Supporting information

Spectral data

Schiff base 4-(((4-methoxyphenyl)imino)methyl)phenol (1a)
Gray solid, mp 200-203 °C; ^{1}H NMR (250 MHz, DMSO-d_6): δ= 3.79 (s, 3H, OMe), 6.85-6.91 (m, 4H, Ar-H), 7.17 (d, *J*= 8.00 Hz, 2H, Ar-H), 7.72 (d, *J*= 8.00 Hz, 2H, Ar-H), 8.38 (s, 1H, CH=N), 9.75 (s, 1H, OH); ^{13}C NMR (62.9 MHz, DMSO-d_6): δ= 60.2 (OMe), 119.1, 120.5, 126.8, 132.7, 135.1, 149.9, 160.0, 162.6, 165.3 (C=N); IR (Neat, Cm^{-1}): 1027, 1243 (sp^2C-O-Csp^3), 1390 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1638 (C=N stretching), 2844-3075 (CH stretching); Analysis calculated for $C_{14}H_{13}NO_2$: C, 73.99; H, 5.77; N, 6.16%. Found: C, 73.71; H, 5.51; N, 5.65%.

4-(1-(4-Methoxyphenyl)-2-oxospiro[azetidine-3,9'-xanthen]-4-yl)phenyl acrylate (2a)
Yellow oil, ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.80 (s, 3H, OMe), 5.08 (d, *J*= 4.75 Hz, 1H, H-3), 5.93-5.98 (m, 1H, acrylat), 6.21-6.25 (m, 1H, acrylat), 6.49-6.52 (m, 1H, acrylat), 6.84–7.50 (m, 16H, Ar-H); ^{13}C NMR (62.9 MHz, $CDCl_3$): δ= 55.5 (OMe), 63.9 (C-4), 73.8 (C-3), 114.5, 116.2, 116.9, 119.0, 121.3, 122.7, 124.3, 127.6, 128.4, 129.1, 131.3, 132.2, 132.8, 149.9, 152.0, 156.6, 164.2 (CO acrylat), 165.6 (CO *β*-lactam). MS m/z = 489 [M^+]. IR (Neat, cm^{-1}): 1384 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1607 (-CH=CH_2 acrylat), 1689 (C=O acrylat), 1751 (C=O *β*-lactam), 2839-3082 (CH stretching). Analysis calculated for $C_{31}H_{23}NO_5$: C, 76.06; H, 4.74; N, 2.86%. Found: C, 76.51; H, 4.93; N, 2.93%.

4-(3-Methoxy-1-(4-methoxyphenyl)-4-oxoazetidin-2-yl) phenyl acrylate (2b)
Yellow oil, ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.73 (s, 3H, OMe), 3.77 (s, 3H, OMe), 4.80 (d, *J*= 4.70 Hz, 1H, H-4,), 5.19 (d, *J*= 4.70 Hz, 1H, H-3), 5.69-5.73 (m, 1H, acrylat,), 6.00-6.05 (m, 1H, acrylat), 6.56-6.64 (m, 1H, acrylat), 6.76–7.51 (m, 8H, Ar-H,); ^{13}C NMR (62.9 MHz, $CDCl_3$): δ= 55.4, 58.4 (OMe), 61.3 (C-4), 84.7 (C-3), 114.1, 114.4, 116.1, 118.8, 122.0, 127.4, 129.0, 131.1, 132.3, 132.9, 156.4, 163.0 (CO acrylat), 163.8 (CO *β*-lactam); MS m/z= 353.2 [M^+]; IR (Neat, Cm^{-1}): 1387 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1608 (-CH=CH_2 acrylat), 1680 (C=O acrylat), 1749 (C=O *β*-lactam), 2839-3071 (CH stretching); Analysis calculated for $C_{20}H_{19}NO_5$: C, 67.98; H, 5.42; N, 3.96%. Found: C, 68.21; H, 5.53; N, 4.03%.

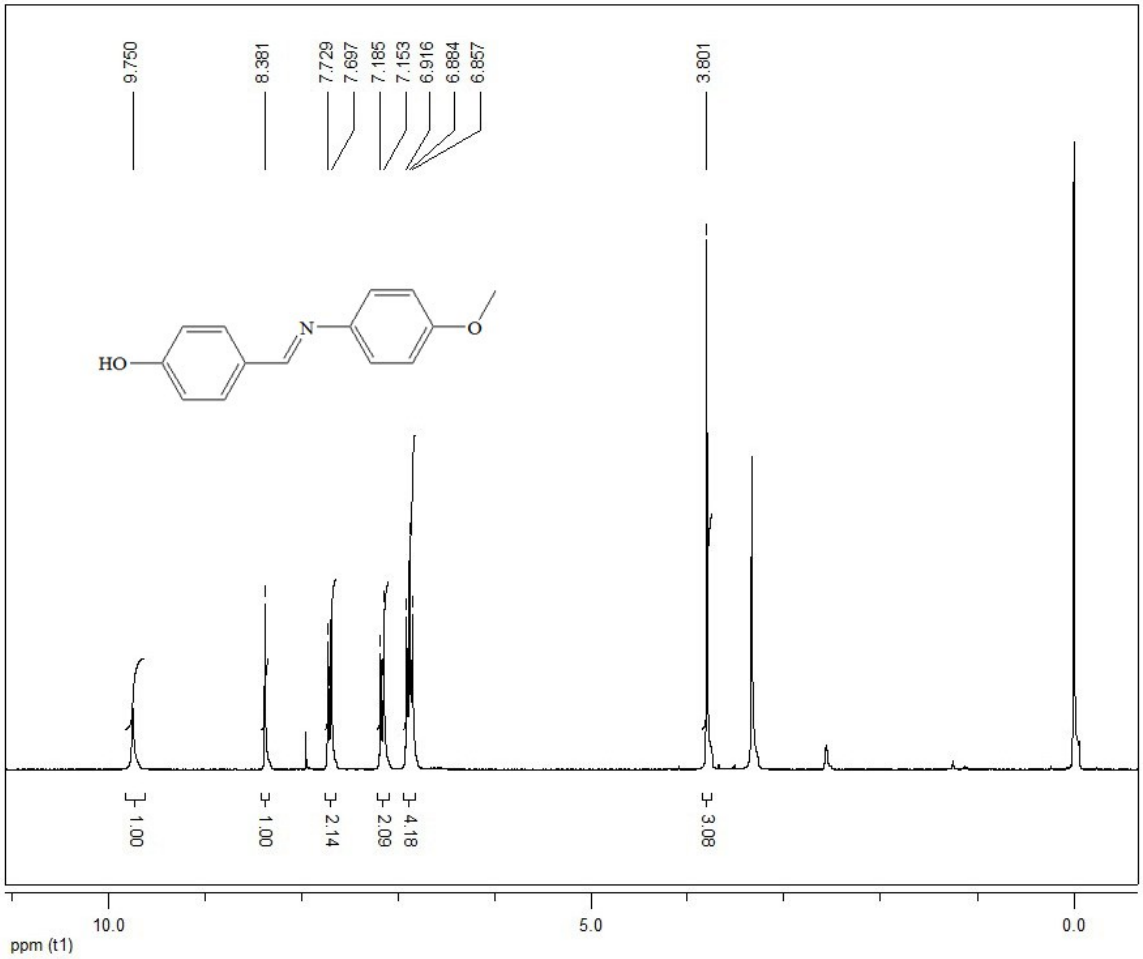
4-(1-(4-Methoxyphenyl)-4-oxo-3-phenoxyazetidin-2-yl) phenyl acrylate (2c)
White solid, mp 155-157 °C; ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.74 (s, 3H, OMe), 5.36 (d, *J*= 4.70 Hz, 1H, H-4), 5.55 (d, *J*= 4.70 Hz, 1H, H-3), 5.96-6.01 (m, 1H, acrylat), 6.21-6.32 (m, 1H, acrylat), 6.53-6.60 (m, 1H, acrylat), 6.79-7.39 (m, 13H, Ar-H); ^{13}C NMR (63 MHz, $CDCl_3$): δ= 55.4 (OMe), 61.4 (C-4), 81.1 (C-3), 114.4, 115.7, 118.9, 121.5, 122.2, 127.7, 129.1, 129.3, 129.5, 130.2, 132.7, 150.8, 156.5, 156.8, 162.3 (CO acrylat), 164.1 (CO *β*-lactam); MS m/z= 415.1 [M^+]; IR (Neat, Cm^{-1}): 1381 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1612 (-CH=CH_2 acrylat), 1682 (C=O acrylat), 1762 (C=O *β*-lactam), 2843-3078 (CH stretching);

Analysis calculated for $C_{25}H_{21}NO_5$: C, 72.28; H, 5.10; N, 3.37; %. Found: C, C, 71.98; H, 4.03; N, 3.21; %.

4-(3-(4-Chlorophenoxy)-1-(4-methoxyphenyl)-4-oxoazetidin-2-yl)phenyl acrylate (2d)
Light yellow oil, ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.74 (s, 3H, OMe), 5.36 (d, *J*= 4.75 Hz, 1H, H-4), 5.50 (d, *J*= 4.75 Hz, 1H, H-3), 6.02-6.03 (m, 1H, acrylat), 6.23-6.34 (m, 1H, acrylat), 6.55-6.62 (m, 1H, acrylat), 6.70-6.82 (m, 4H, Ar-H), 7.08-7.14 (m, 4H, Ar-H), 7.26-7.39 (m, 4H, Ar-H); ^{13}C NMR (62.9 MHz, $CDCl_3$): δ= 55.4 (OMe), 61.3 (C-4), 81.3 (C-3), 114.4, 115.9, 117.0, 118.9, 121.6, 127.7, 129.1, 129.2, 129.4, 130.0, 132.9, 150.9, 155.4, 156.6, 162.0 (CO acrylat), 164.2 (CO *β*-lactam); MS m/z= 449 [M^+]; IR (Neat, Cm^{-1}): 1393 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1628 (-CH=CH_2 acrylat), 1681 (C=O acrylat), 1736 (C=O *β*-lactam), 2869-3078 (CH stretching); Analysis calculated for $C_{25}H_{20}ClNO_5$: C, 66.74; H, 4.48; N, 3.11%. Found: C, 66.25; H, 4.39; N, 3.08%.

