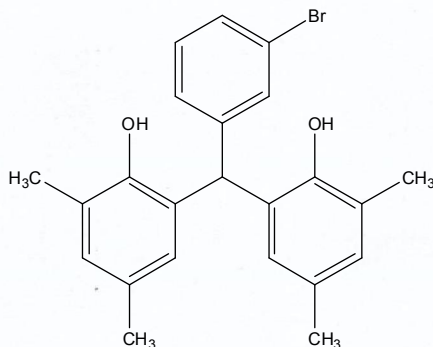
F2 - Processing parameters
SI   32768
SF   100.6127690 MHz
WDW   EM
SSB   0
LB   1.00 Hz
GB   0
PC   1.40

2-F+Me

171.18
120.95
36.84
39.31
39.51
39.72
39.93
40.14
40.35
40.56

115.28
115.50
124.17
124.44
127.42
127.77
128.07
128.15
129.80
130.56
130.88
131.98
132.13
150.64
159.51
161.94

3Br + Me

17.19
20.94
39.33
39.54
39.75
39.96
40.17
40.38
40.59
43.50

121.84
124.65
127.57
128.07
128.73
128.98
129.86
130.57
130.94
131.98
148.90
150.68

BRUKER

Current Data Parameters
NAME   Carbon13-3
EXPNO   129
PROCNO   1

F2 - Acquisition Parameters
Date_   20140524
Time_   11.03
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zgpg30
TD   65536
SOLVENT   DMSO
NS   2500
DS   4
SWH   4404.039 Hz
FIDRES   0.616517 Hz
AQ   0.8110580 sec
RG   32768
DW   12.375 usec
DE   6.00 usec
TE   300.0 K
D1   1.00000000 sec
d11   0.03000000 sec
d12   0.00002000 sec

======== CHANNEL f1 ========
NUC1   13C
P1   7.50 usec
PL1   -2.00 dB
SFO1   100.6204965 MHz

======== CHANNEL f2 ========
CPDPRG2   waltz16
NUC2   1H
PCPD2   80.00 usec
PL2   -4.00 dB
PL12   18.50 dB
PL13   18.50 dB
SFO2   400.1316005 MHz

F2 - Processing parameters
SI   32768
SF   100.6127690 MHz
WDW   EM
SSB   0
LB   1.00 Hz
GB   0
PC   1.40

17.21
20.97
21.07
39.30
39.51
39.72
39.93
40.14
40.34
40.55
43.26

124.38
127.30
128.18
128.94
129.45
129.58
131.95
134.81
141.78
150.69

ppm
20 40 60 80 100 120 140 160 180 200 220 240

tert-butyl + 4-N

30.35
31.70
34.27
35.16
39.29
39.50
39.70
39.91
40.12
40.33
40.54
44.12

121.76
123.47
125.08
130.50
130.64
130.87
137.52
141.46
146.18
151.02
153.25

BRUKER

Current Data Parameters
NAME   Carbon13-3
EXPNO   122
PROCNO   1

F2 - Acquisition Parameters
Date_   20140518
Time   13.53
INSTRUM   spect
PROBHD   5 mm Multinucl
PULPROG   zgpg30
TD   65536
SOLVENT   DMSO
NS   2500
DS   4
SWH   40404.039 Hz
FIDRES   0.616517 Hz
AQ   0.8110580 sec
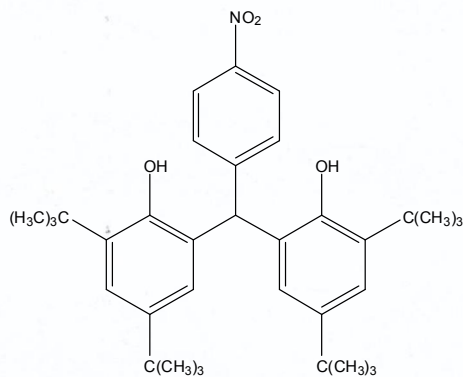RG   32768
DW   12.375 usec
DE   6.00 usec
TE   300.0 K
D1   1.00000000 sec
d11   0.03000000 sec
d12   0.00002000 sec

======== CHANNEL f1 ========
NUC1   13C
P1   7.50 usec
PL1   -2.00 dB
SFO1   100.6204965 MHz

======== CHANNEL f2 ========
CPDPRG2   waltz16
NUC2   1H
PCPD2   80.00 usec
PL2   -4.00 dB
PL12   18.50 dB
PL13   18.50 dB
SFO2   400.1316005 MHz

F2 - Processing parameters
SI   32768
SF   100.6127690 MHz
WDW   EM
SSB   0
LB   1.00 Hz
GB   0
PC   1.40

Then + Me

16.41
17.20
20.56
20.95
39.31
39.52
39.73
39.94
40.15
40.35
40.56
43.28

114.88
123.88
124.32
124.68
127.30
127.45
127.61
128.29
129.19
129.41
129.81
129.90
130.28
130.85
131.58
132.02
141.99
150.66
153.50