Supporting Information

EXTRACT OF BARBERRY AS ENTIRELY GREEN CATALYST FOR THE SYNTHESIS OF STRUCTURALLY DIVERSE 3,4,5-SUBSTITUTED FURAN-2(5*H*)-ONES

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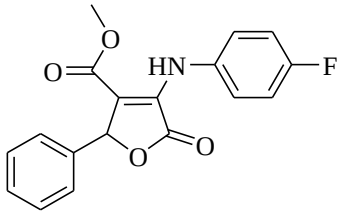
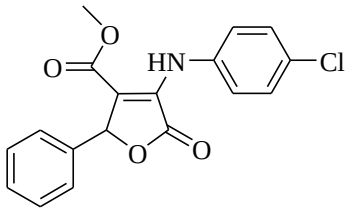
Methyl 4-(4-fluorophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



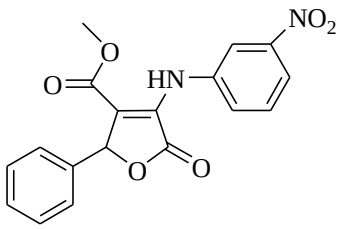
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.76 (s, 3H, OCH_3), 5.69 (s, 1H, benzylic), 6.98 (t, J = 8.4 Hz, 2H), 7.21-7.43 (m, 7H, aromatic) 8.95 (br, 1H, NH).

Methyl 4-(4-chlorophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



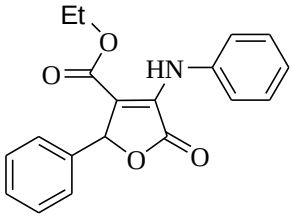
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.77 (s, 3H, OCH_3), 5.72 (s, 1H, benzylic), 7.22-7.32 (m, 7H, aromat), 7.46 (d, *J* = 8.8 Hz , 2H aromatic), 8.97 (br, 1H, NH).

Methyl 4-(3-nitrophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



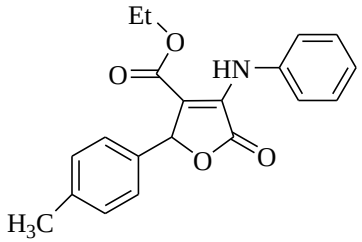
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.79 (s, 3H,OCH_3), 5.83 (s, 1H, benzylic), 7.27-7.34 (m, 5H, aromat), 7.48 (t, *J* = 8.4 Hz, 1H aromatic), 7.96 (d, *J* = 8 Hz, 1H aromatic), 8.06 (d, *J* = 8 Hz, 1H aromatic), 8.35 (s, 1H), 9.06 (br, 1H, NH).

Ethyl 2,5-dihydro-5-oxo-2-phenyl-4-(phenylamino)furan-3-carboxylate



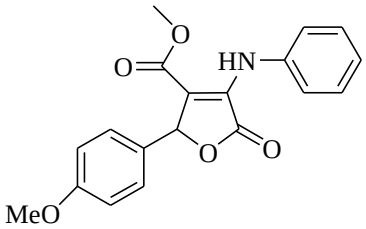
^{1}H NMR (400 MHz, $CDCl_3$) δ: 1.22 (t, *J* = 7.2 ,CH3), 4.21 (q, *J*=7.2, CH_2), 5.76 (s, 1H, benzylic), 7.10-7.51 (m,10H, aromatic), 9.10 (br, 1H, NH).

Ethyl 2,5-dihydro-5-oxo-4-(phenylamino)-2-p-tolylfuran-3-carboxylate



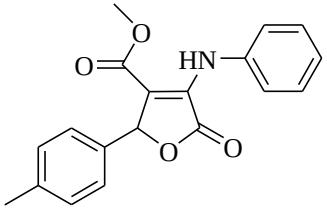
^{1}H NMR (400 MHz, $CDCl_3$) δ: 2.28 (s, CH_3), 1.22 (t, *J* = 7.2 ,CH_3), 4.21 (q, *J*=7.2, CH_2), 5.73 (s, 1H, benzylic), 7.05-7.51 (m, 9H, aromatic), 8.87 (br, 1H, NH).

Methyl 2,5-dihydro-2-(4-methoxyphenyl)-5-oxo-4-(phenylamino)furan-3-carboxylate



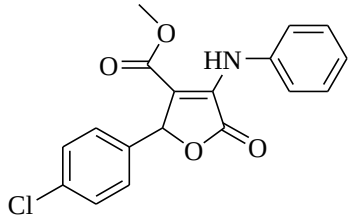
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.76 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 5.72 (s, 1H, benzylic), 6.80 (d, *J* = 8.4 Hz, 2H aromatic), 7.12-7.23 (m, 5H, aromatic), 7.47 (d, *J* = 8.4 Hz, 2H aromatic), 8.88 (br, 1H, NH).

Methyl 2,5-dihydro-5-oxo-4-(phenylamino)-2-p-tolylfuran-3-carboxylate



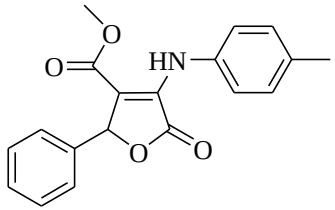
^{1}H NMR (400 MHz, $CDCl_3$) δ: 2.29 (s, 3H, CH_3), 3.78 (s, 3H, OCH_3), 5.73 (s, 1H, benzylic), 7.07-7.32 (m, 7H, aromatic), 7.49 (d, *J* = 8.4 Hz, 2H), 8.90 (br, 1H, NH).

Methyl 2-(4-chlorophenyl)-2,5-dihydro-5-oxo-4-(phenylamino)furan-3-carboxylate



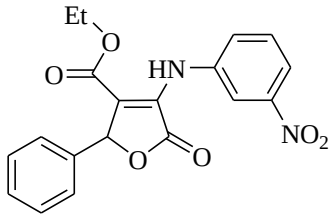
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.79 (s, 3H, OCH_3) 5.75 (s, 1H, benzylic), 7.14-7.34 (m, 7H, aromatic), 7.46 (d, *J* = 8.4 Hz, 2H aromatic), 8.93 (br, 1H, NH).

Methyl 4-(p-tolylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



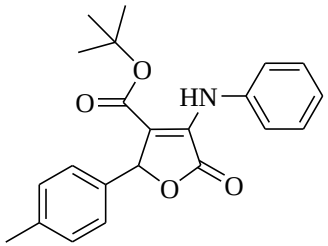
^{1}H NMR (400 MHz, $CDCl_3$) δ: 2.27 (s, 3H, CH_3), 3.76 (s, 3H, OCH_3), 5.72 (s, 1H, benzylic), 7.09 (d, *J* = 8 Hz, 2H), 7.22-7.270 (m, 5H, aromatic), 7.34 (d, *J* = 8.4 Hz, 2H), 8.86 (br, 1H, NH).

Ethyl 4-(3-nitrophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



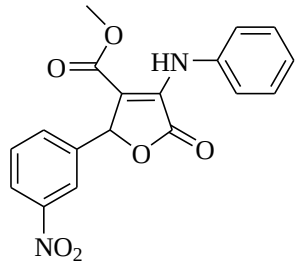
^{1}H NMR (400 MHz, CDCl3) δ: 1.22 (t, *J* = 7.2 ,CH_3), 4.23 (q, *J*=7.2, CH_2), 5.83 (s, 1H, benzylic), 7.31-8.34 (m, 9H, aromatic), 8.341 (s, 1H), 9.158 (br, 1H, NH).

tert-Butyl 2,5-dihydro-5-oxo-4-(phenylamino)-2-p-tolylfuran-3-carboxylate



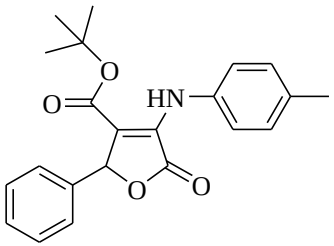
^{1}H NMR (400 MHz, $CDCl_3$) δ: 1.38 (s, 9H, CH_3), 2.28 (s, 3H, CH_3), 5.64 (s, 1H, benzylic), 7.04-7.50 (m, 9H, aromatic), 9.29 (br, 1H, NH).

Methyl 2,5-dihydro-2-(3-nitrophenyl)-5-oxo-4-(phenylamino)furan-3-carboxylate



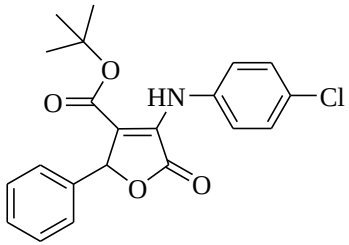
^{1}H NMR (400 MHz, $CDCl_3$) δ: 3.80 (s, 3H, OCH_3), 5.90 (s, 1H, benzylic), 7.17 (t, *J* = 7.2 Hz, 1H), 7.31-7.58 (m, 6H, aromatic), 8.13 (d, *J* = 8.4 Hz, 1H), 8.18(s, 1H, aromat), 8.88 (br, 1H, NH).

tert-Butyl 4-(p-tolylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



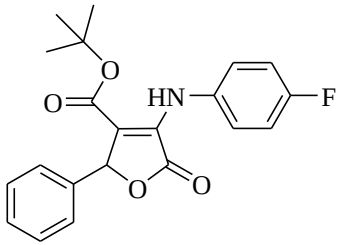
^{1}H NMR (400 MHz, $CDCl_3$) δ: 1.35 (s, 9H, CH_3), 2.25 (s, 3H, CH_3), 5.63 (s, 1H, benzylic), 7.06-7.35 (m, 9H, aromatic), 9.09 (br, 1H, NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 165.1 and 162.9 (CO of ester), 157.0, 135.6, 135.4, 133.7, 129.5, 128.4, 128.5, 127.6, 122.5, 114.3 (10 C aromatic), 83.2 (C-O), 61.8 (benzylic C), 27.9 (3 CH_3), 20.9 (CH_3); MS m/z (%): 57 (42), 77 (25), 102 (39), 130 (100), 158 (42), 175 (24), 263 (29), 291 (39), 309 (52), 365 (M+, 28).

