

Supporting Information

Novel biocompatible Core/Shell Fe₃O₄@NFC@Co (II) as a new catalyst in multicomponent reaction: an efficient and sustainable methodology and novel reusable for one-pot synthesis of 4H-pyran and pyranopyrazole in aqueous medium

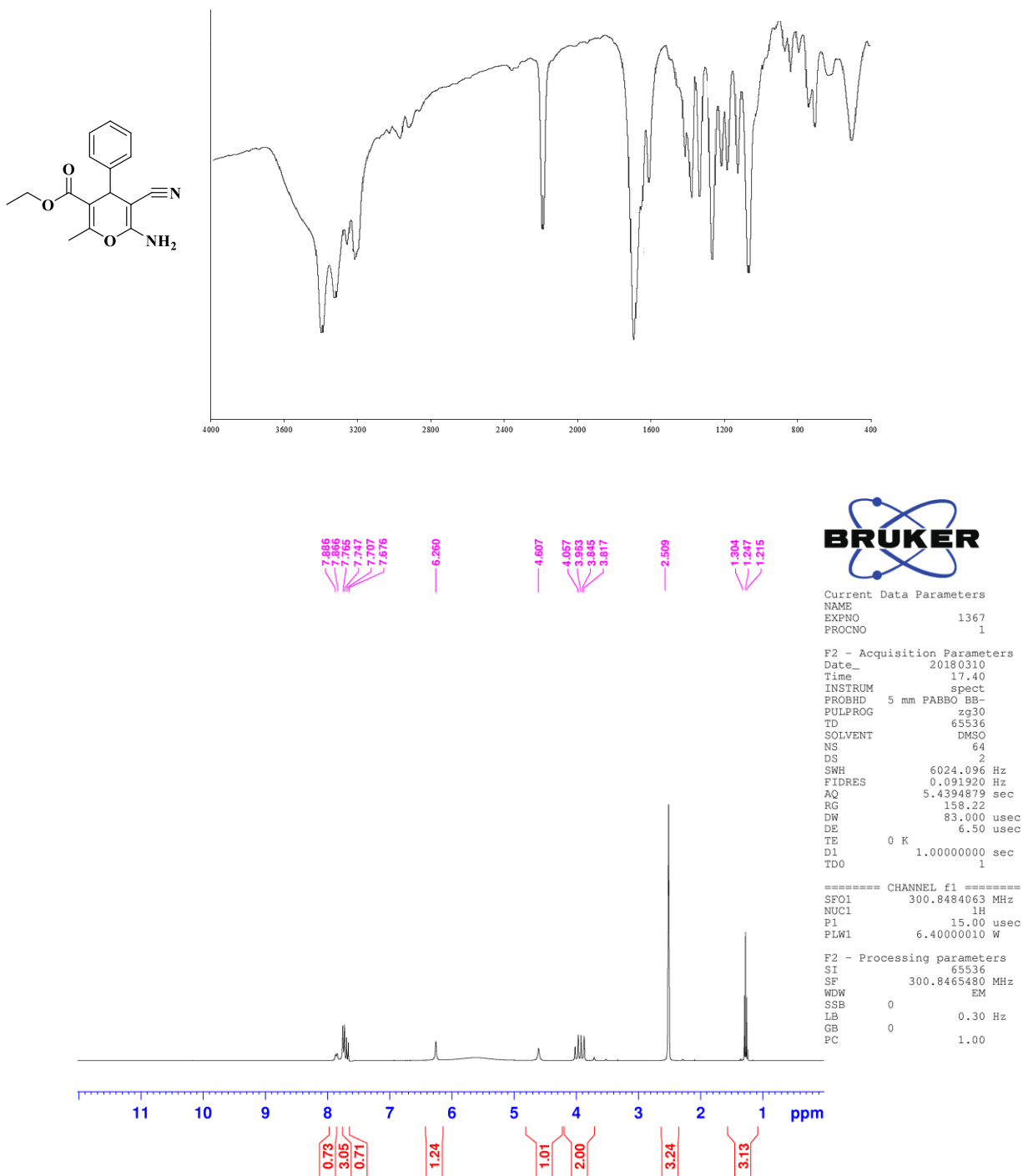
Pouya Ghamari kargar, ^a Ghodsieh Bagherzade*^a and Hossein Eshghi ^b

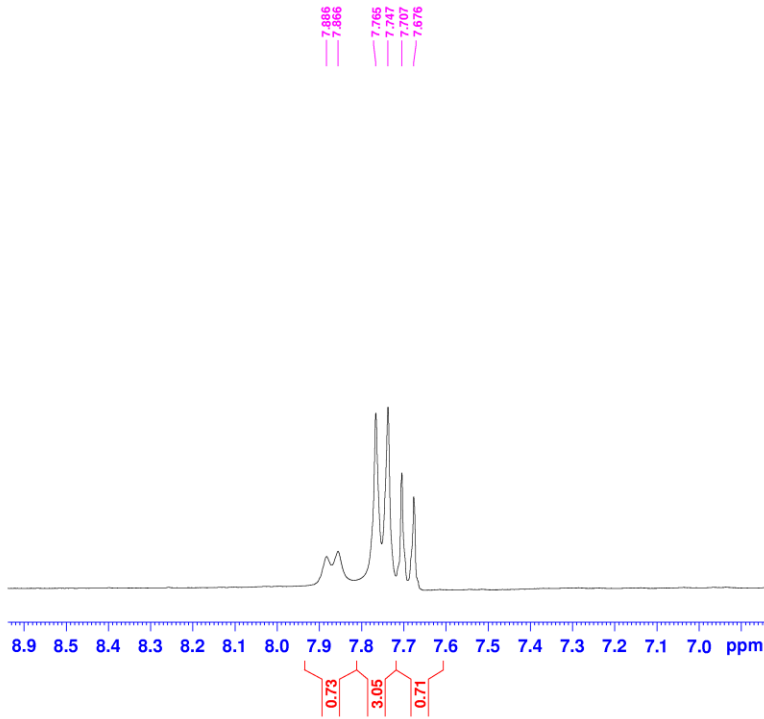
a. Department of Chemistry, Faculty of Sciences, University of Birjand, Birjand, 97175-615, Iran. E-mail: gbagherzade@gmail.com, bagherzadeh@birjand.ac.ir; ax: +98 56 32345192; Tel: +98 56 32345192 Address here.

b. Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran.