4-(3-(2,4-Dichlorophenoxy)-1-(4-methoxyphenyl)-4-oxoazetidin-2-yl)phenyl acrylate (2e)
Light yellow oil, ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.74 (s, 3H, OMe), 5.40 (d, *J*= 4.70 Hz, 1H, H-4), 5.50 (d *J*= 4.70 Hz, 1H, H-3), 5.98-6.18 (m, 1H, acrylat), 6.30-6.35 (m, 1H, acrylat), 6.55-6.62 (m, 1H, acrylat), 6.92-7.34 (m, 11H, Ar-H); ^{13}C NMR (62.9 MHz, $CDCl_3$): δ= 55.4 (OMe), 60.9 (C-4), 81.6 (C-3), 114.5, 116.0, 118.9, 121.7, 122.3, 124.2, 127.4, 127.7, 129.1, 130.0, 131.2, 132.3, 132.9, 151.0, 151.4, 156.7, 161.7 (CO acrylat), 162.7 (CO *β*-lactam); MS m/z= 483.3 [M^+]; IR (Neat, Cm^{-1}): 1389 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1612 (-CH=CH_2 acrylat), 1681 (C=O acrylat), 1751 (C=O *β*-lactam), 2885-3086 (CH stretching); Analysis calculated for $C_{25}H_{19}Cl_2NO_5$: C, 62.00; H, 3.95; N, 2.89%. Found: C, 62.11; H, 4.02; N, 2.95%.