tert-Butyl 4-(4-chlorophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate

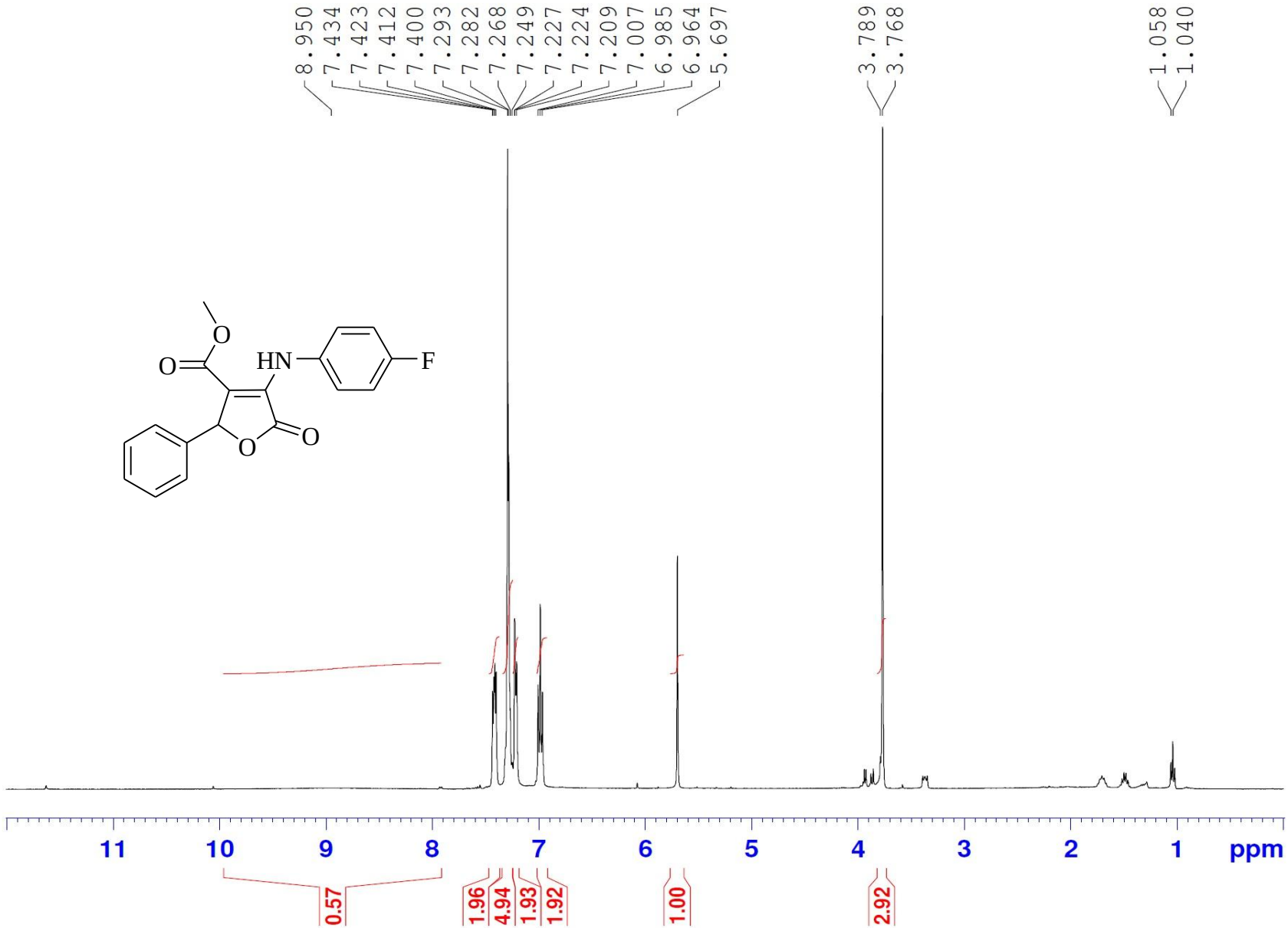


^{1}H NMR (400 MHz, $CDCl_3$) δ: 1.36 (s, 9H, CH_3), 5.64 (s, 1H, benzylic), 7.18-7-47 (m, 9H, aromat), 9.36 (br, 1H, NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 165.0, 162.9 (ester C), 156.6, 134.96, 134.95, 131.0, 129.0, 128.68, 128.60, 127.5, 123.3, 114.6 (10 C aromatic and vinyl), 83.5 (C-O), 61.6(benzylic C).27.9 (CH_3); MS m/z (%): 57 (48), 77 (34), 102 (46), 130 (100), 158 (32), 175 (76), 284 (36), 329 (92), 311 (45), 385 (M^+, 33), 387 (M^++2, 12), 389 (M^++4, 0.5).

tert-Butyl 4-(4-fluorophenylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3-carboxylate