Spectral data of compounds 4H-pyran and pyranopyrazol:

Spectral data of ethyl 6-amino-5-cyano-2-methyl-4-phenyl-4H-pyran-3-carboxylate (Table 3, entry 1)



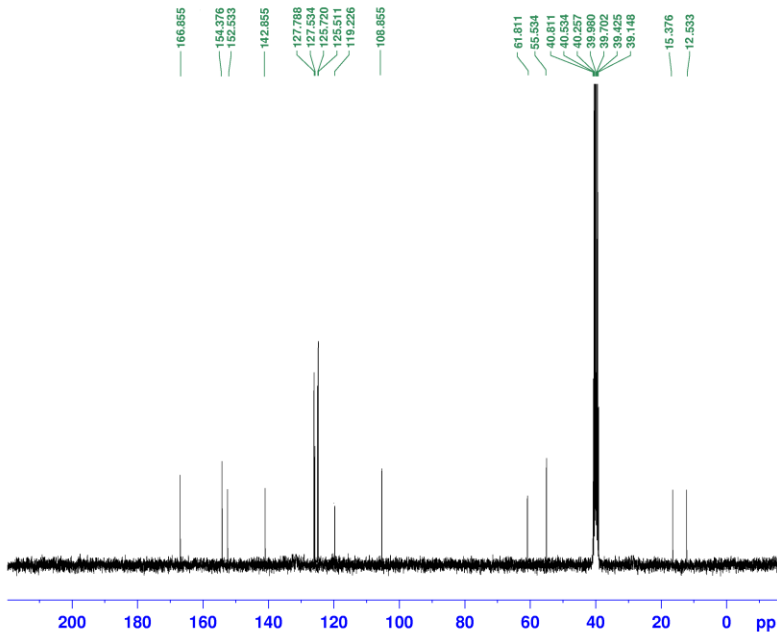


Current Data Parameters
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 EXPNO 1367
 PROCNO 1

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 PULPROG zg30
 TD 65536
 SOLVENT DMSO
 NS 64
 DS 2
 SWH 6024.096 Hz
 FIDRES 0.091920 Hz
 AQ 5.4394879 sec
 RG 158.22
 DW 83.000 usec
 DE 6.50 usec
 TE 0 K
 D1 1.0000000 sec
 TD0 1

===== CHANNEL f1 =====
 SF01 300.8484063 MHz
 NUC1 1H
 P1 15.00 usec
 PLW1 6.40000010 W

F2 - Processing parameters
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 SF 300.8465480 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00



Current Data Parameters
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 EXPNO 1826
 PROCNO 1

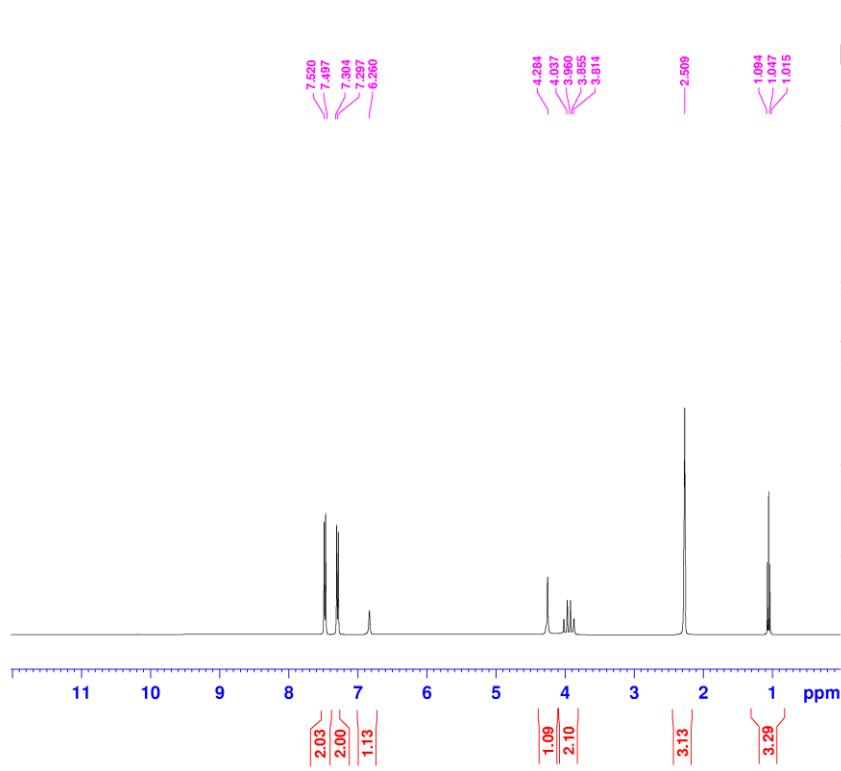
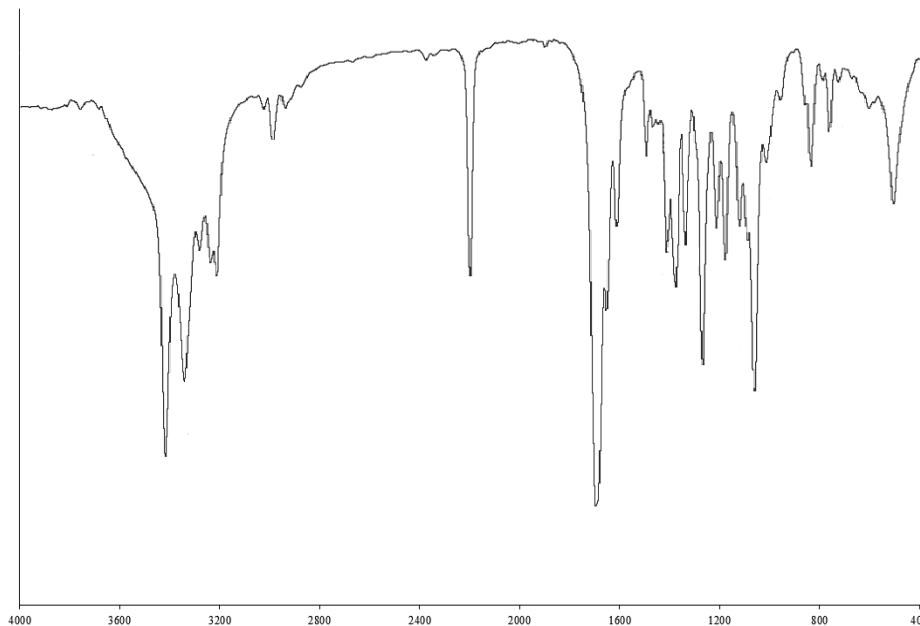
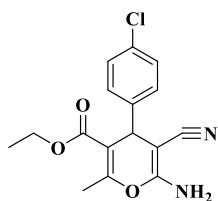
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 TD 65536
 SOLVENT DMSO
 NS 512
 DS 4
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 FIDRES 0.276427 Hz
 AQ 1.8087935 sec
 RG 202
 DW 27.600 usec
 DE 6.50 usec
 TE 0 K
 D1 2.0000000 sec
 D11 0.03000000 sec
 TD0 1