4-(1-(4-Methoxyphenyl)-3-(naphthalen-2-yloxy)-4-oxoazetidin-2-yl)phenyl acrylate (2f)
Brown oil, ^{1}H NMR (250 MHz, $CDCl_3$): δ= 3.72 (s, 3H, OMe), 5.39 (d, *J*= 4.65 Hz, 1H, H-4), 5.65 (d, *J*= 4.70 Hz, 1H, H-3), 5.94-5.98 (m, 1H, acrylat), 6.23-6.33 (m, 1H, acrylat), 6.51-6.81 (m, 1H, acrylat), 6.90-7.75 (m, 15H, Ar-H); ^{13}C NMR (62.9 MHz, $CDCl_3$): δ= 55.4 (OMe), 61.5 (C-4), 81.0 (C-3), 109.2, 114.0, 114.4, 116.0, 118.3, 118.9, 121.5, 121.9, 124.2, 126.4, 126.8, 127.6, 129.1, 129.5, 130.1, 131.0, 132.2, 132.8, 133.8, 156.6, 162.4 (CO acrylat), 163.8 (CO *β*-lactam); MS m/z= 465 [M^+]; IR (Neat, Cm^{-1}): 1389 (CH_3 bending), 1480-1600 (C=C aromatic ring), 1605 (-CH=CH_2 acrylat), 1682 (C=O acrylat), 1751 (C=O *β*-lactam), 2831-3070 (CH stretching); Analysis calculated for $C_{29}H_{23}NO_5$: C, 74.83; H, 4.98; N, 3.01%. Found: C, 74.97; H, 5.11; N, 3.13%.