^{1}H NMR (400 MHz, $CDCl_3$) δ: 1.35 (s, 9H, CH_3), 5.61 (s, 1H, benzylic), 6.94-7.43 (m, 9H, aromatic) 9.37 (br, 1H, NH); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 165.1, 162.9 (ester CO), 160.2 (d, J^{CF} =245.9), 156.8, 135.0, 132.3 (d, J^{CF} =3.0), 128.6, 128.5, 127.6, 124.4 (d, J^{CF} =8.4), 115.8 (d, J^{CF} =22.6), 114.5 (10 C aromatic and vinyl), 83.3 (C-O), 62.0 (benzylic C), 27.9 (CH_3); MS m/z (%): 57 (76), 77 (30), 102 (43), 130 (100), 158 (41), 175 (76), 268 (42), 295 (29), 313 (88), 361 (51), 369 (M^+, 29).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6.964
5.697
3.789
3.768
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1.040
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F
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9
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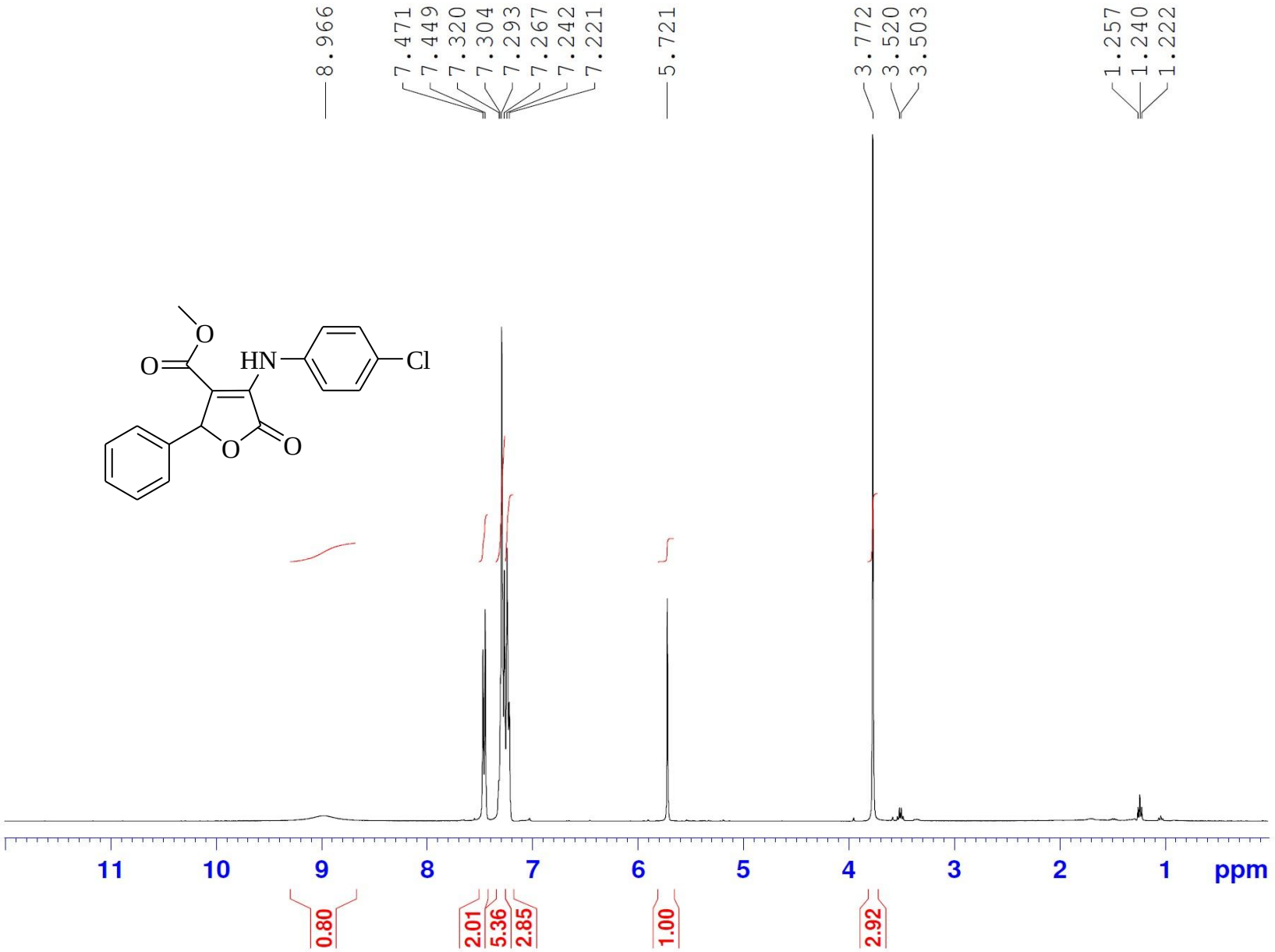
1.00
2.92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1.257
1.240
1.222
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O
HN
Cl