===== CHANNEL f1 =====
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 NUC1 13C
 P1 10.00 usec
 PLW1 30.00000000 W

===== CHANNEL f2 =====
 SF02 300.8477518 MHz
 NUC2 1H
 CPDPRG2 waltz16
 ECPD2 90.00 usec
 PLW2 6.40000010 W
 PLW12 0.17778000 W
 PLW13 0.14399999 W

F2 - Processing parameters
 SI 32768
 SF 75.6479250 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
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 PC 1.40

Spectral data of ethyl-6-amino-4-(4-chlorophenyl)-5-cyano-2-methyl-4H-pyran-3-carboxylate
(Table 3, entry 2):

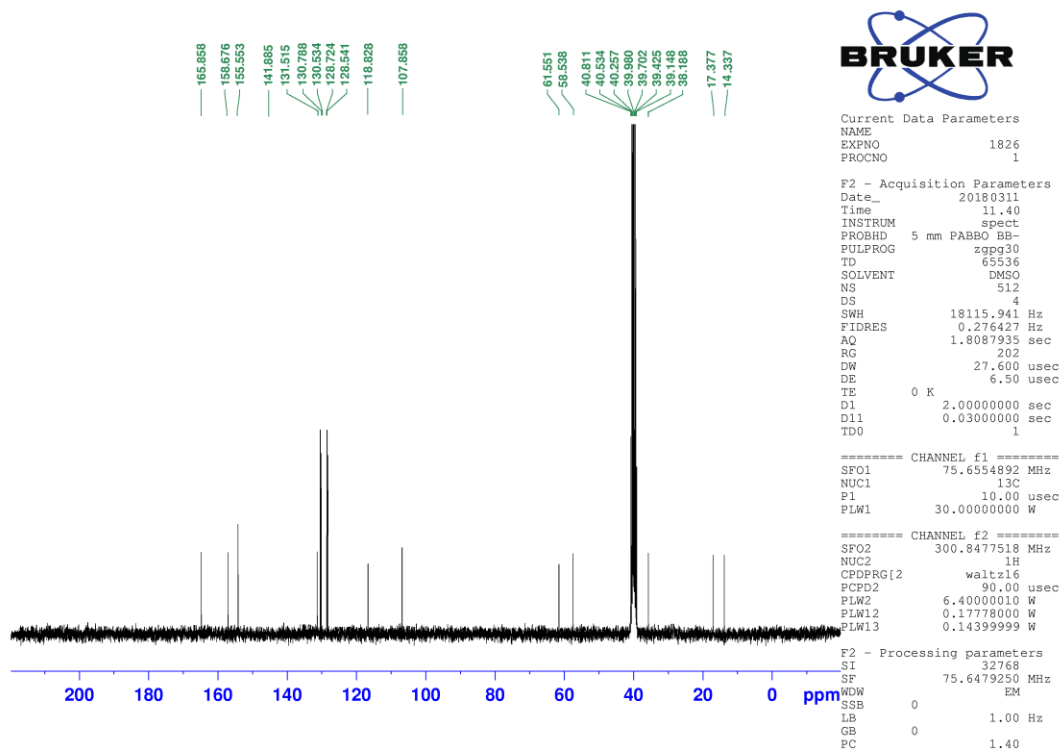


Current Data Parameters
NAME 1367
EXPNO 1
PROCNO 1

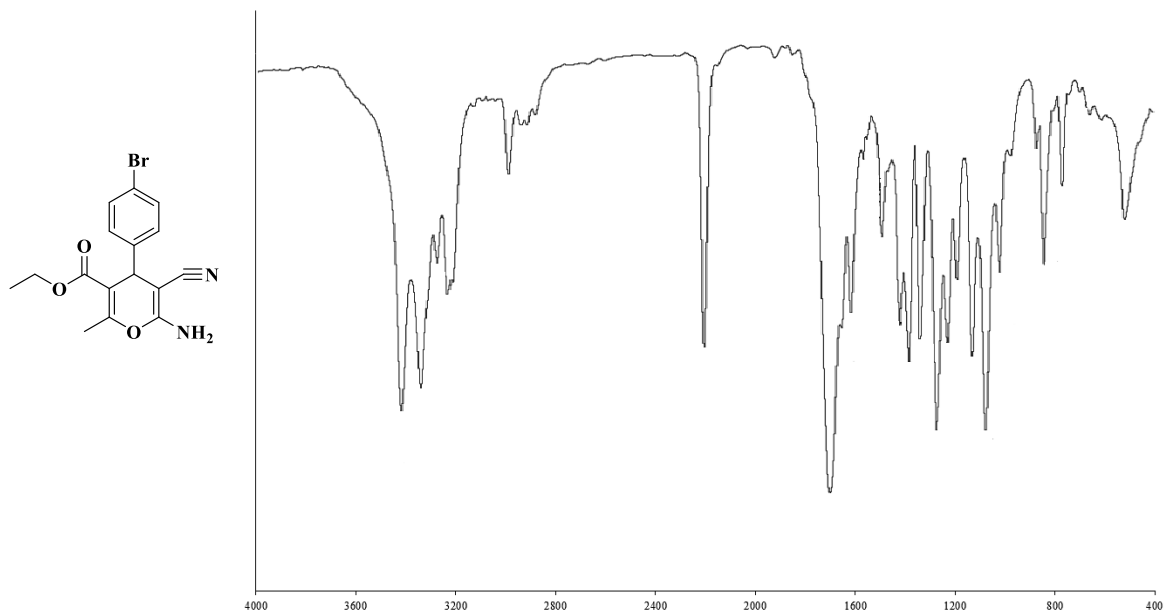
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PULPROG zg30
TD 65536
SOLVENT DMSO
NS 64
DS 2
SWH 6024.096 Hz
FIDRES 0.091920 Hz
AQ 5.4394879 sec
RG 158.22
DW 83.000 usec
DE 6.50 usec
TE 0 K
D1 1.00000000 sec
TD0 1