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2.14
2.09
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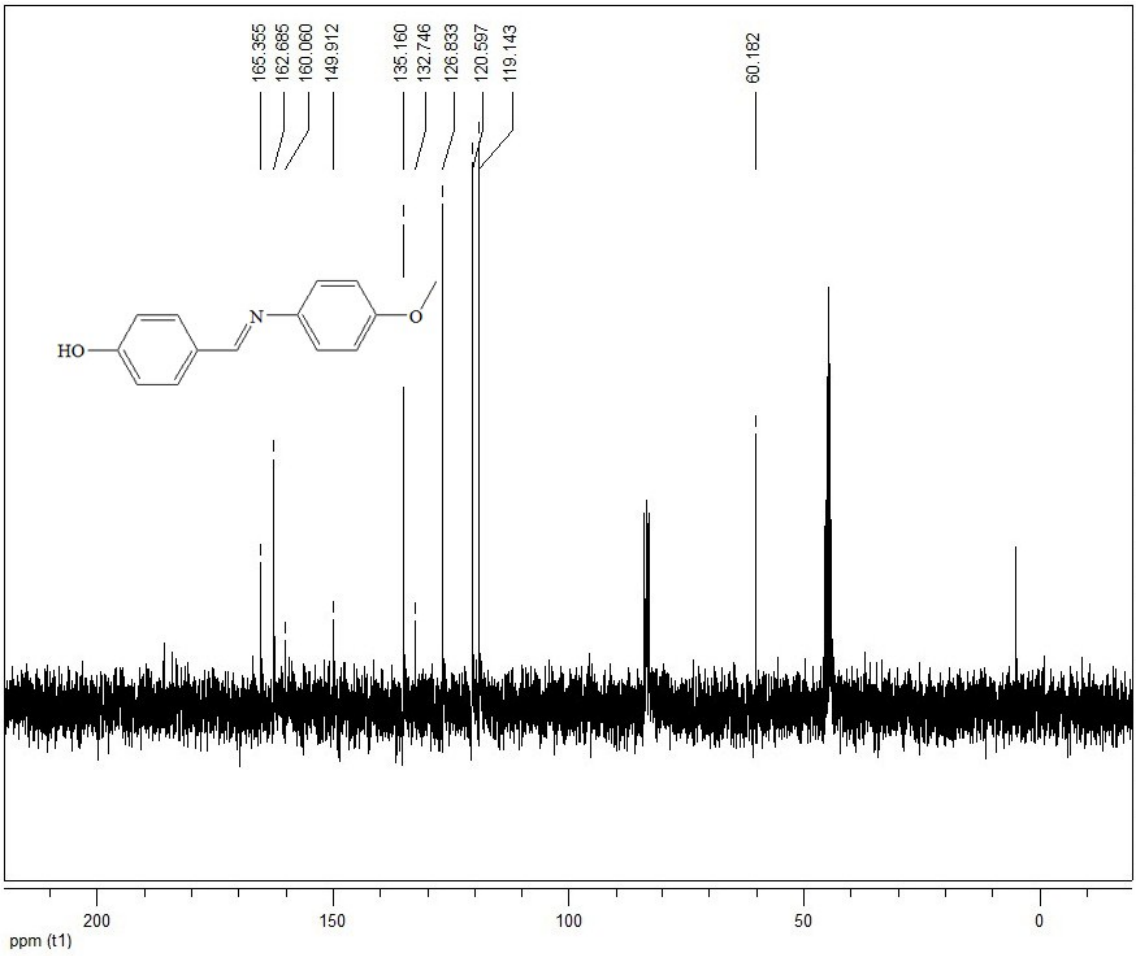
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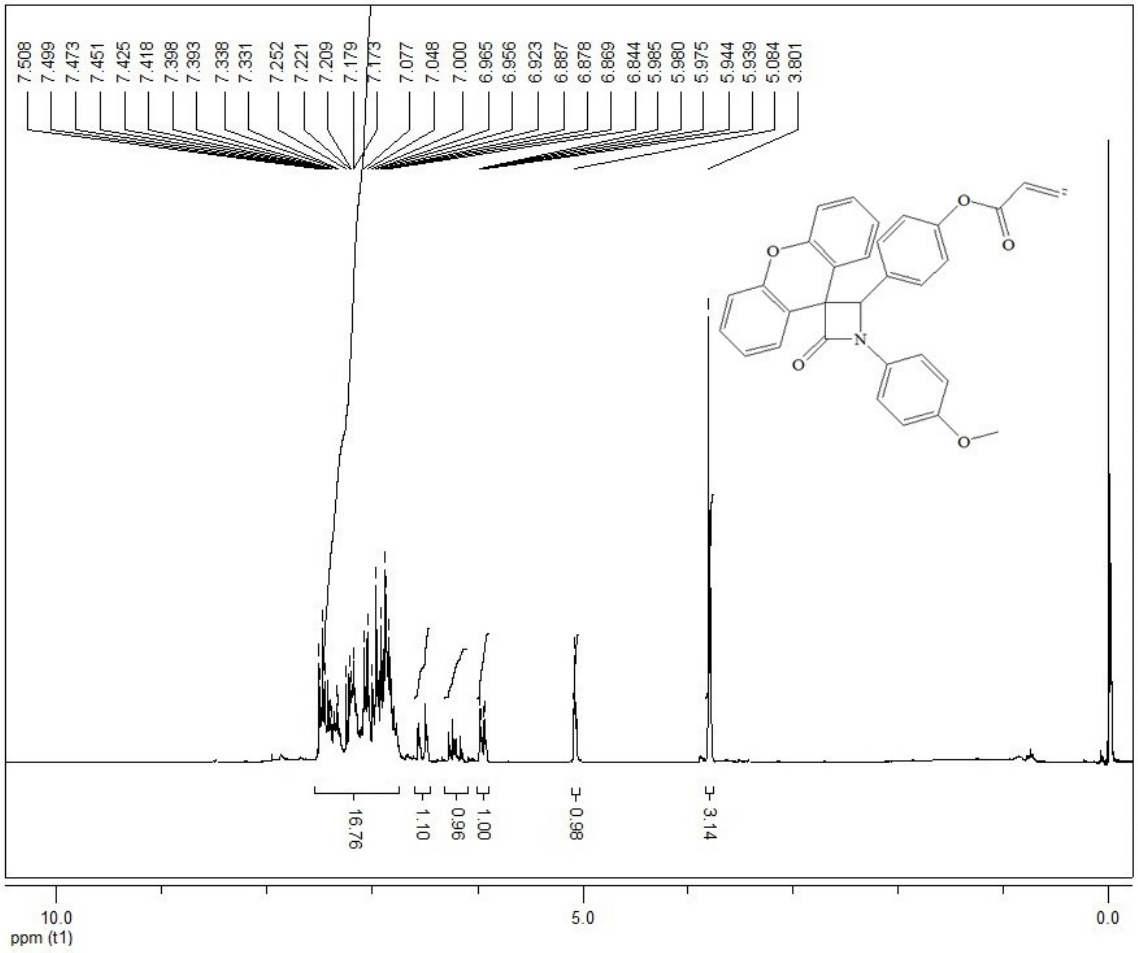
50
0
ppm (t1)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7.173
7.077
7.048
7.000
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6.923
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6.869
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1.00
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3.14
10.0
ppm (t1)
5.0
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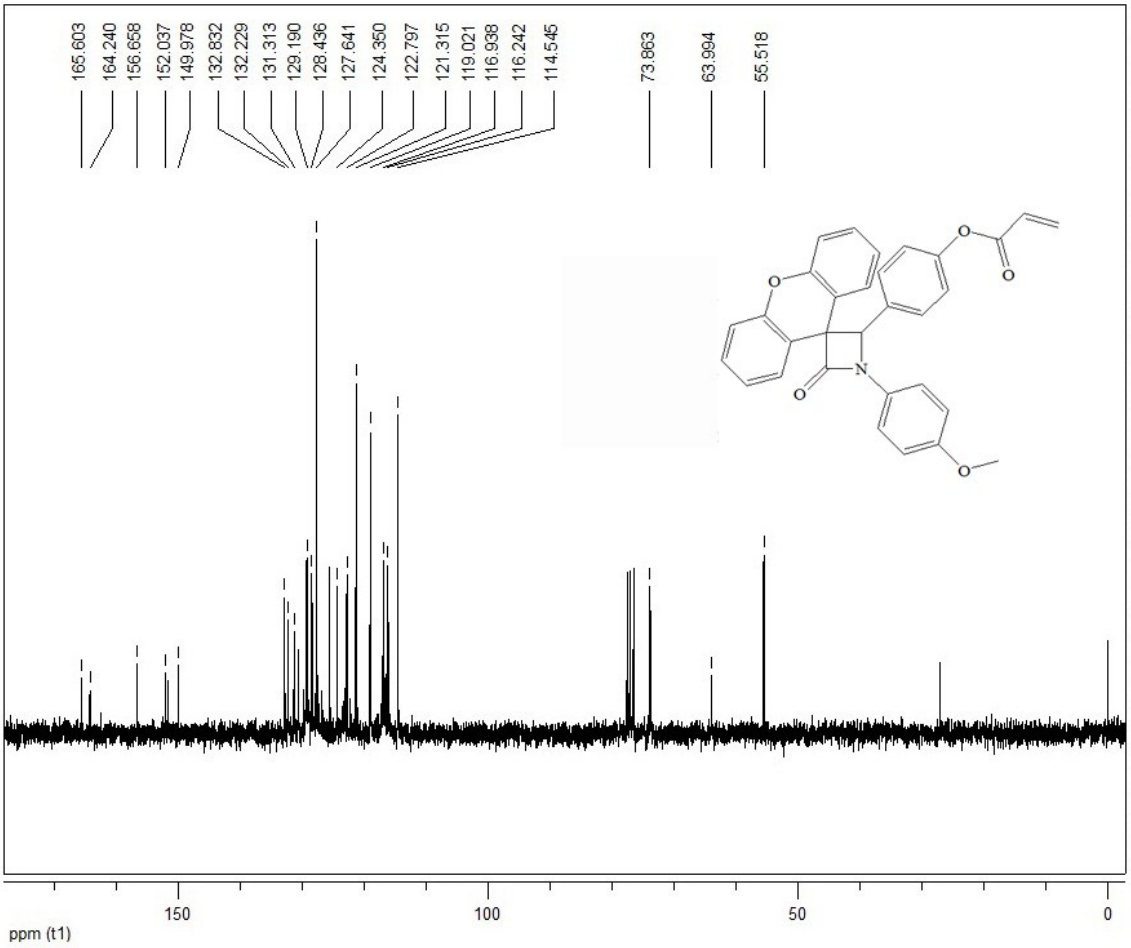
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121.315