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O
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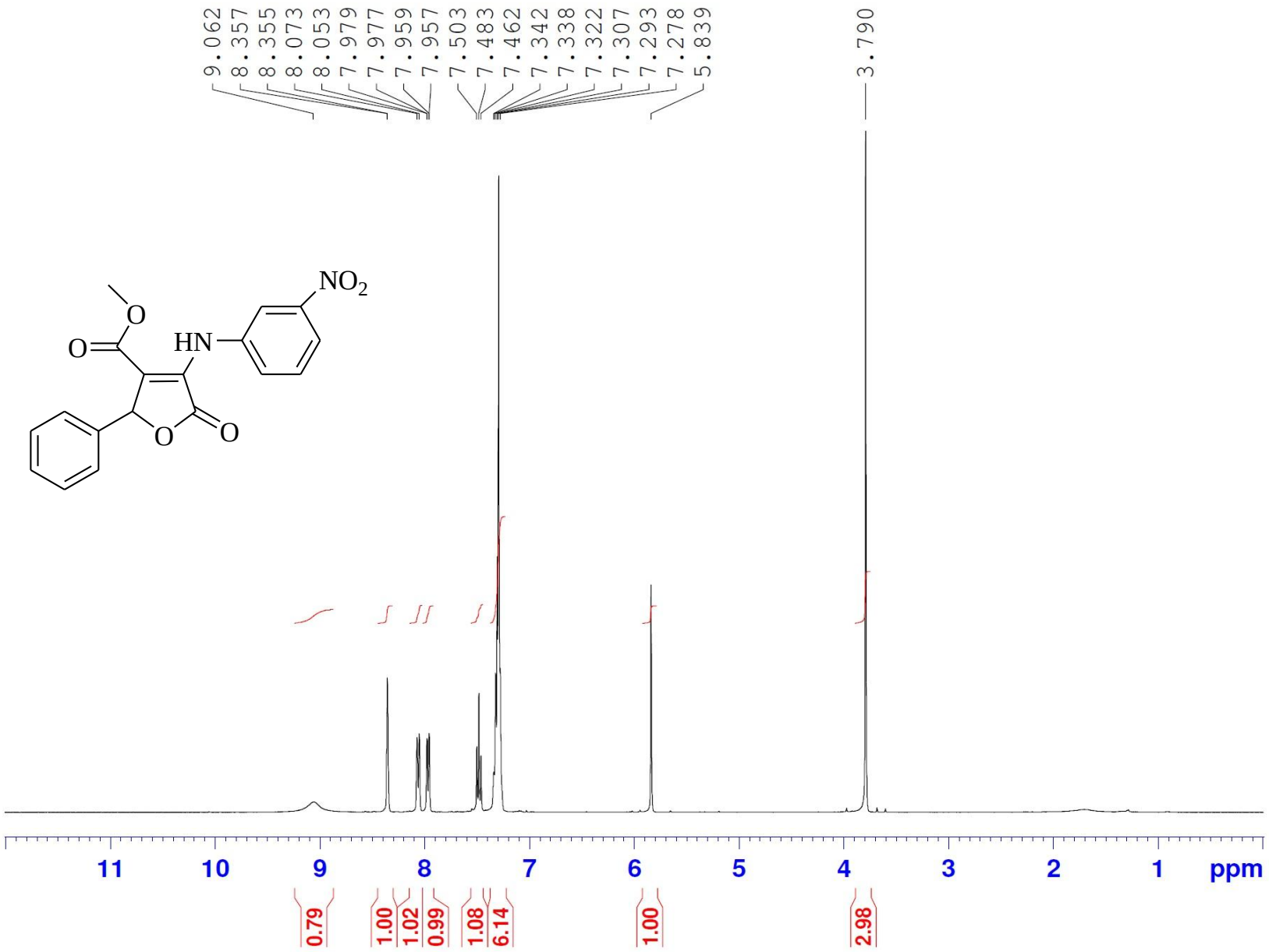
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7.342
7.338
7.322
7.307
7.293
7.278
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3.790
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O
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7
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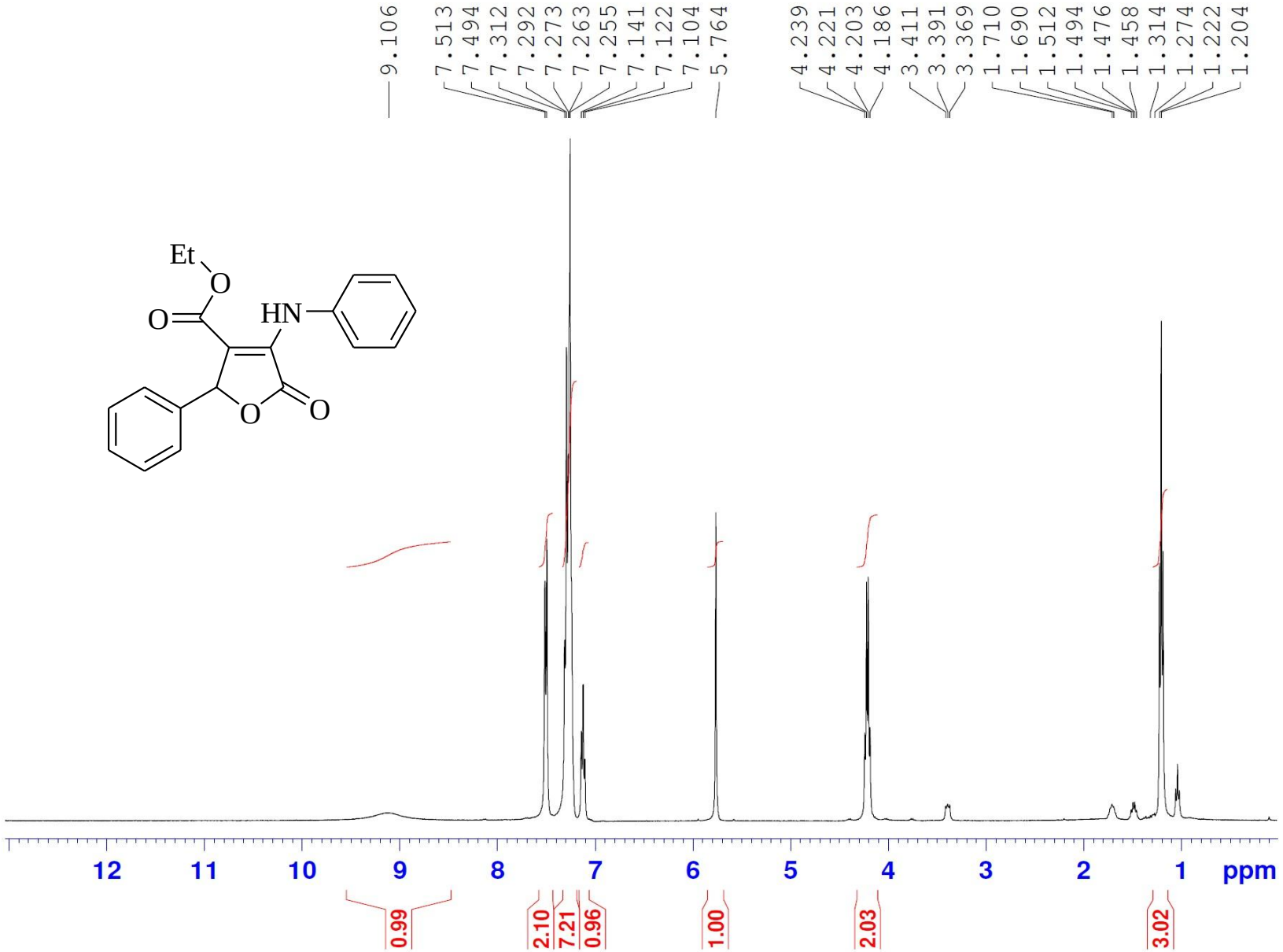
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4.203
4.186
3.411
3.391
3.369
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1.690
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1.494
1.476
1.458
1.314
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10
9
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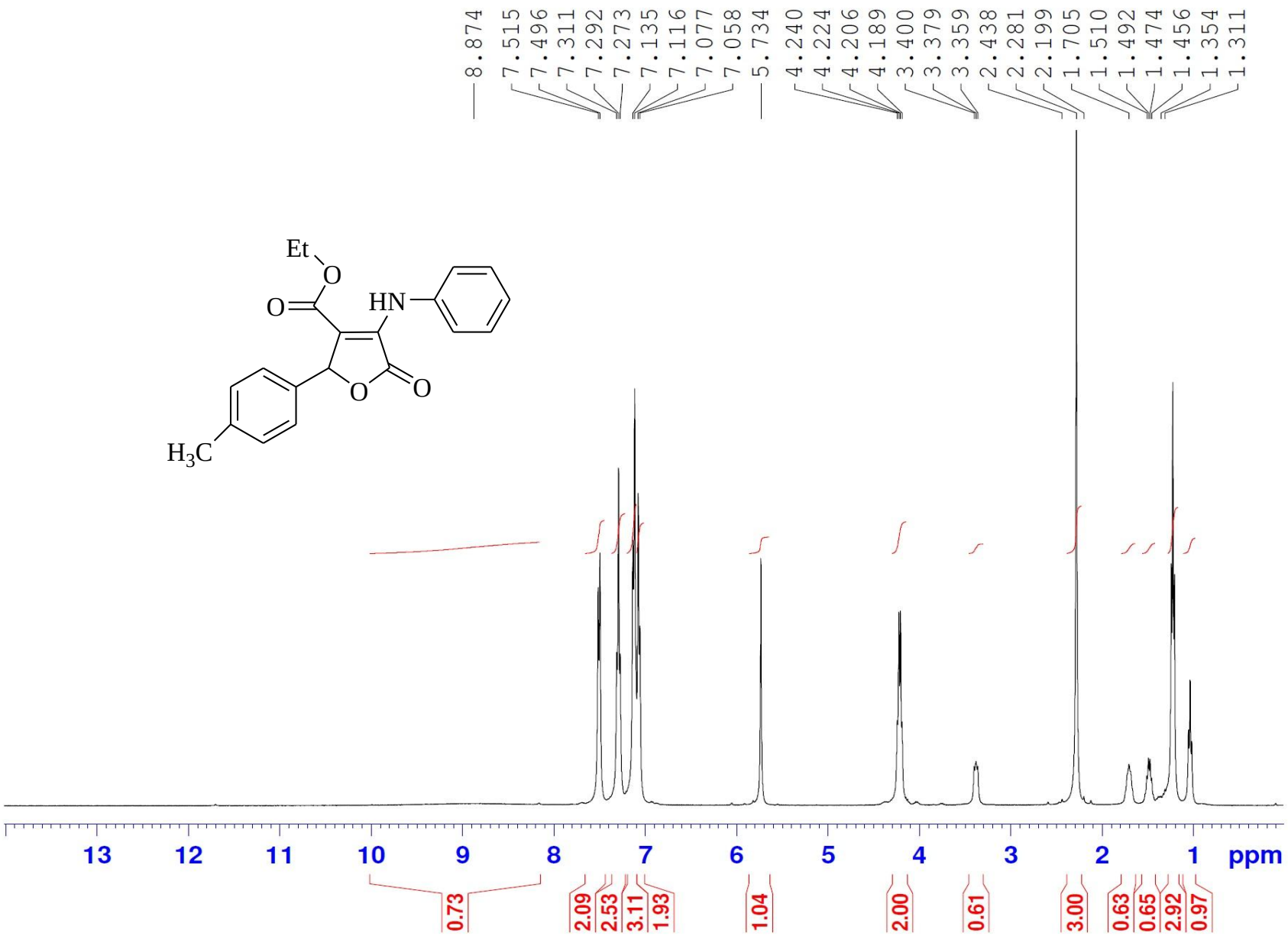
3.02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4.224
4.206
4.189
3.400
3.379
3.359
2.438
2.281
2.199
1.705
1.510
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1.456
1.354