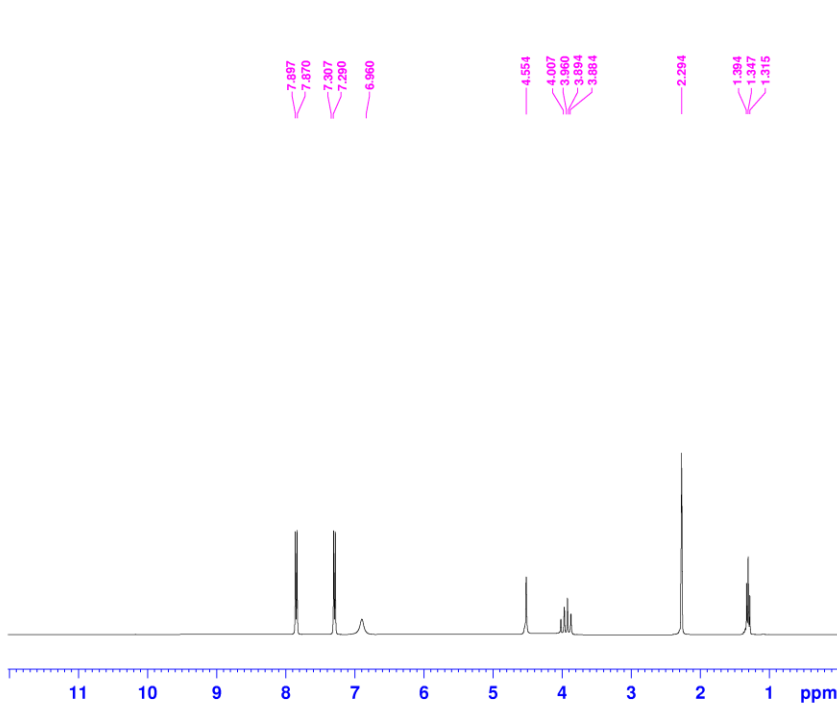
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NUC1 1H
P1 15.00 usec
PLW1 6.40000010 W

F2 - Processing parameters
SI 65536
SF 300.8465480 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



Spectral data of ethyl 6-amino-4-(4-bromophenyl)-5-cyano-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 3):



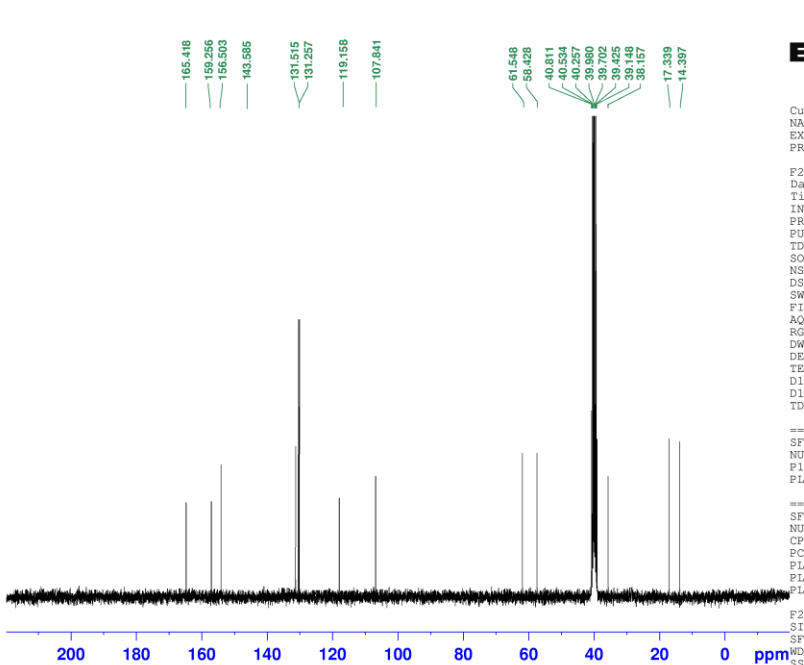


Current Data Parameters
 NAME
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 PROCNO 1

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 SOLVENT DMSO
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 DS 2
 SWH 6024.096 Hz
 FIDRES 0.091920 Hz
 AQ 5.4394879 sec
 RG 158.22
 DW 83.000 usec
 DE 6.50 usec
 TE 0 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 SF01 300.8484063 MHz
 NUC1 1H
 P1 15.00 usec
 PLW1 6.40000010 W

F2 - Processing parameters
 SI 65536
 SF 300.8465480 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00



Current Data Parameters
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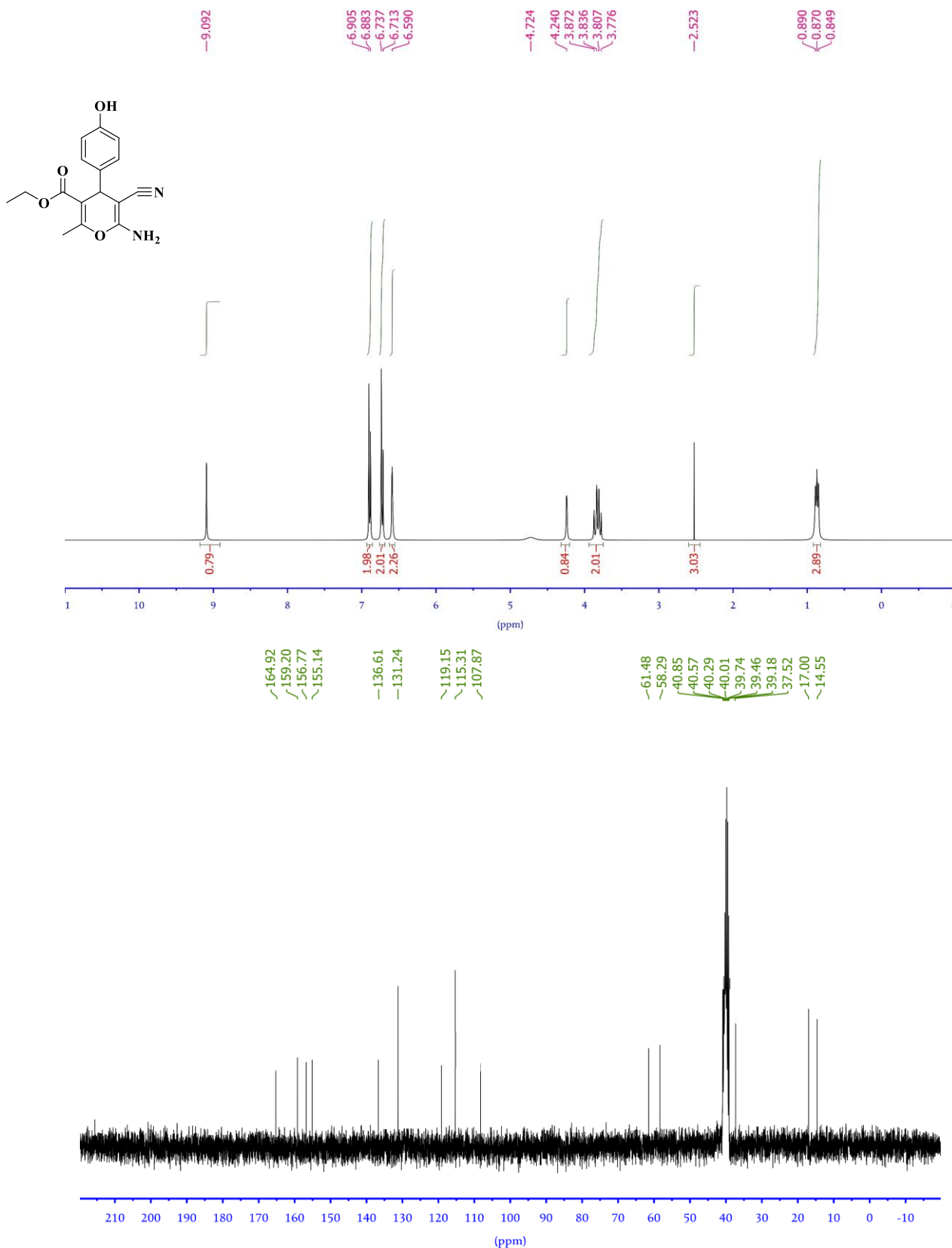
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 PULPROG zgpg30
 TD 65536
 SOLVENT DMSO
 NS 512
 DS 4
 SWH 18115.941 Hz
 FIDRES 0.276427 Hz
 AQ 1.8087935 sec
 RG 202
 DW 27.600 usec
 DE 6.50 usec
 TE 0 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 1