119.021
116.938
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63.994
55.518
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O
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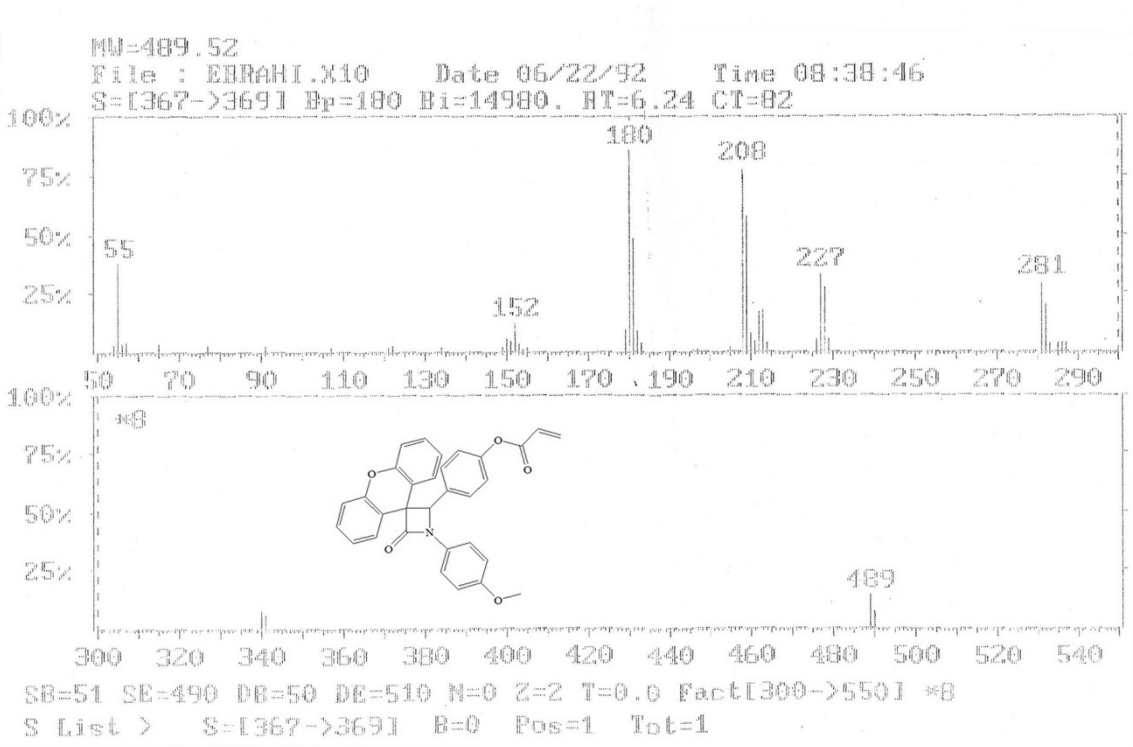
50
0
ppm (t1)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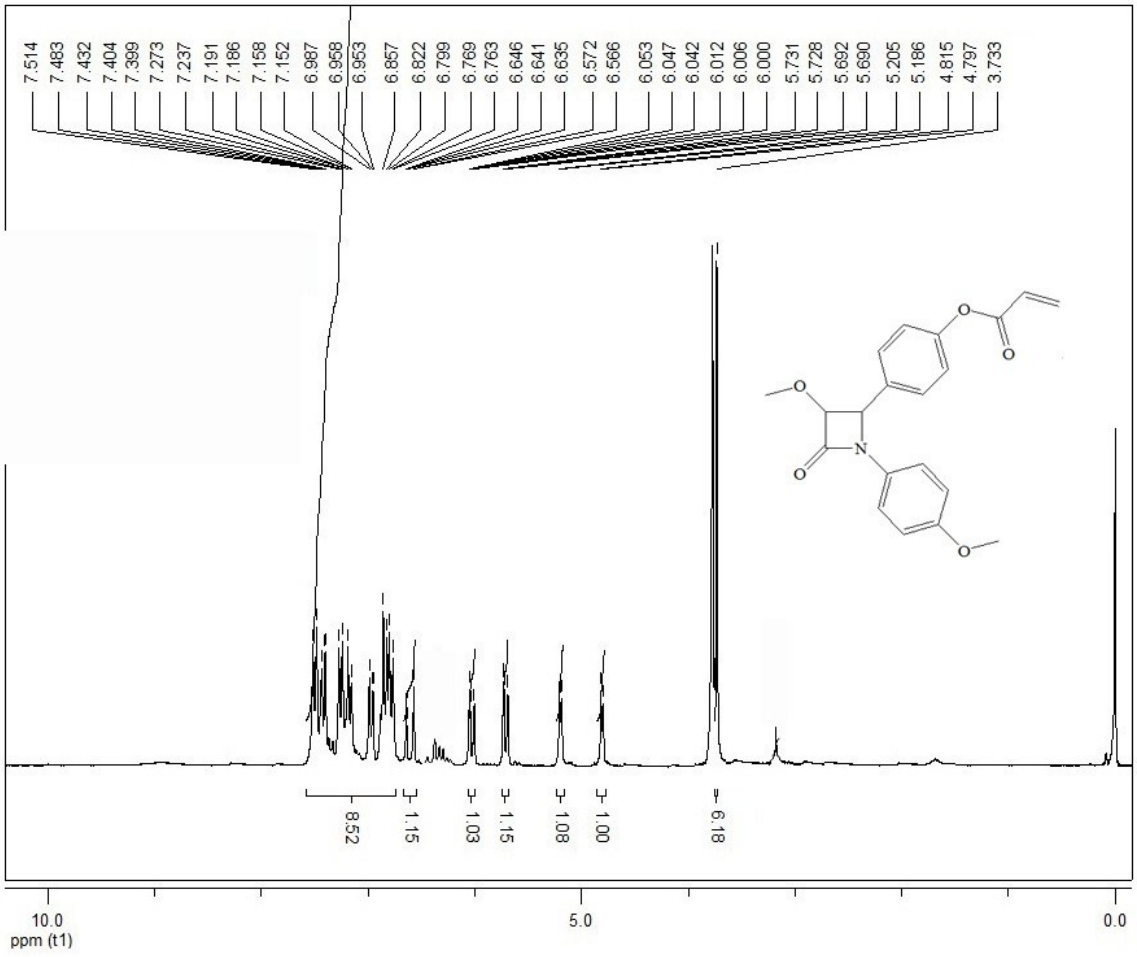
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6.958
6.953
6.857
6.822
6.799
6.769
6.763
6.646
6.641
6.635
6.572
6.566
6.053
6.047
6.042
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5.731
5.728
5.692
5.690
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3.733
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1.15
1.08
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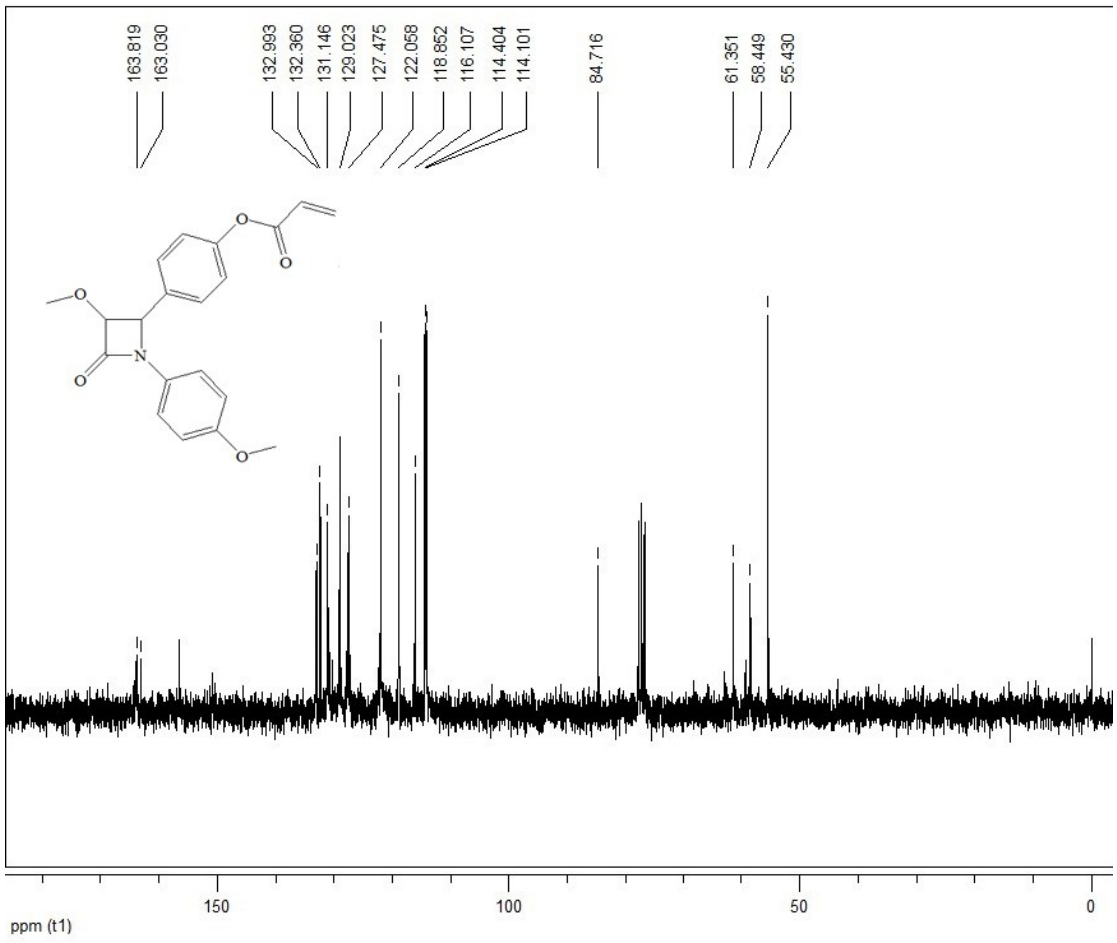
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O