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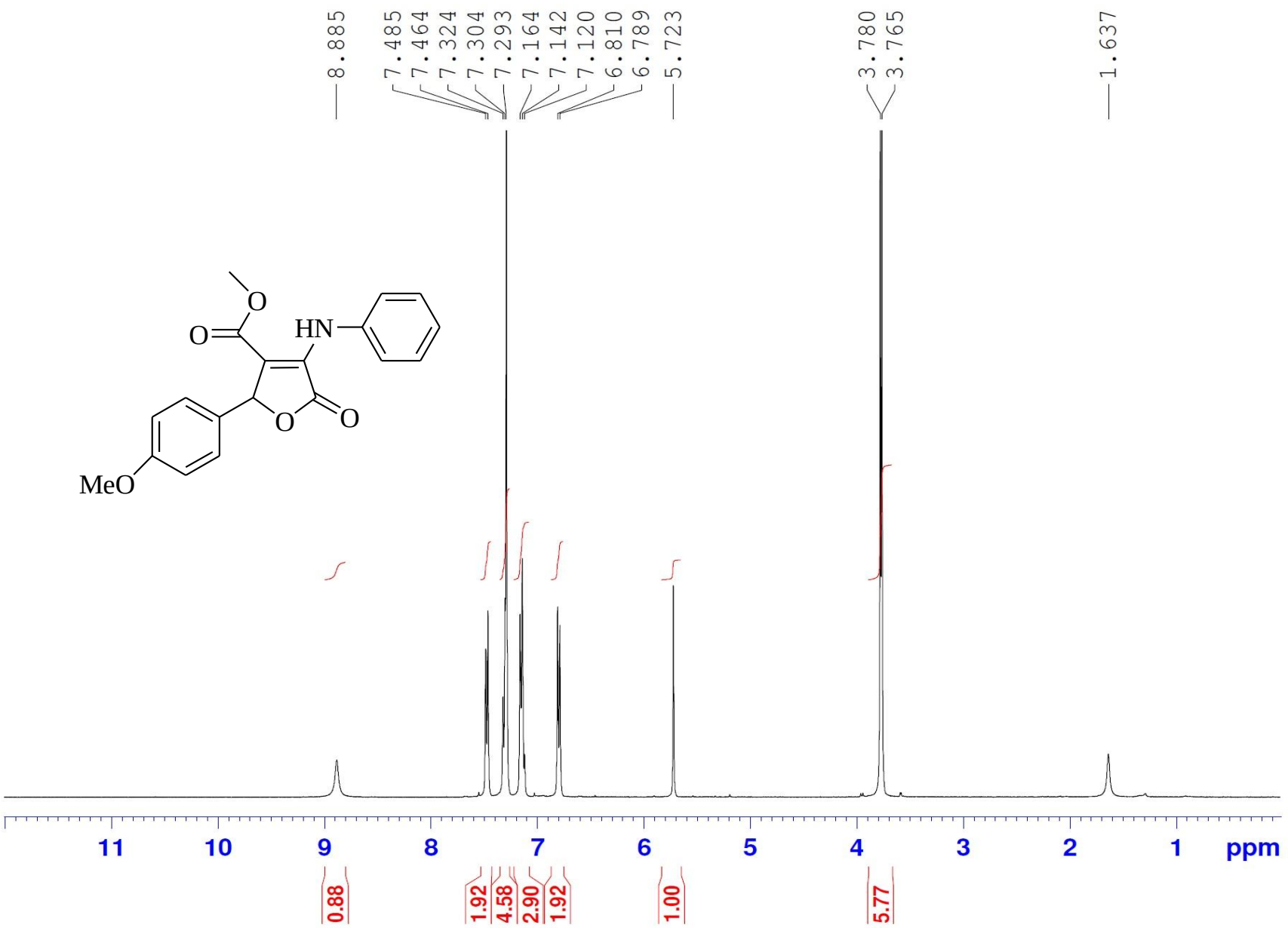
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1.637
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MeO
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10
9
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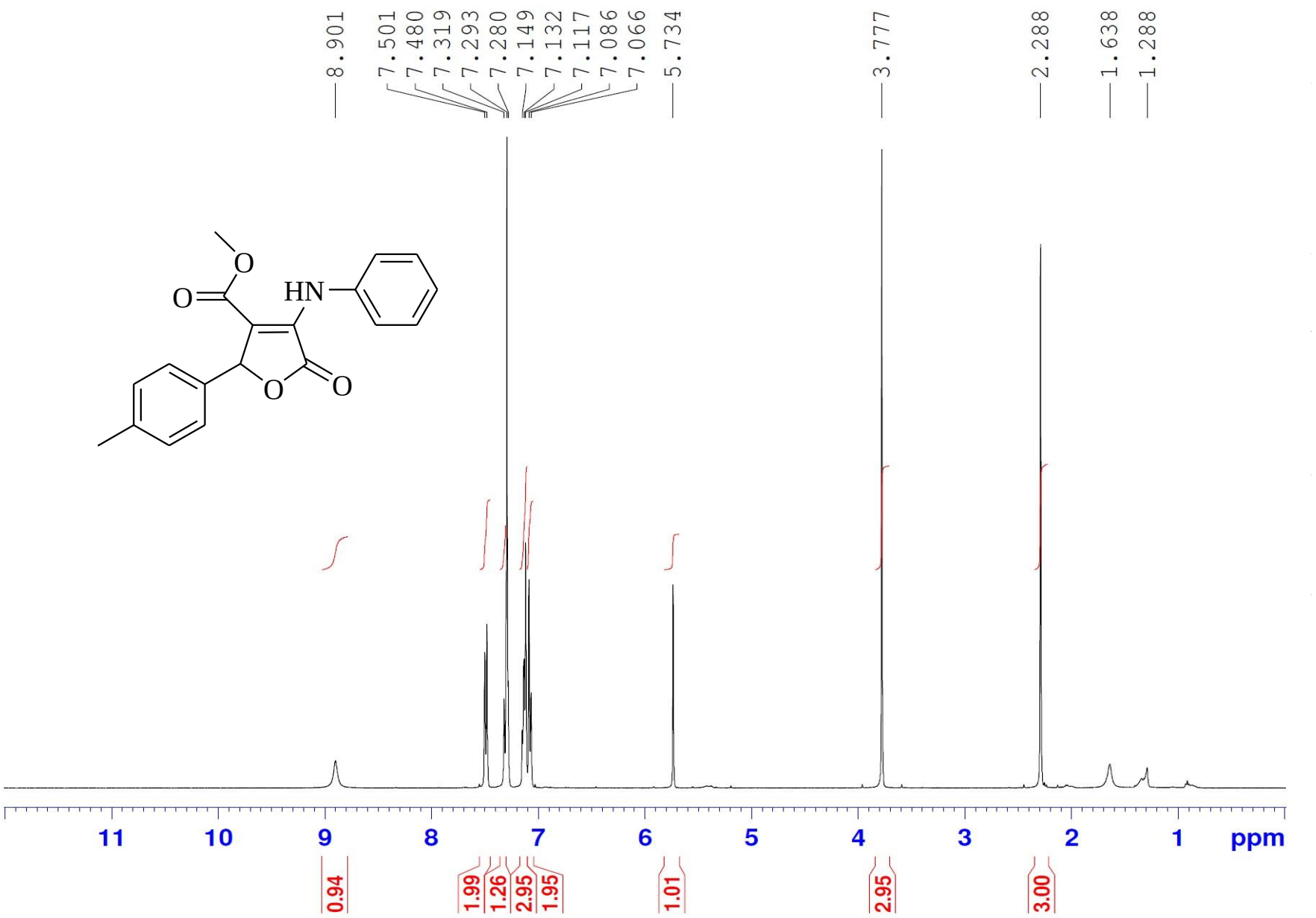
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7.132
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3.777
2.288
1.638
1.288
O
O
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O
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10
9
8
7
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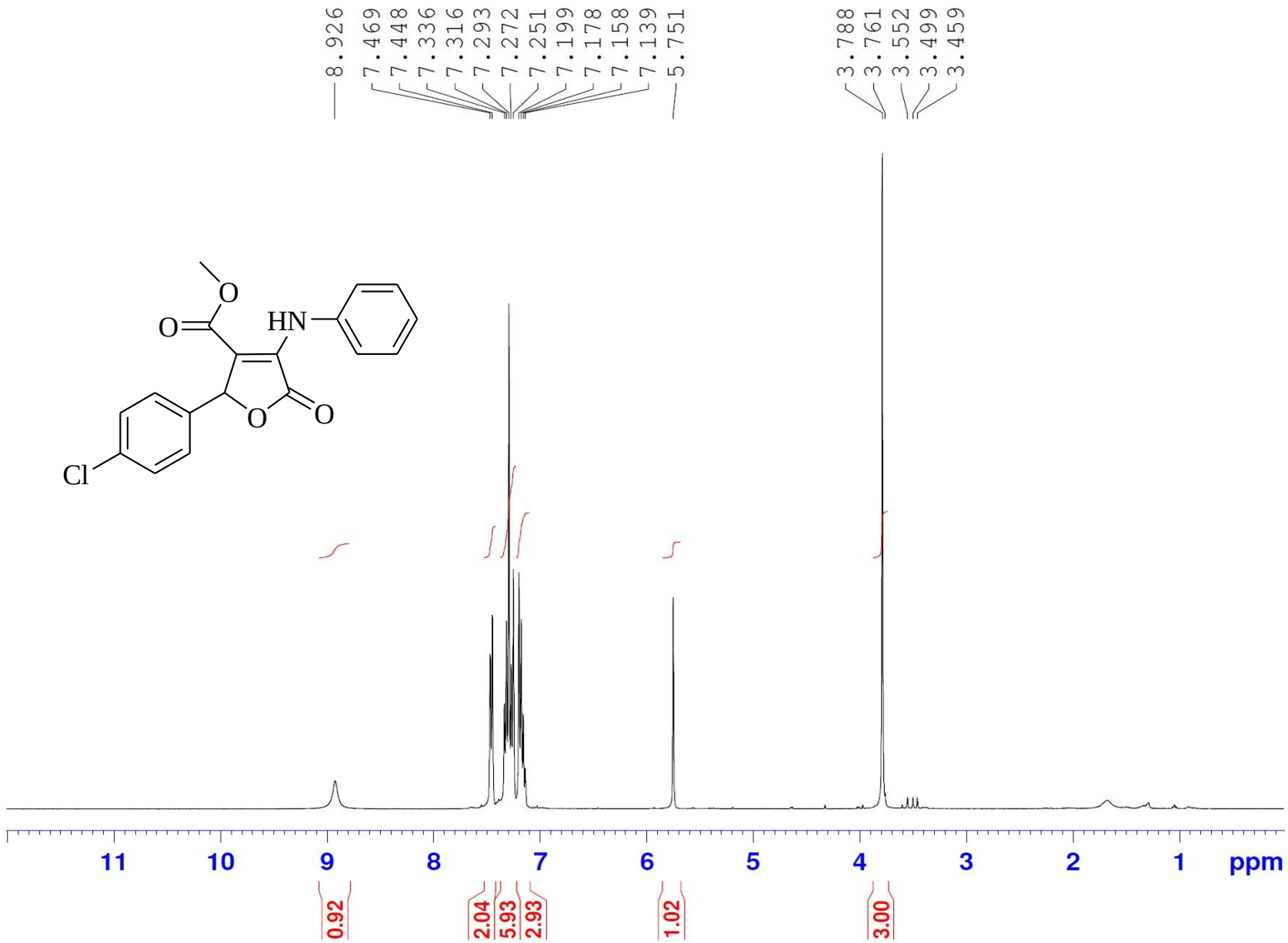
3.00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3.788
3.761
3.552
3.499
3.459
O
O
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Cl
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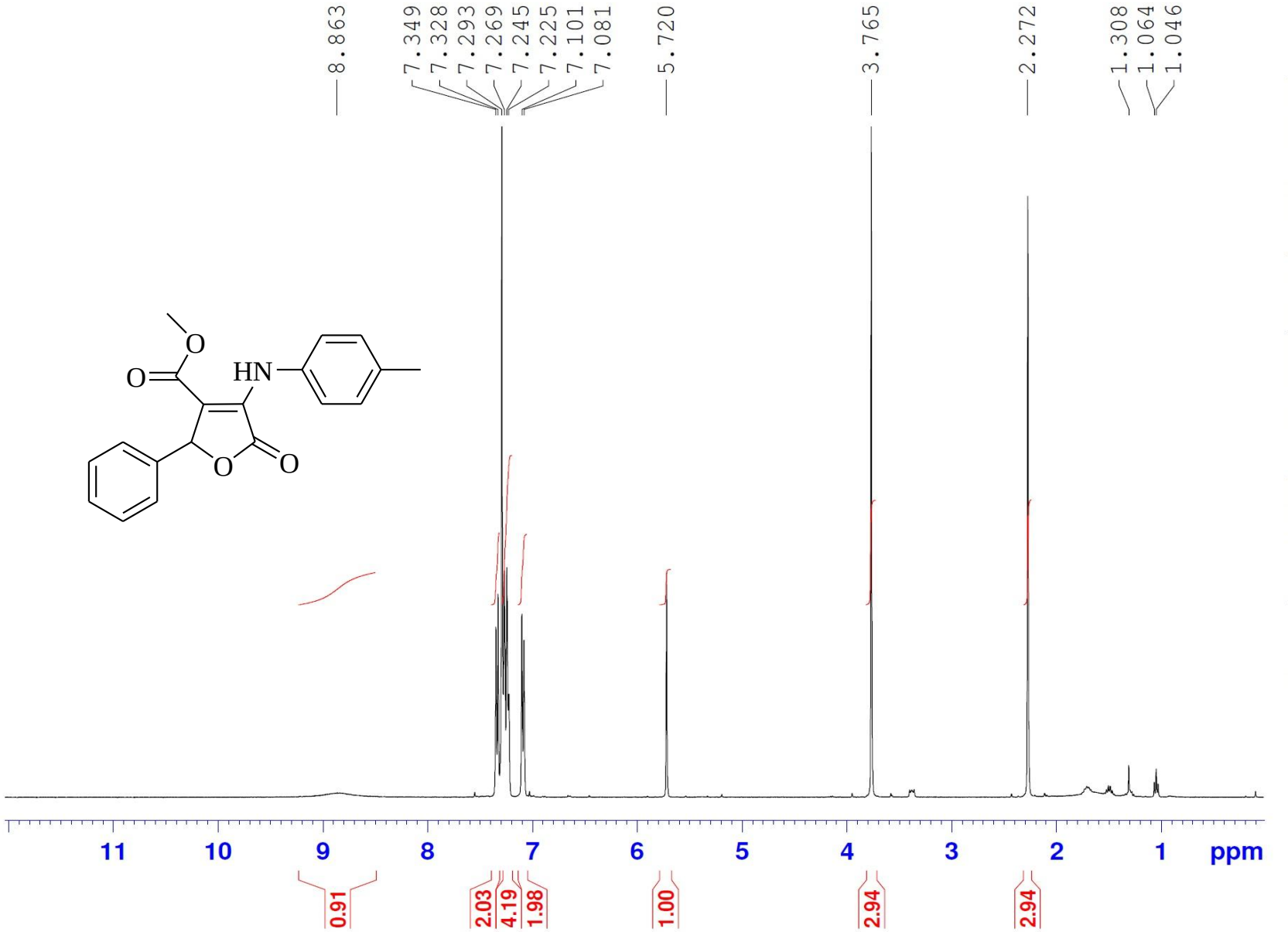
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O
O
HN
O
O
11
10
9
8
7