===== CHANNEL f1 =====
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 NUC1 13C
 P1 10.00 usec
 PLW1 30.00000000 W

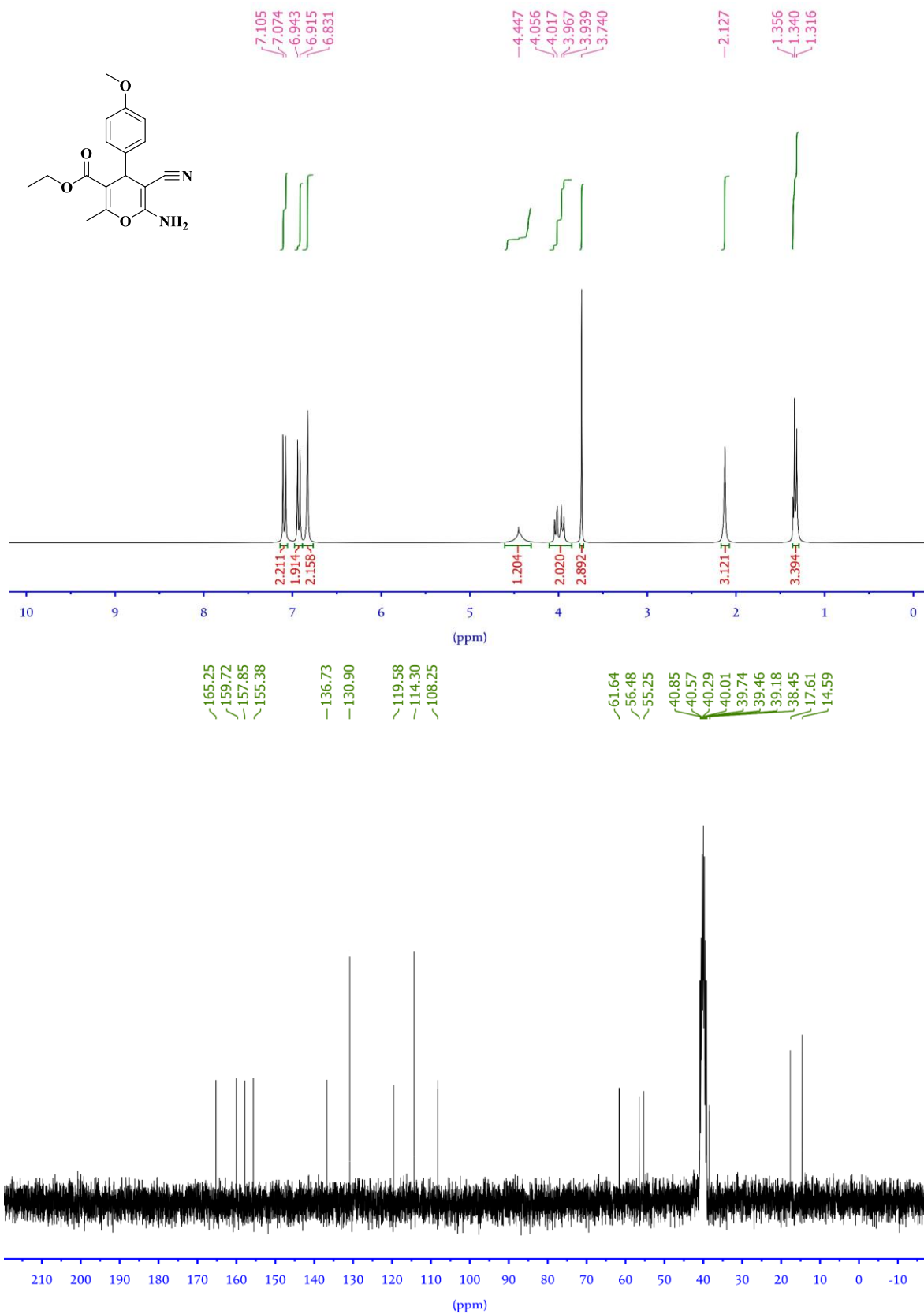
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 NUC2 1H
 CPDPRG2 waltz16
 ECPD2 90.00 usec
 PLW2 6.40000010 W
 PLM12 0.17778000 W
 PLM13 0.14399999 W

F2 - Processing parameters
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 SF 75.6479250 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40