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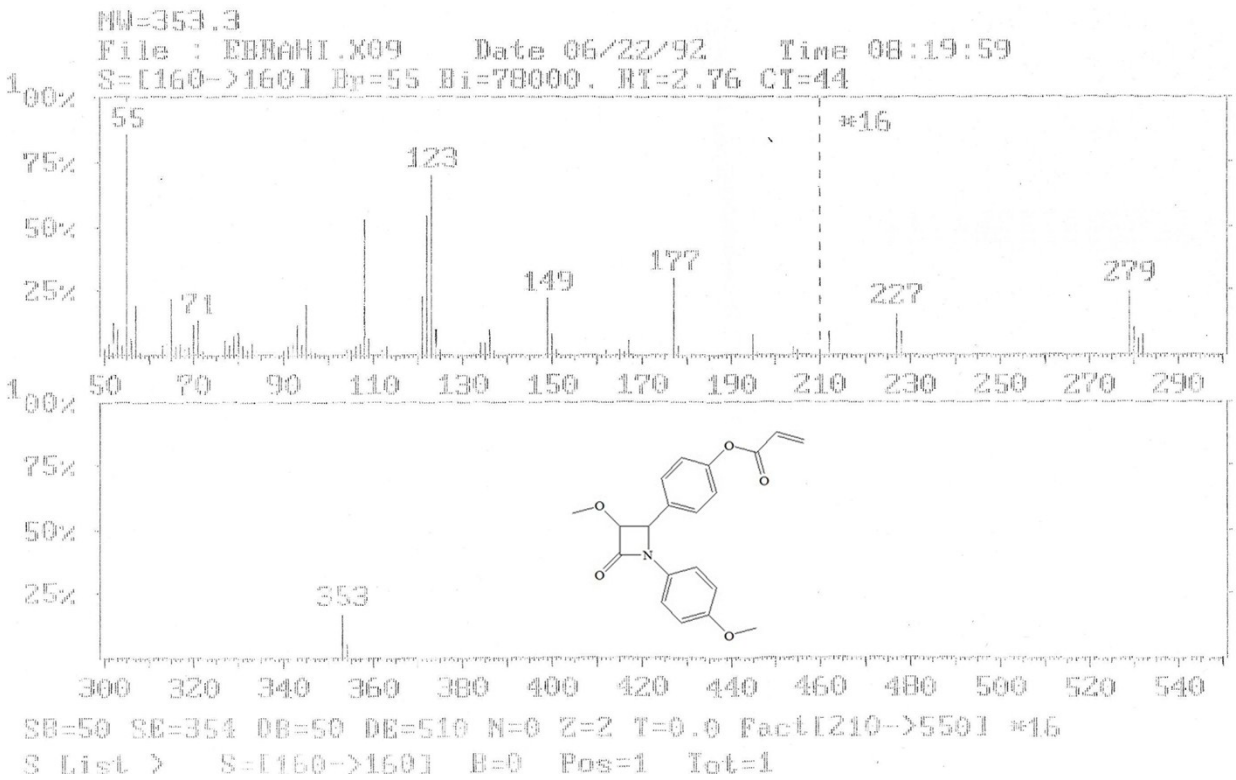
ppm (t1)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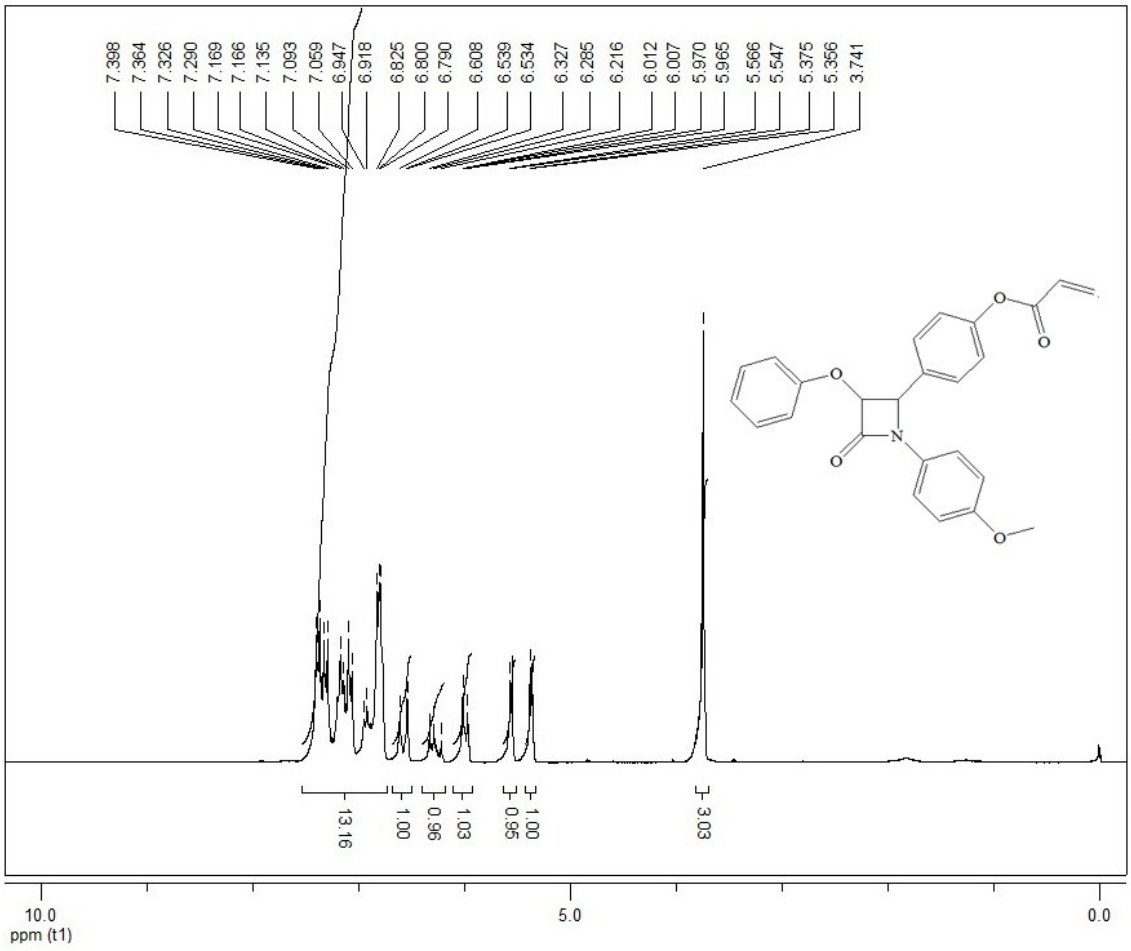
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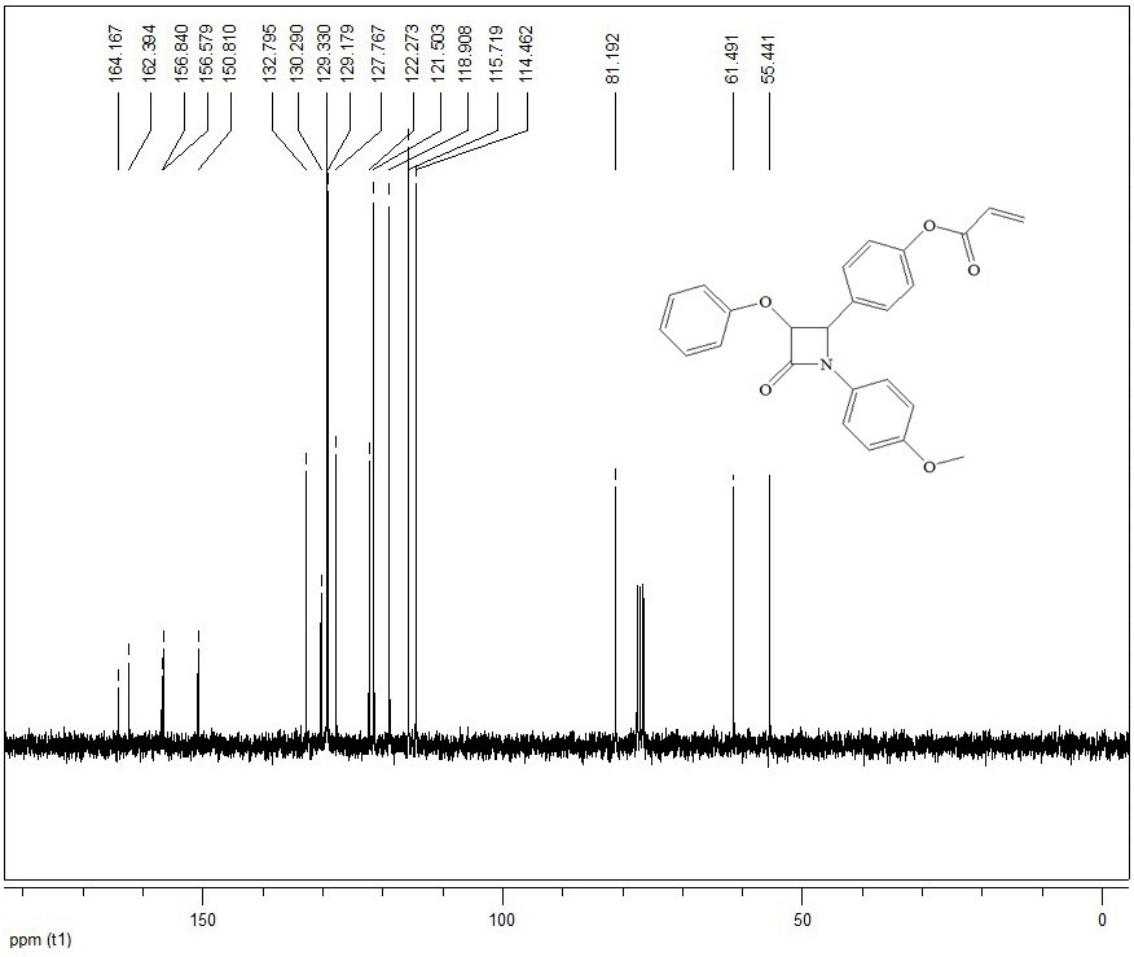
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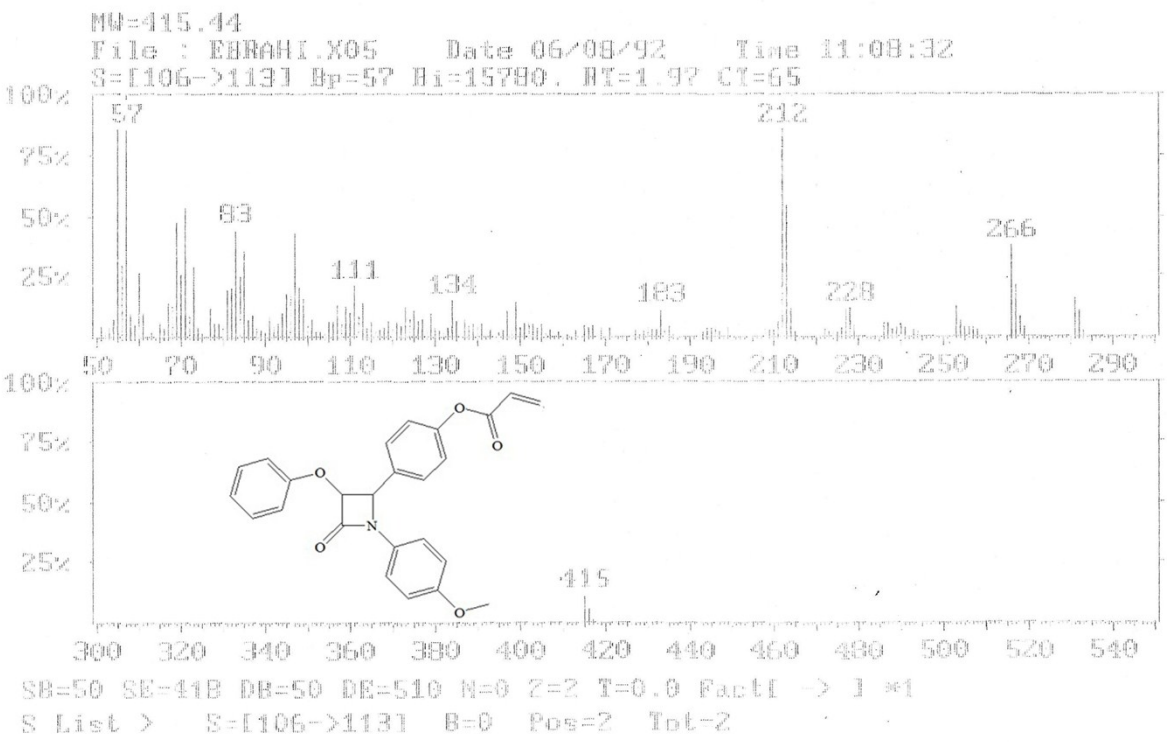
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100%
75%
50%
25%
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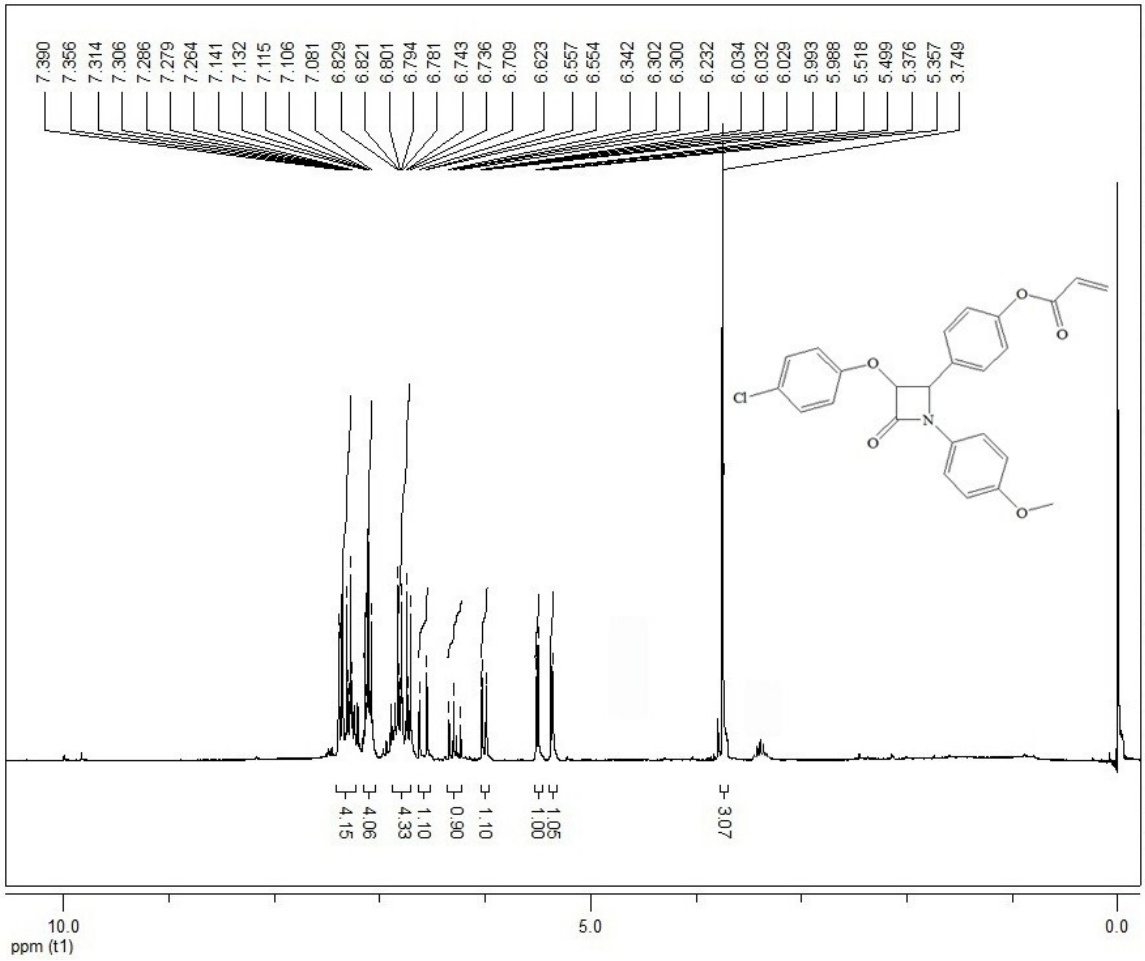
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6.821
6.801
6.794
6.781
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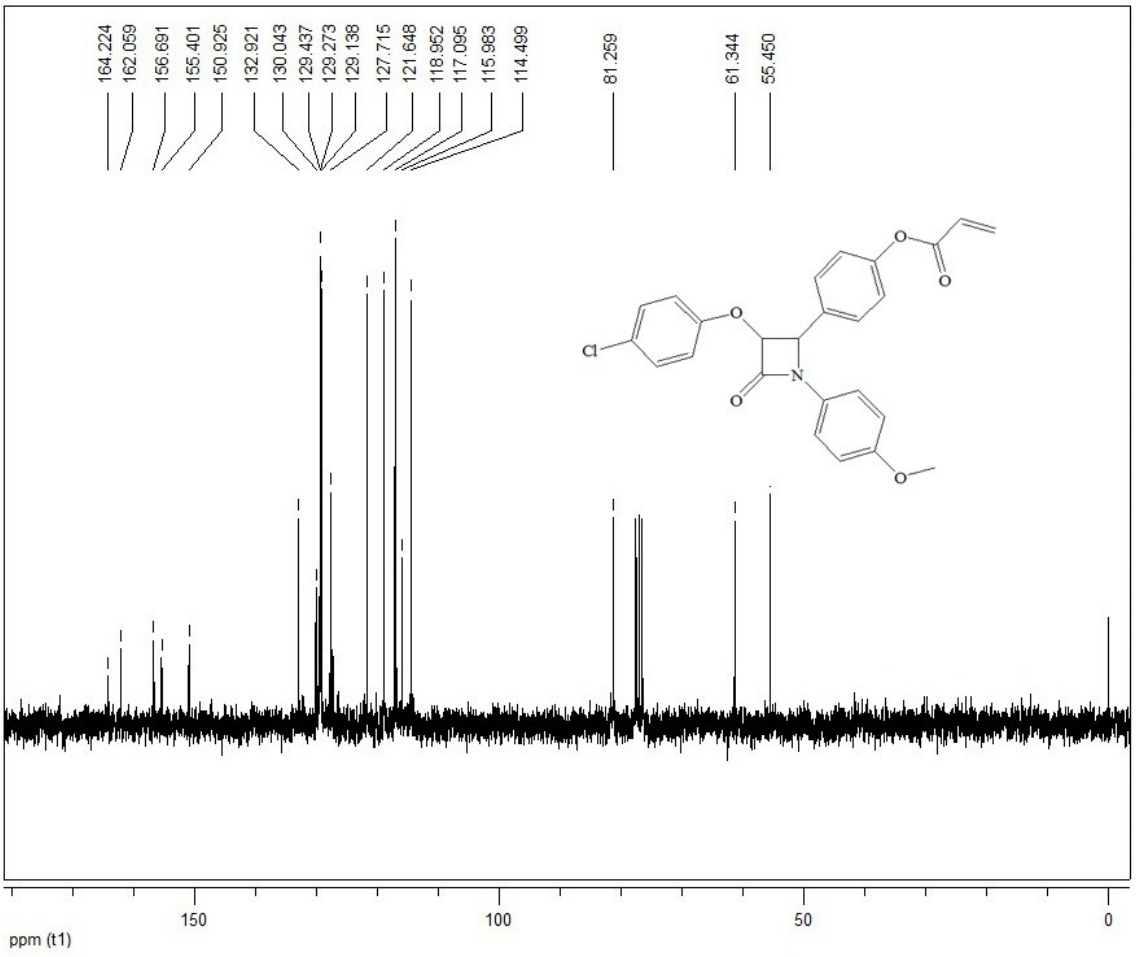
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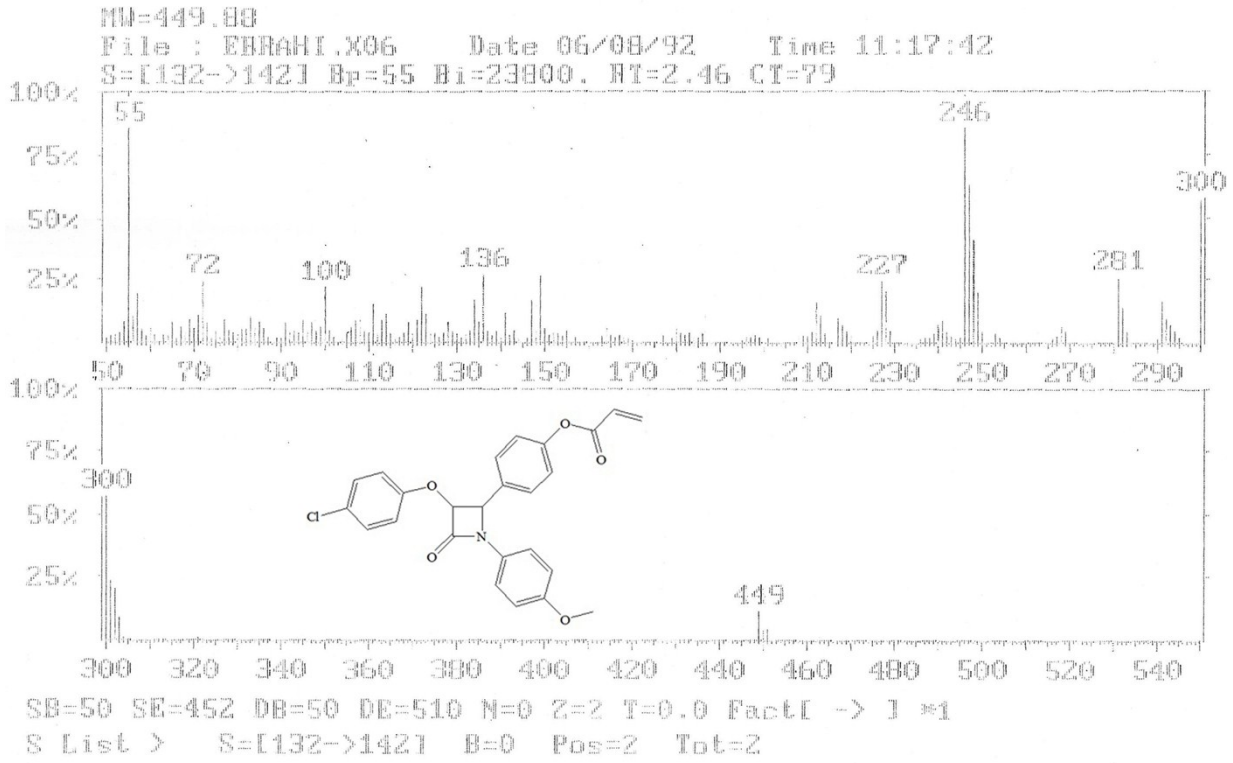