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ppm
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4.19
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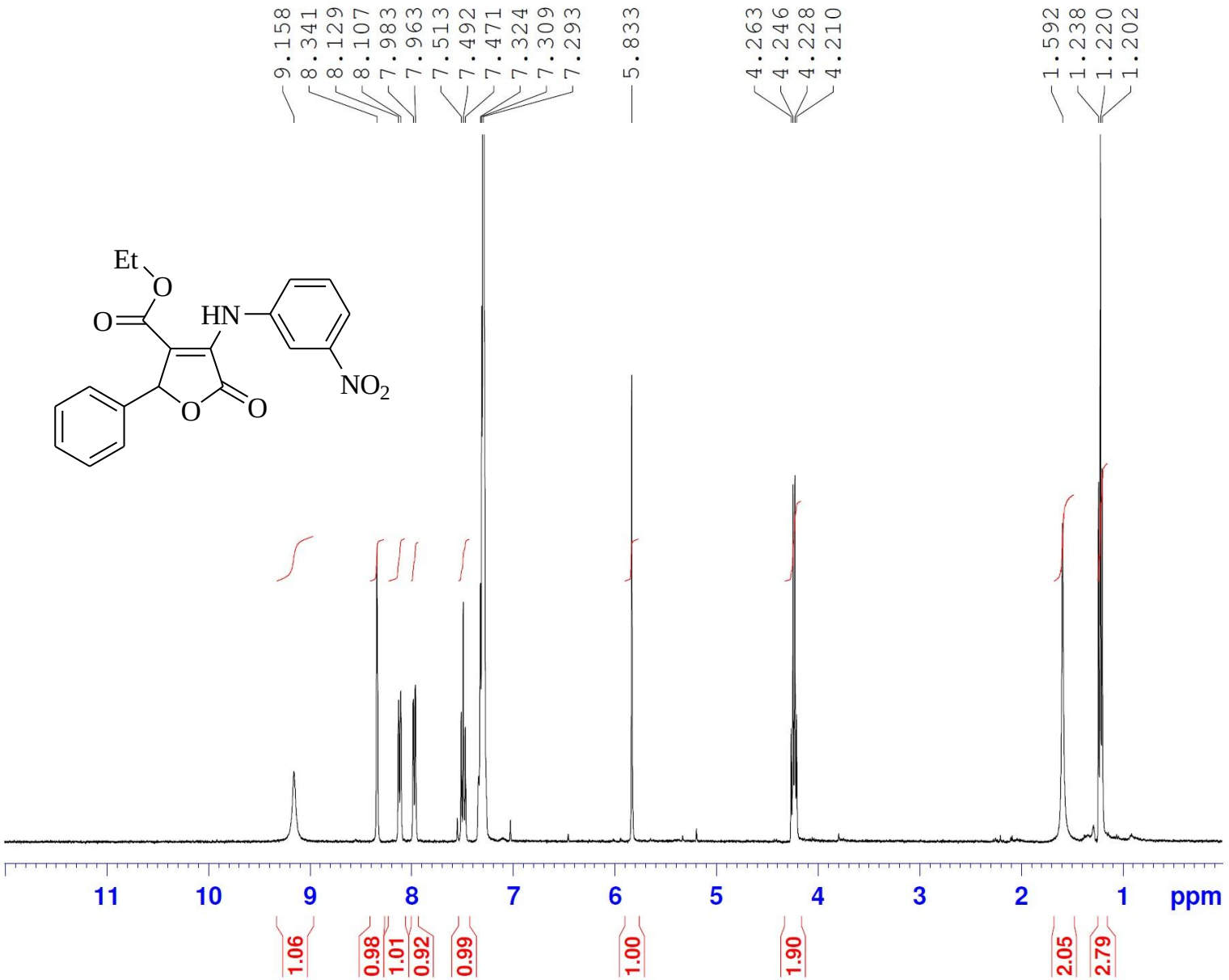
2.94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7.309
7.293
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4.263
4.246
4.228
4.210
1.592
1.238
1.220
1.202
Et
O
O
HN
NO2
O
O
11
10
9
8
7
6
5
4
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0.99
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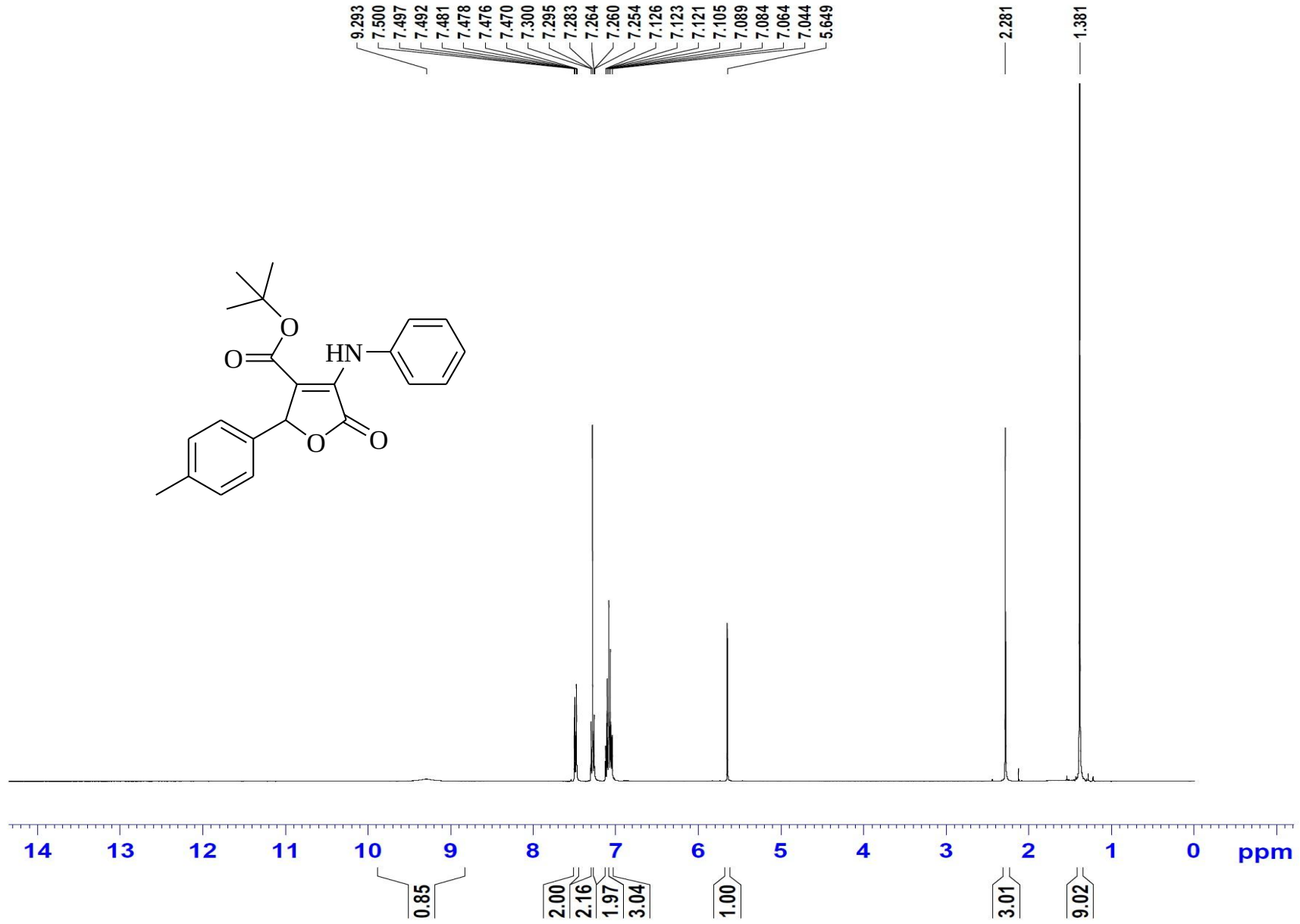
1.90
2.05
2.79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7.254
7.126
7.123
7.121
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7.089
7.084
7.064
7.044
5.649
2.281
1.381
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O
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13
12
11
10
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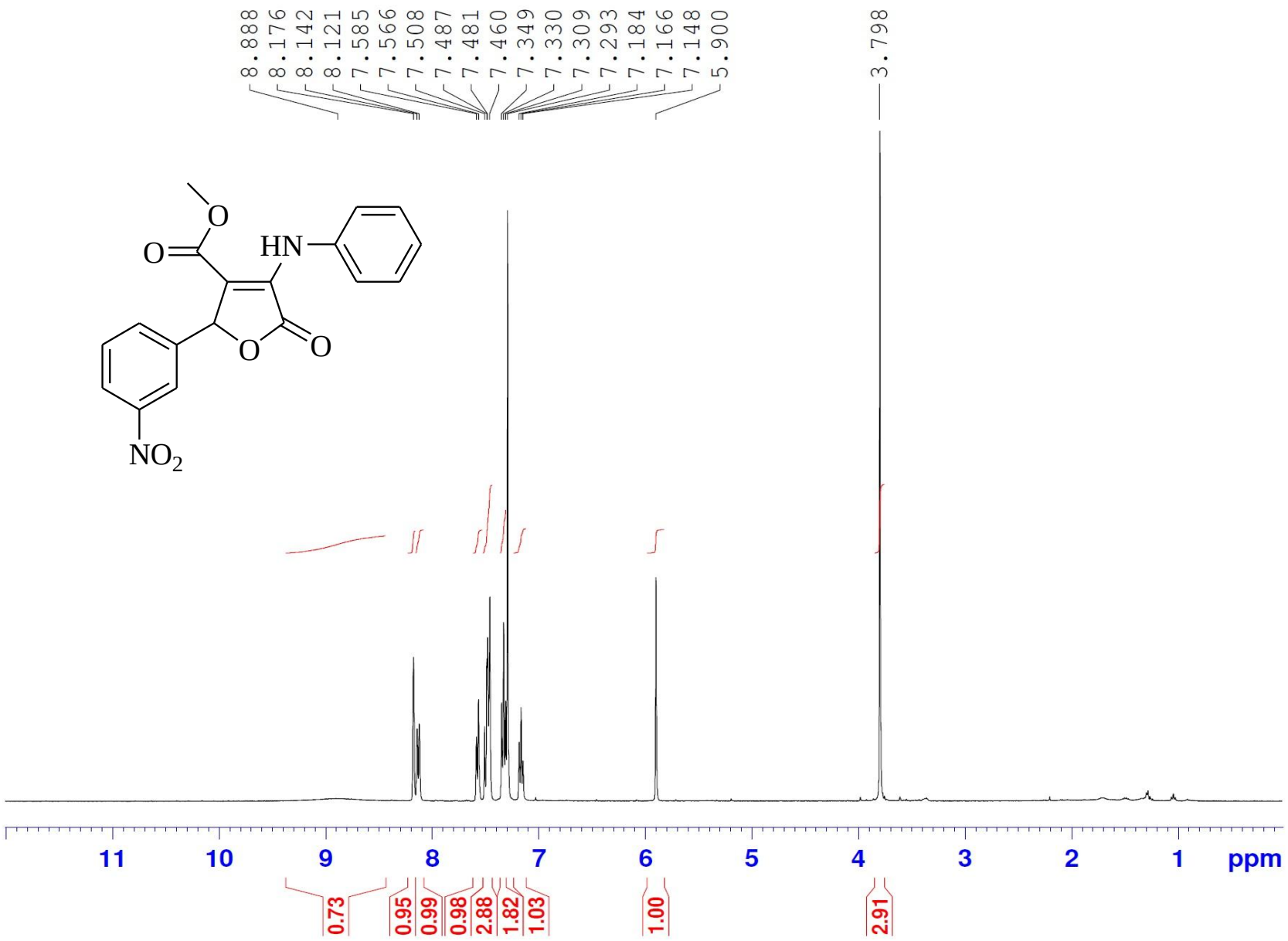
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7.166
7.148
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3.798