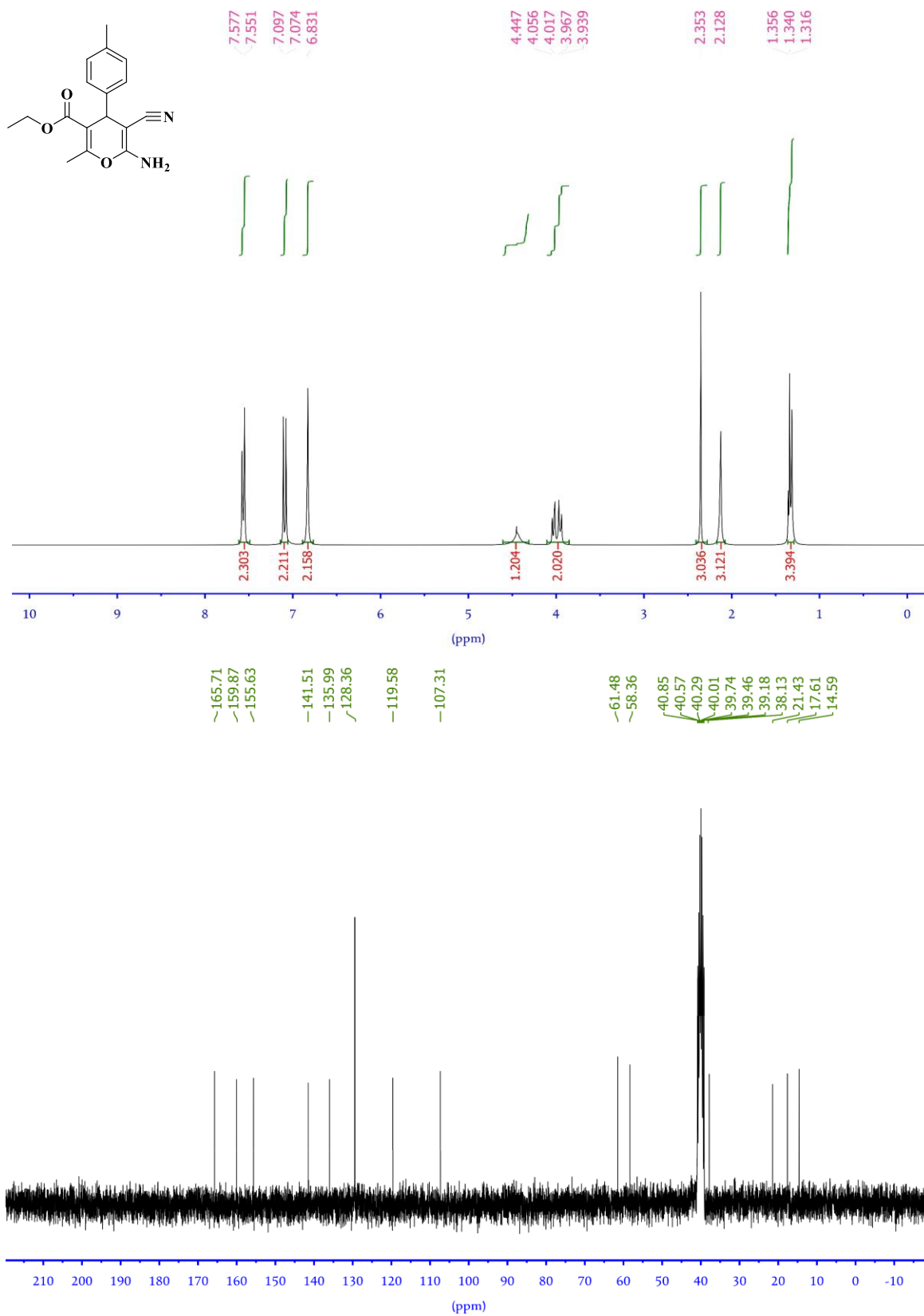
ethyl 6-amino-5-cyano-4-(4-hydroxyphenyl)-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 4):



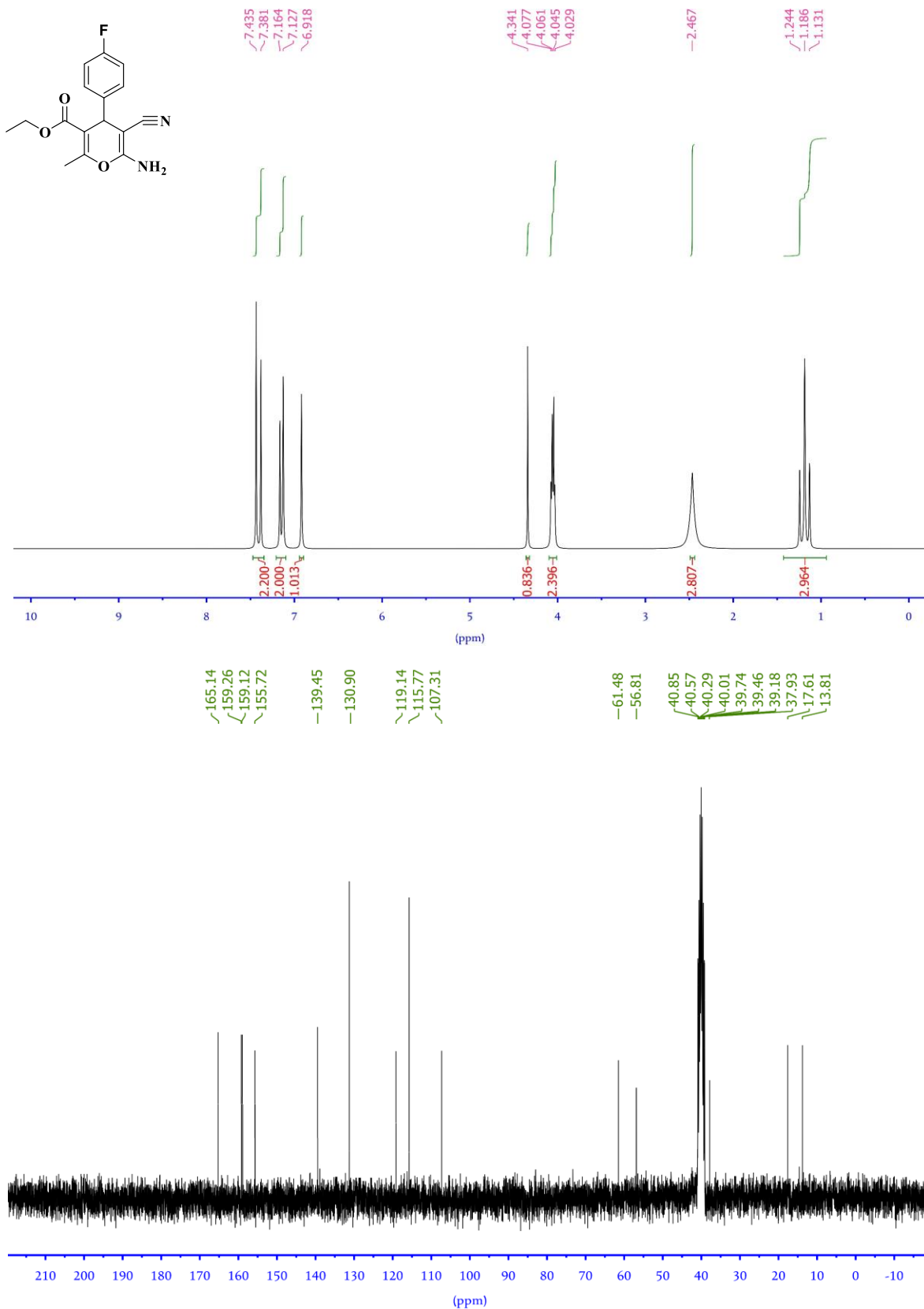
ethyl 6-amino-5-cyano-4-(4-methoxyphenyl)-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 5):