ppm (t1)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75%
50%
25%
300
449
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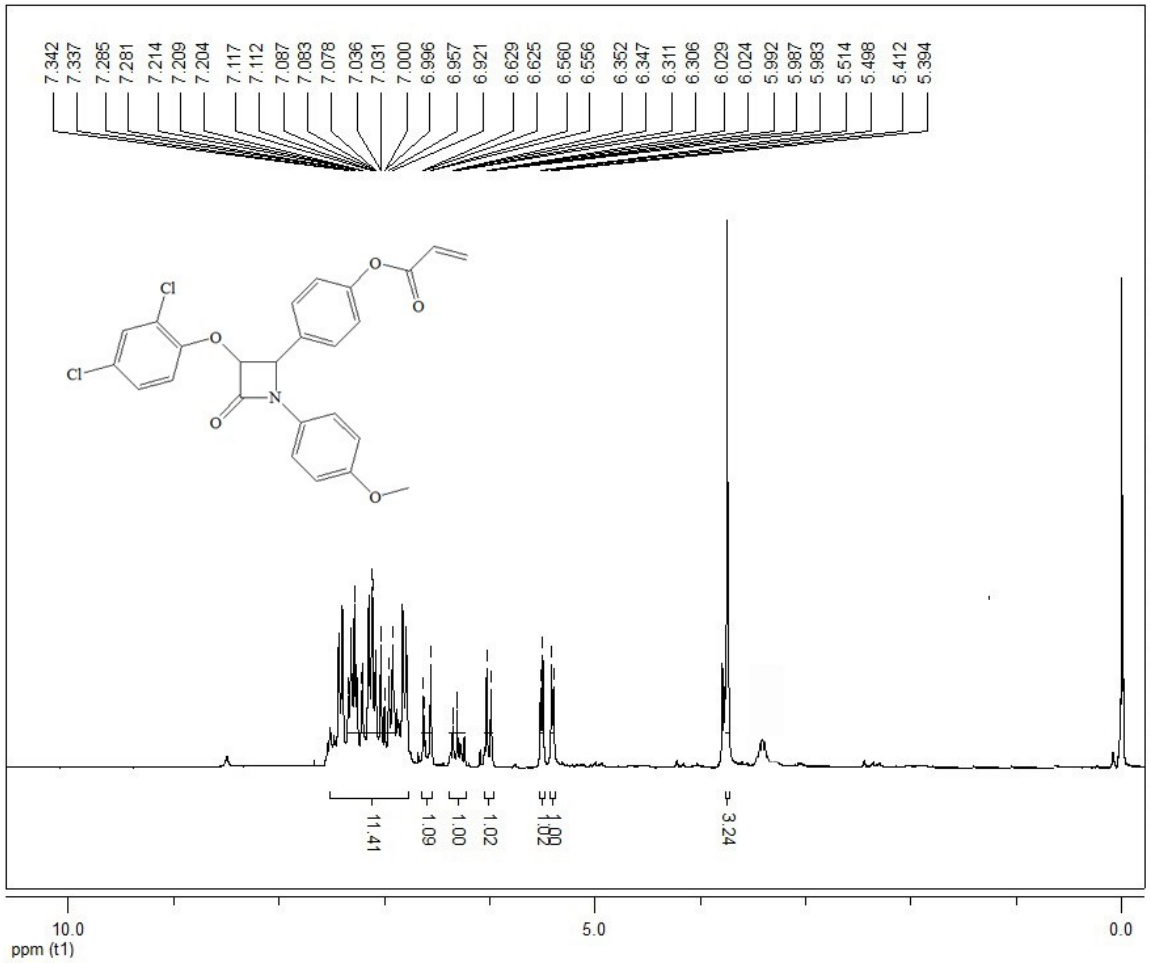
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O
O
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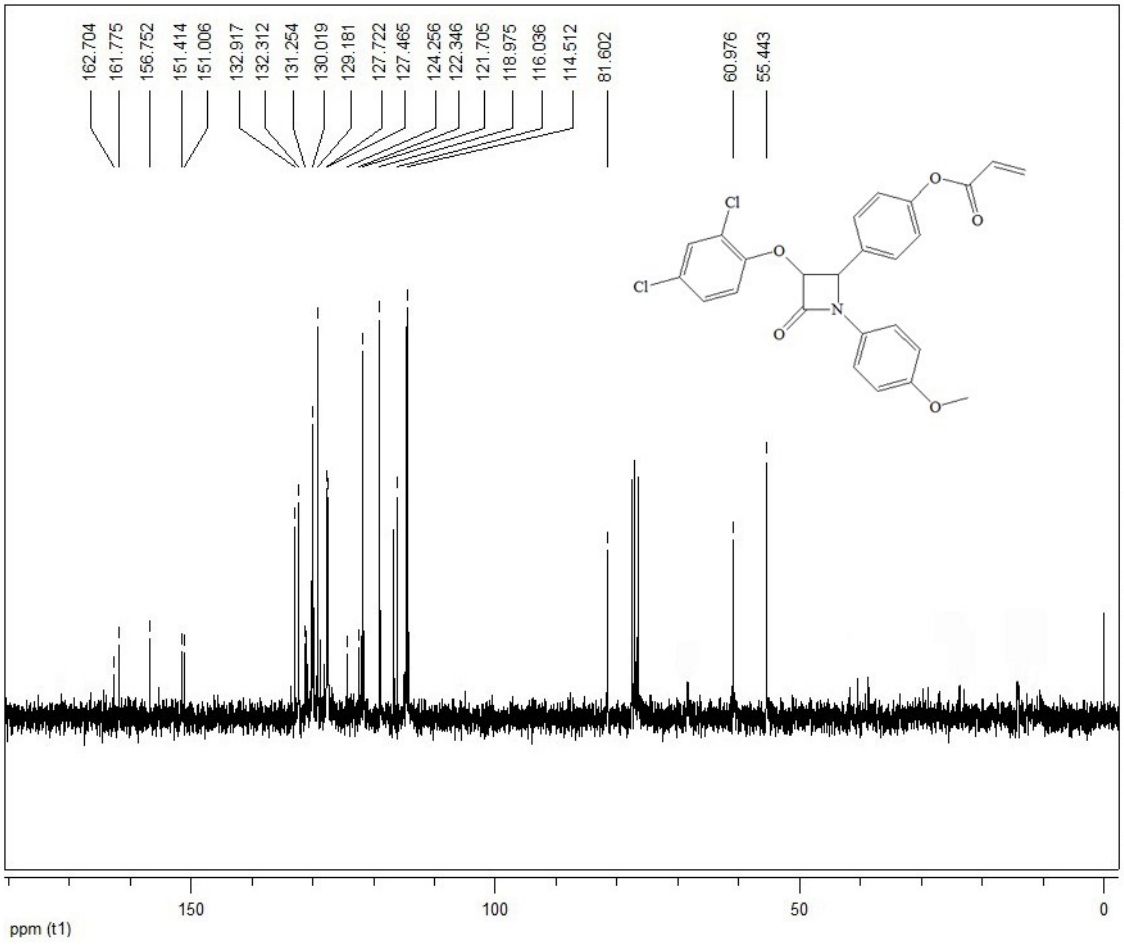
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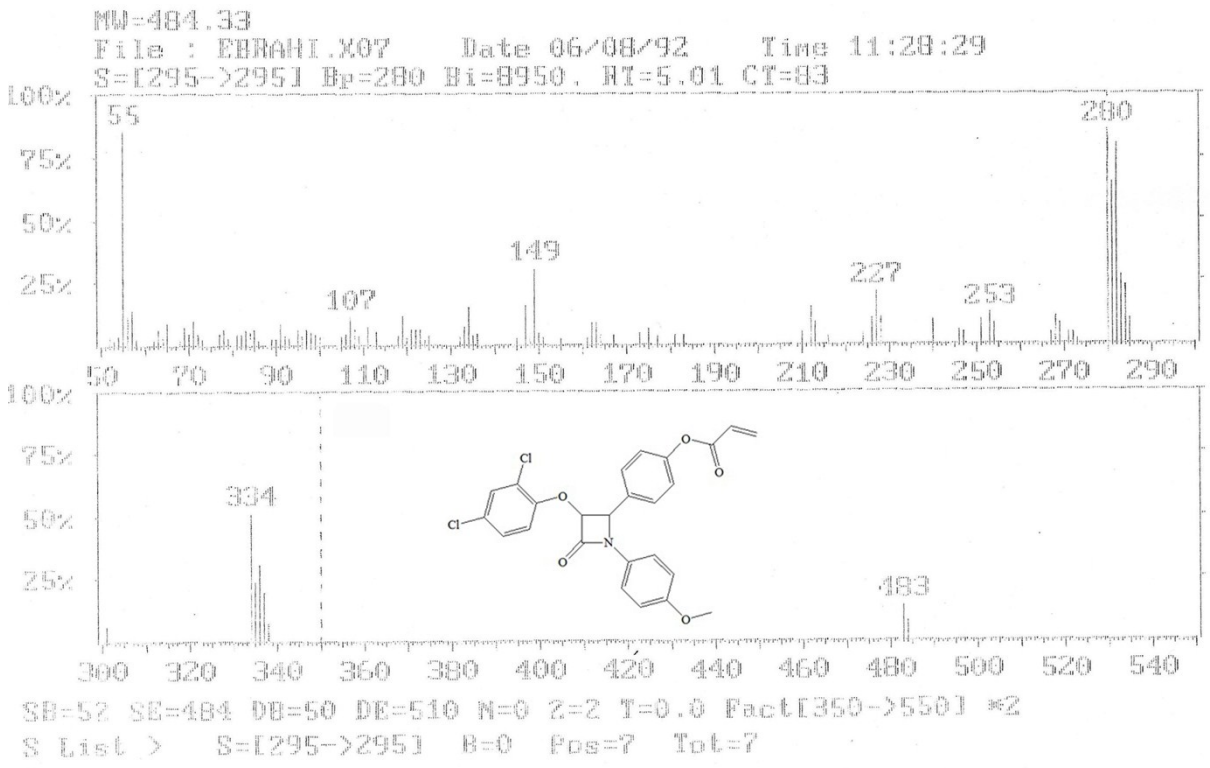
ppm (t1)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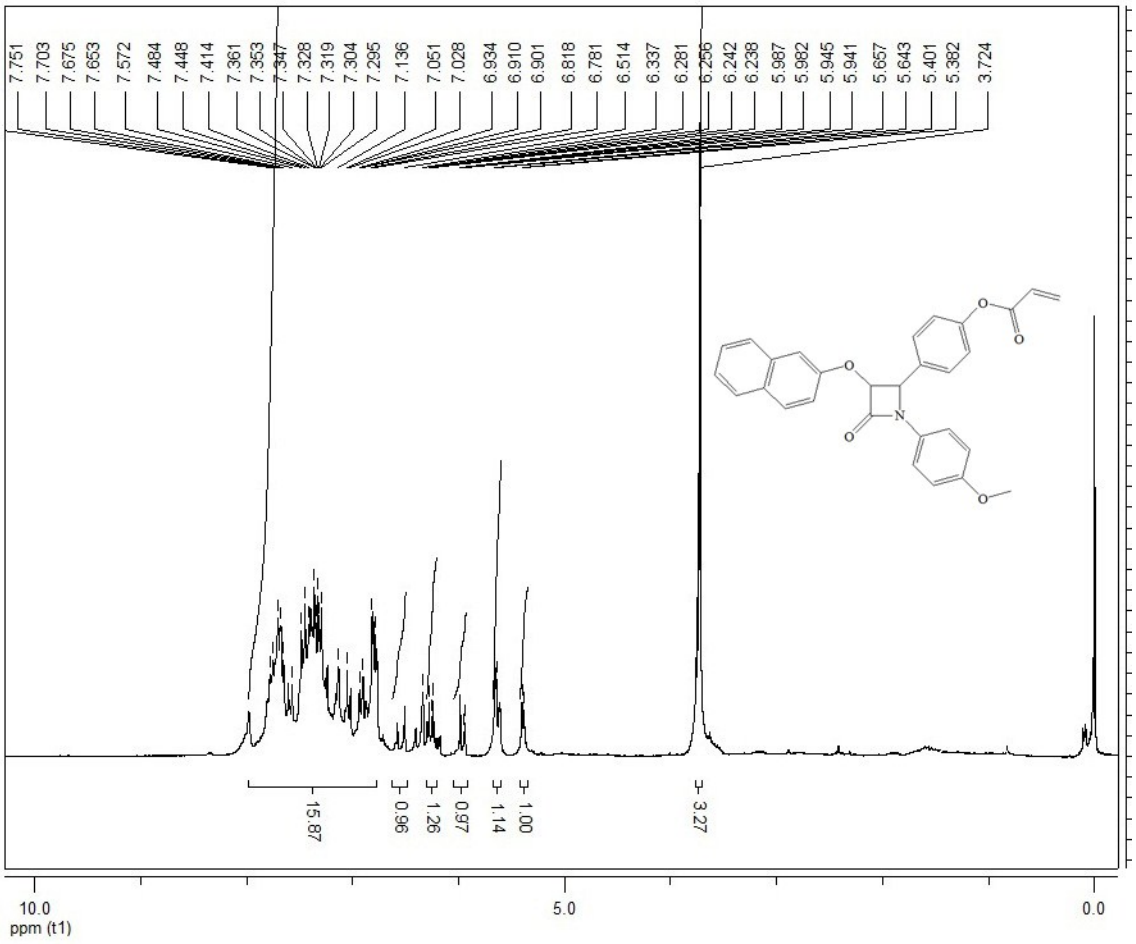
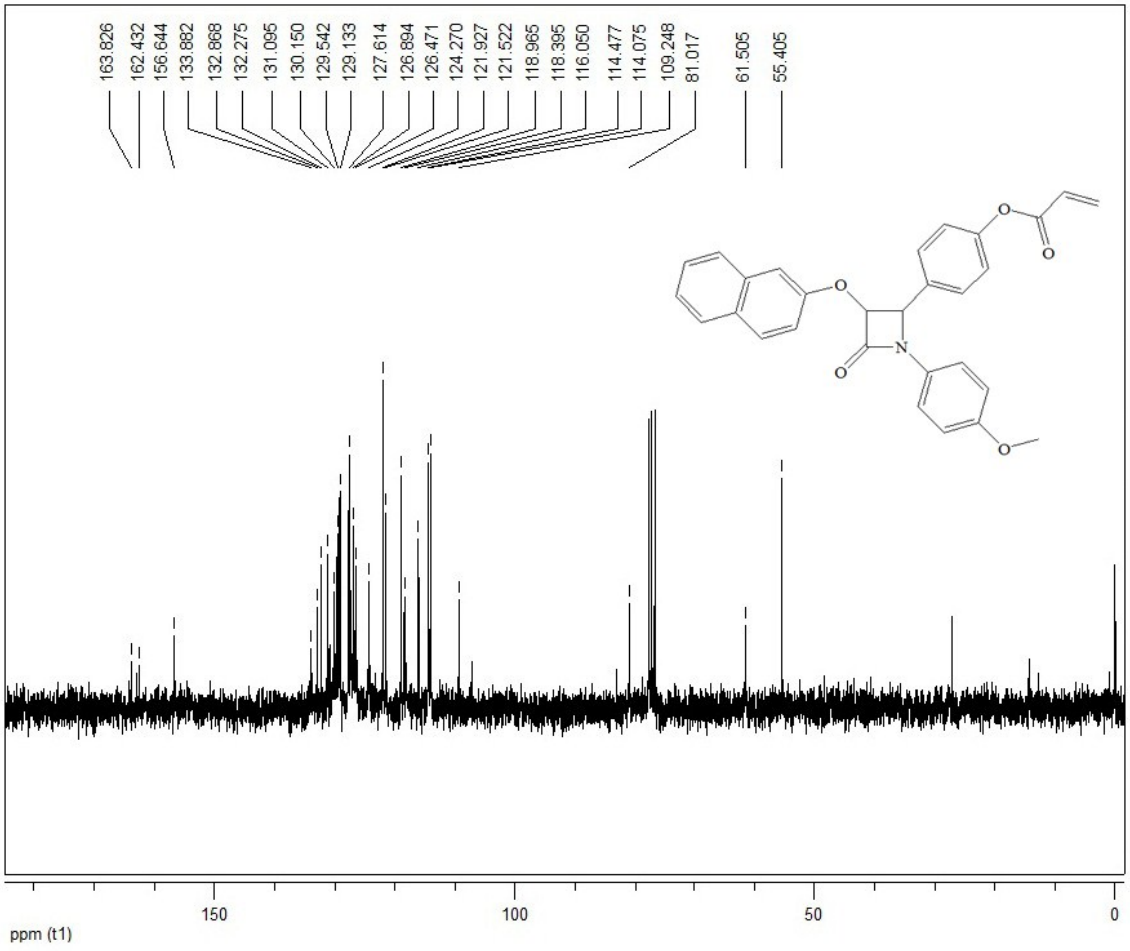
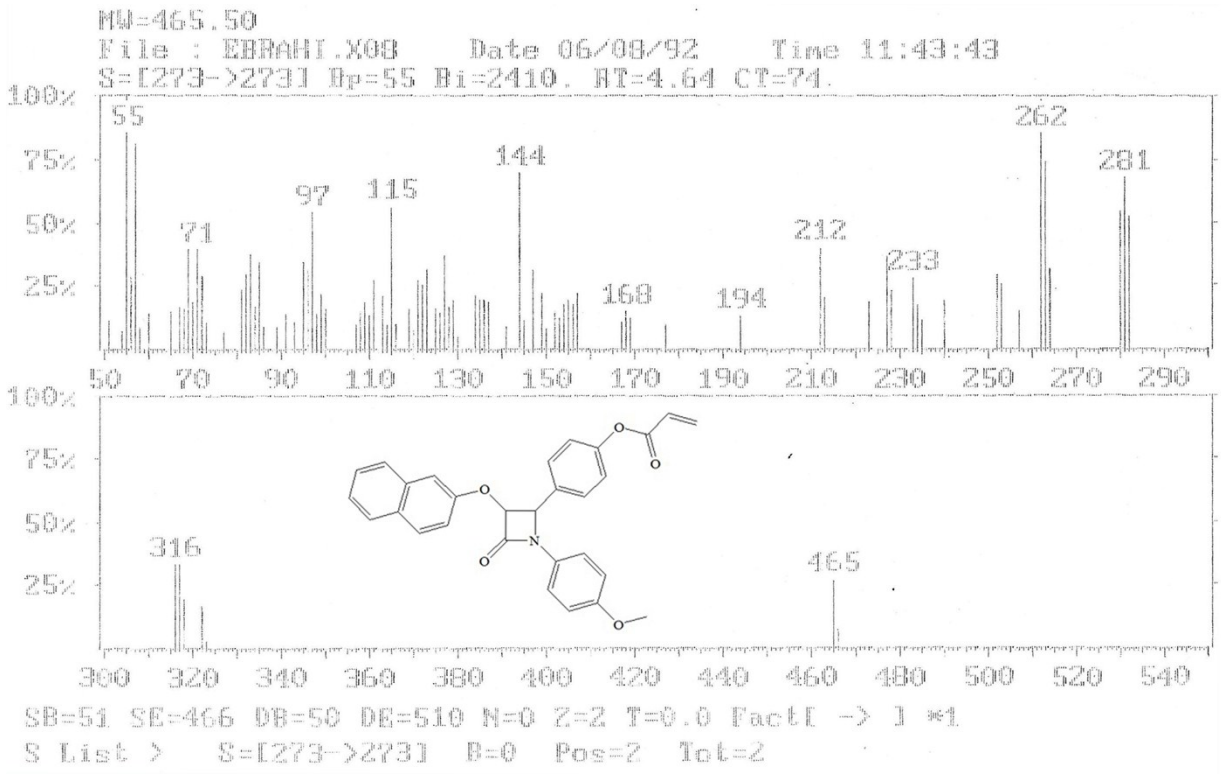
100%
75%
50%
25%
334
483
300 320 340 360 380 400 420 440 460 480 500 520 540
SB=52 SE=484 DB=50 DE=510 N=0 Z=2 T=0.0 Fact[350->550] *2
S List > S=[295->295] B=0 Pos=7 Tot=7


7.751
7.703
7.675
7.653
7.572
7.484
7.448
7.414