O
O
HN
O
O
NO2
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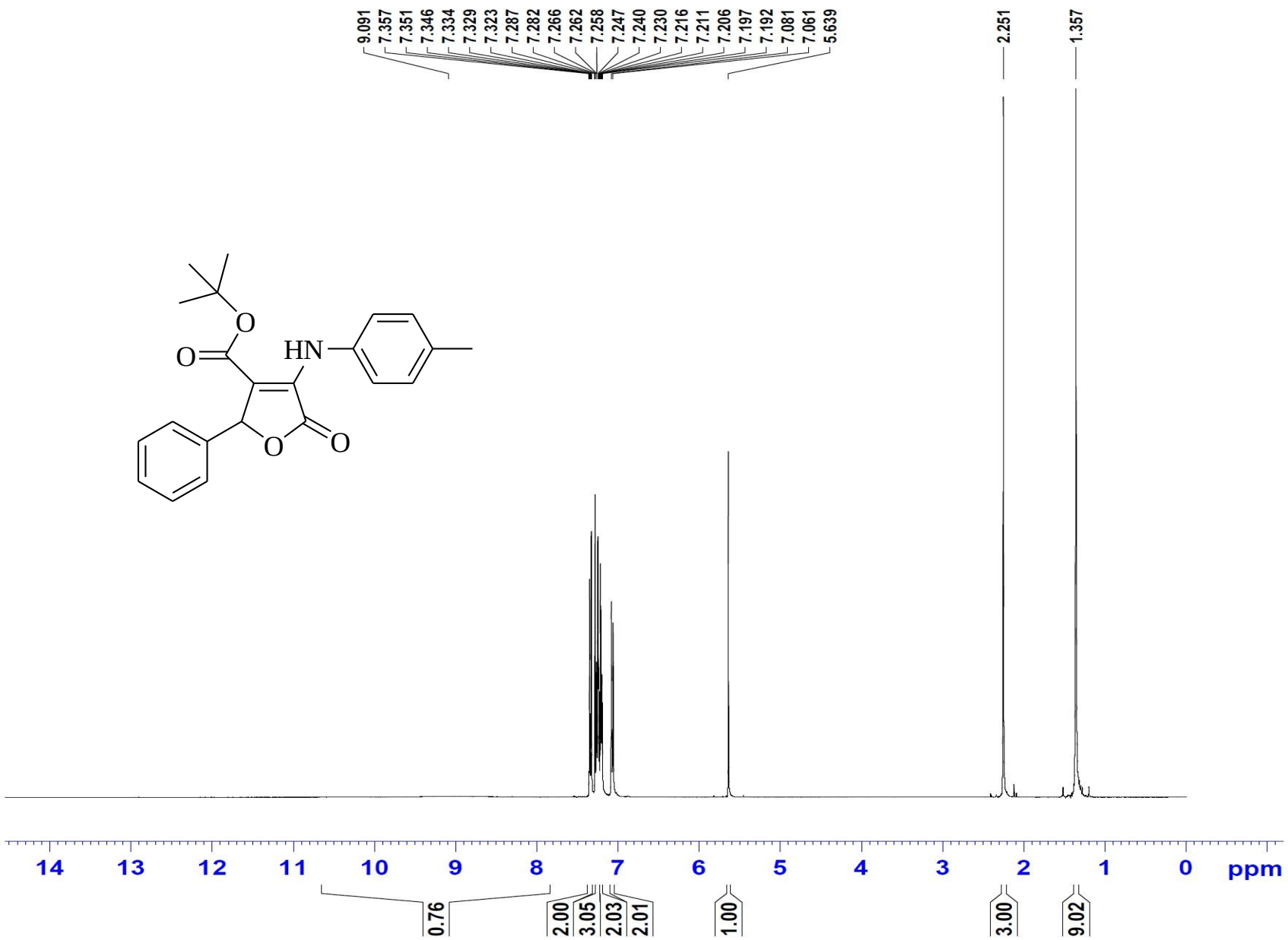
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7.211
7.206
7.197
7.192
7.081
7.061
5.639
2.251
1.357
O
O
HN
O
O
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13
12
11
10
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6
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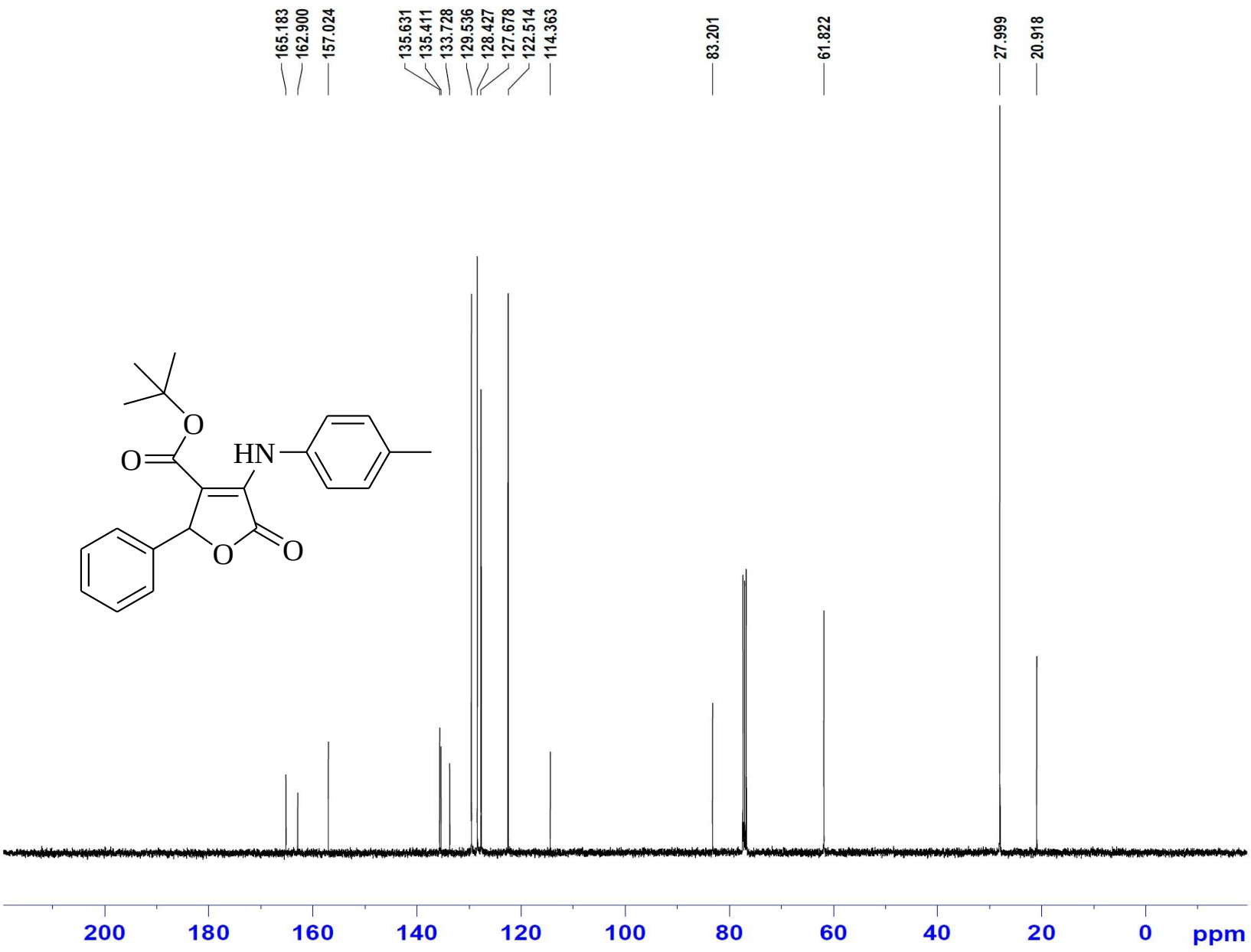
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128.427
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122.514
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61.822
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O
HN
O
O
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120
100
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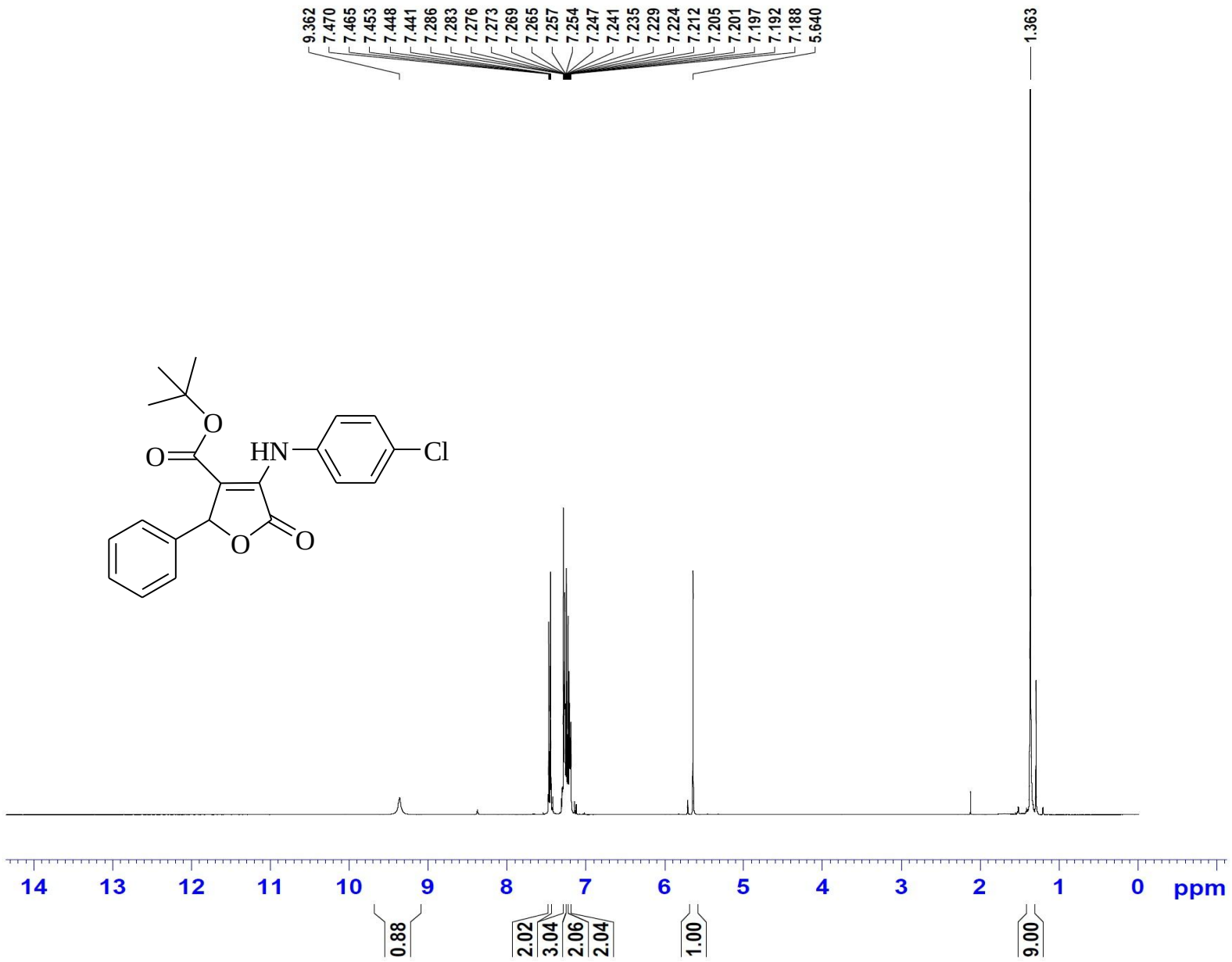
60
40
20
0
ppm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7.269
7.265
7.257
7.254
7.247
7.241
7.235
7.229
7.224
7.212
7.205
7.201
7.197
7.192
7.188
5.640
1.363
O
O
HN
Cl
O
O