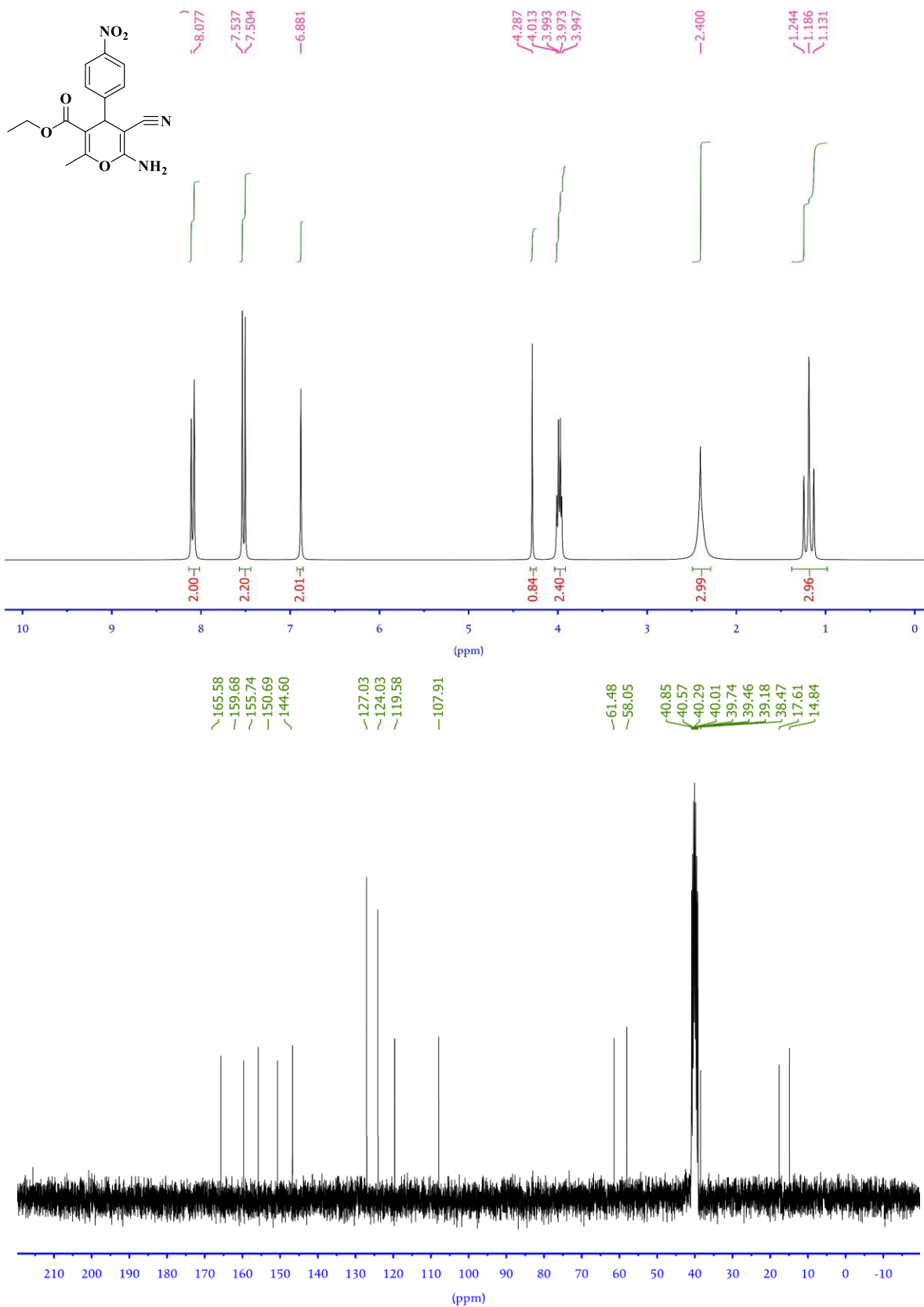
ethyl 6-amino-5-cyano-2-methyl-4-(p-tolyl)-4H-pyran-3-carboxylate (Table 3, entry 6):