7.361
7.353
7.347
7.328
7.319
7.304
7.295
7.136
7.051
7.028
6.934
6.910
6.901
6.818
6.781
6.514
6.337
6.281
6.256
6.242
6.238
5.987
5.982
5.945
5.941
5.657
5.643
5.401
5.382
3.724
15.87
0.96
1.26
0.97
1.14
1.00
3.27
10.0
ppm (t1)
5.0
0.0


163.826
162.432
156.644
133.882
132.868
132.275
131.095
130.150
129.542
129.133
127.614
126.894
126.471
124.270
121.927
121.522
118.965
118.395
116.050
114.477
114.075
109.248
81.017
61.505
55.405
O
O
O
O
N
O
150
100
50
0
ppm (t1)


MW=465.50
File : EBRAHI.X08 Date 06/08/92 Time 11:43:43
S=[273->273] Bp=55 Bi=2410. RT=4.64 CT=74.
100%
75%
50%
25%
55
71
97
115
144
168
194
212
233
262
281
50 70 90 110 130 150 170 190 210 230 250 270 290
316
465
300 320 340 360 380 400 420 440 460 480 500 520 540
SB=51 SE=466 DB=50 DE=510 N=0 Z=2 T=0.0 Fact[->] *1
S List > S=[273->273] B=0 Pos=2 Tot=2