14
13
12
11
10
9
8
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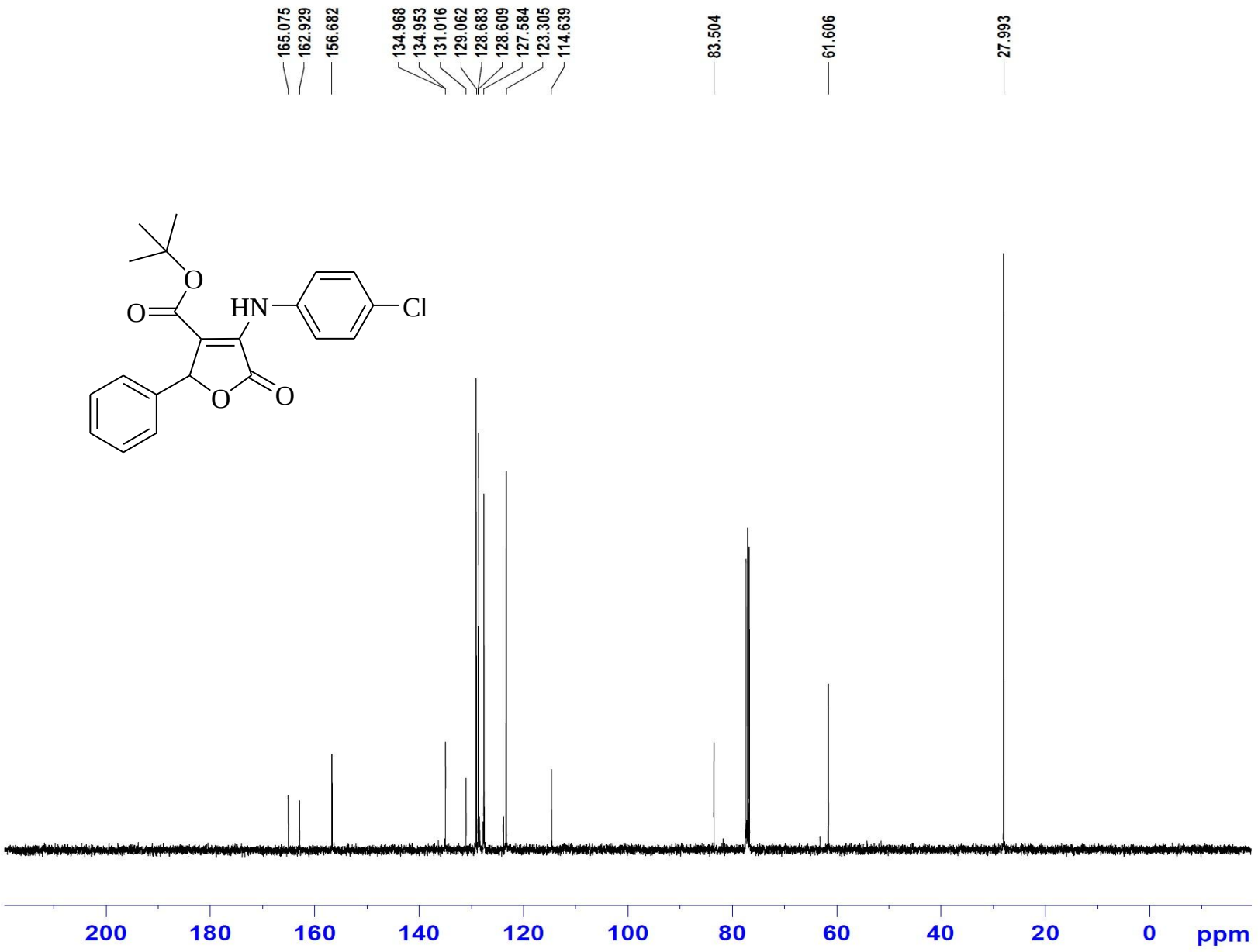
9.00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134.953
131.016
129.062
128.683
128.609
127.584
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114.639
83.504
61.606
27.993
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O
HN
Cl
O
O
200
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120
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60
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20
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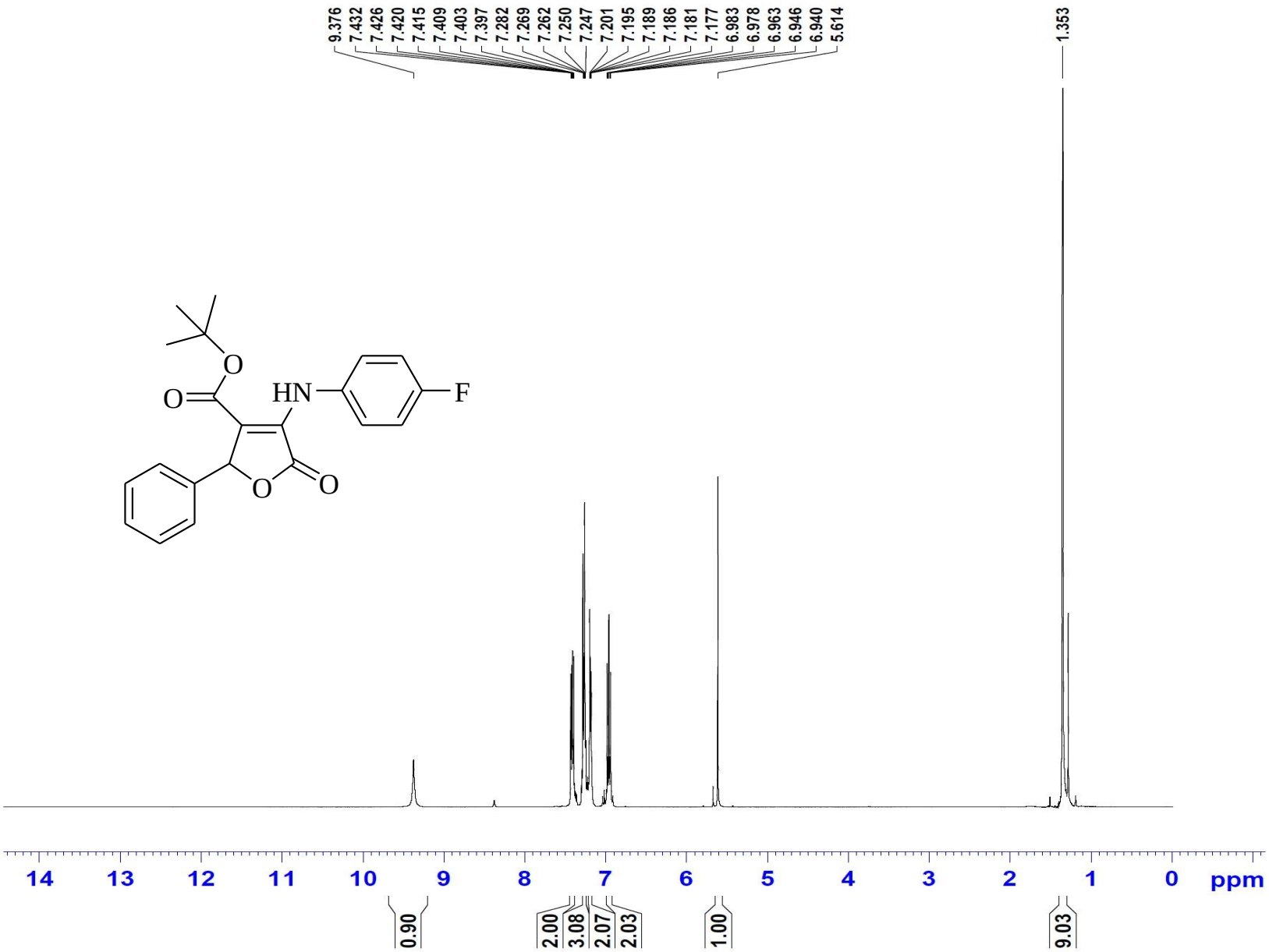
ppm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7.201
7.195
7.189
7.186
7.181
7.177
6.983
6.978
6.963
6.946
6.940
5.614
1.353
O
O
HN
F
O
O
14
13
12
11
10
9
8
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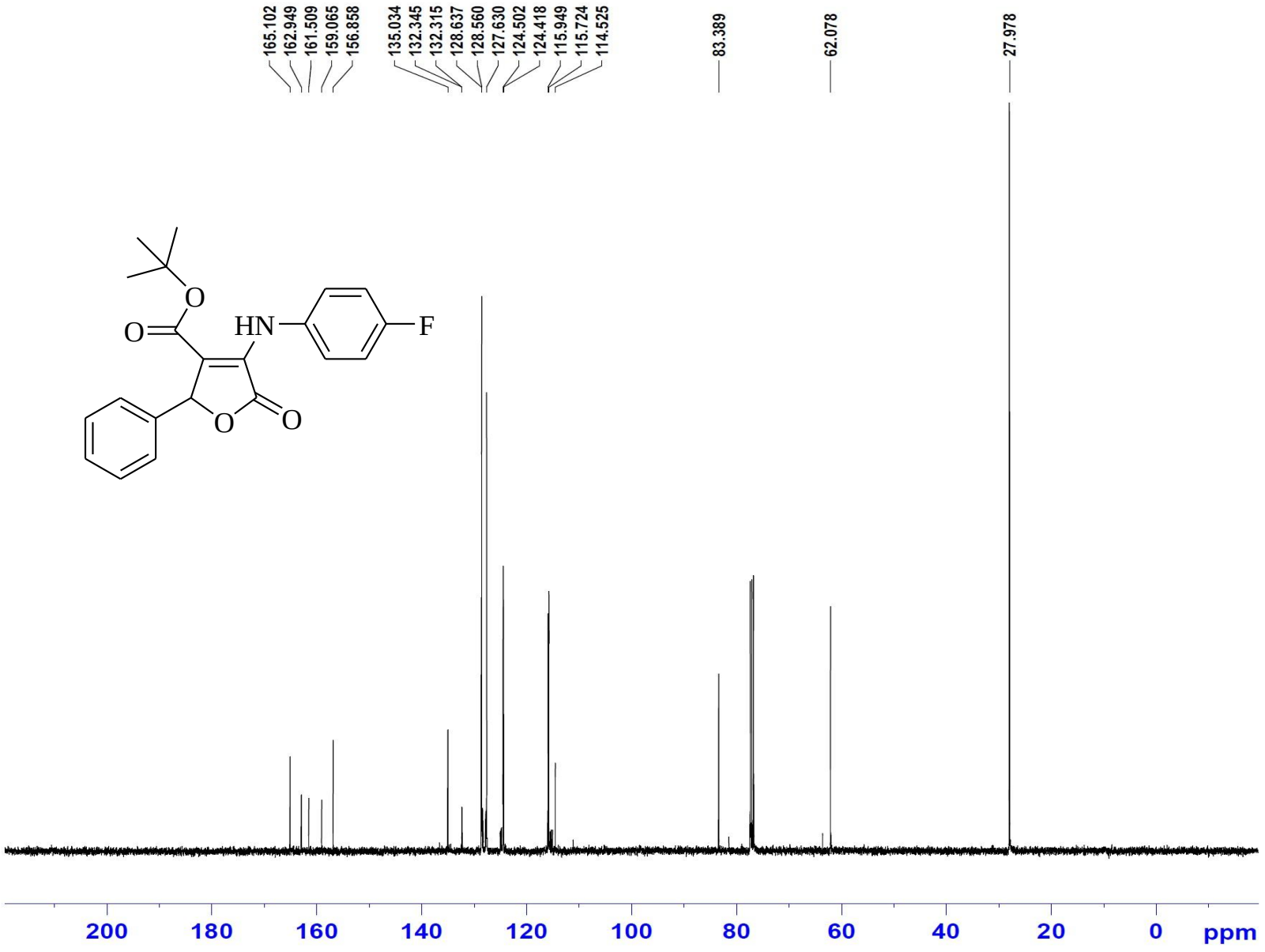
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115.949
115.724
114.525
83.389
62.078
27.978
O
O
HN
F
O
O
200
180
160
140
120
100
80
60
40
20
0
ppm