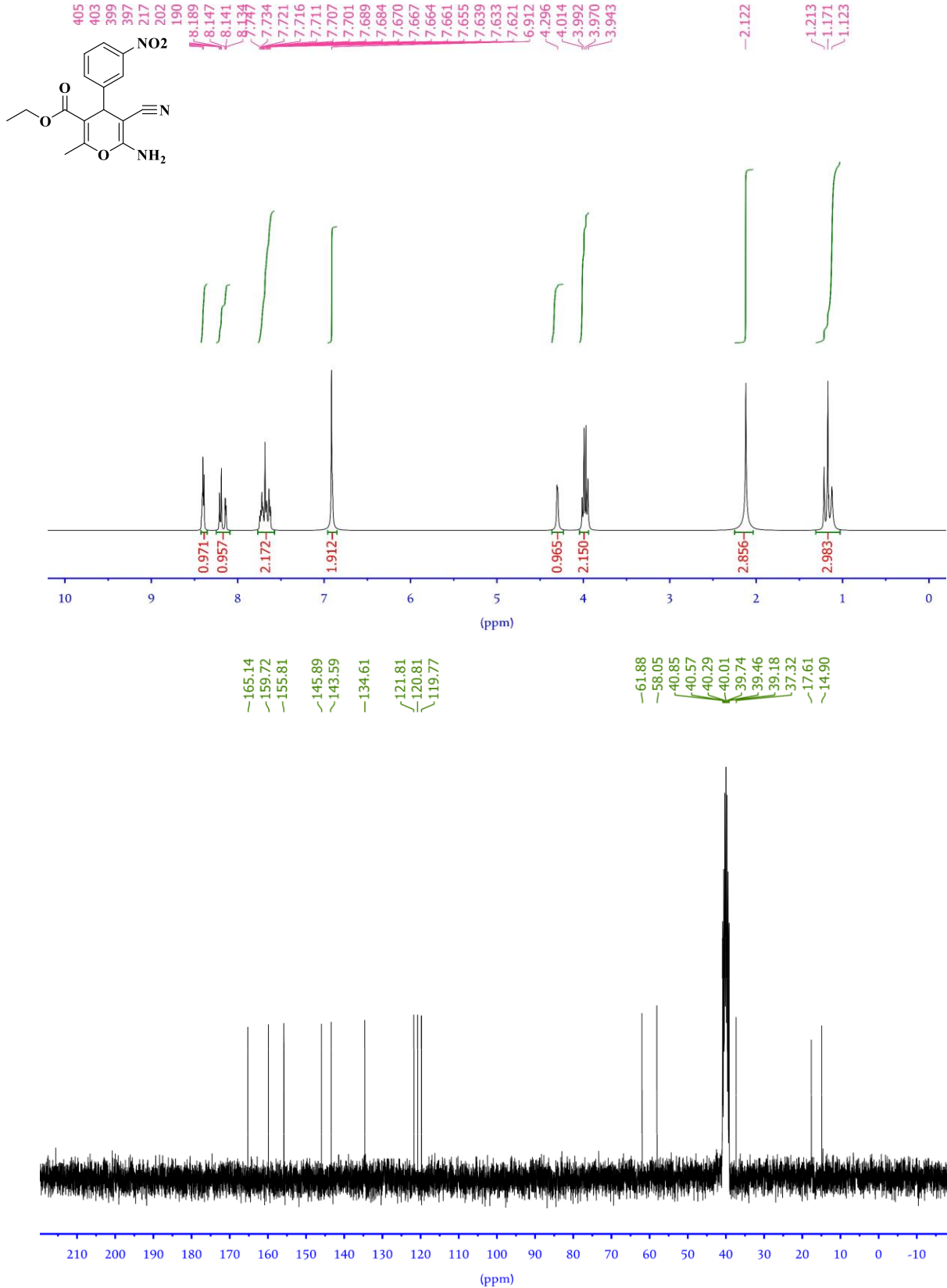
ethyl 6-amino-5-cyano-4-(4-fluorophenyl)-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 7):



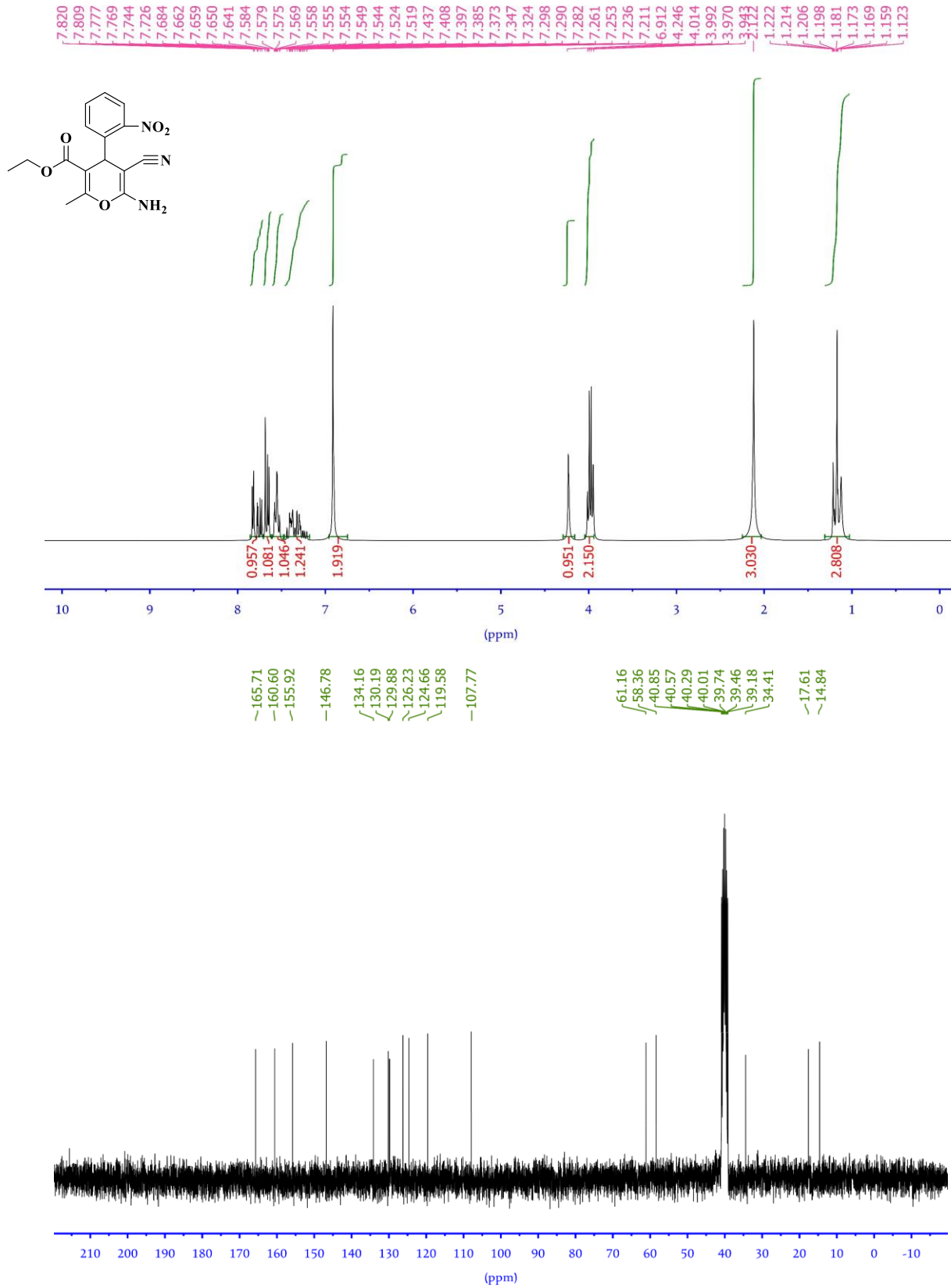
ethyl 6-amino-5-cyano-2-methyl-4-(4-nitrophenyl)-4H-pyran-3-carboxylate (Table 3, entry 8):



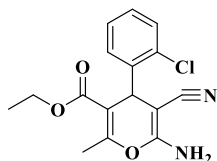
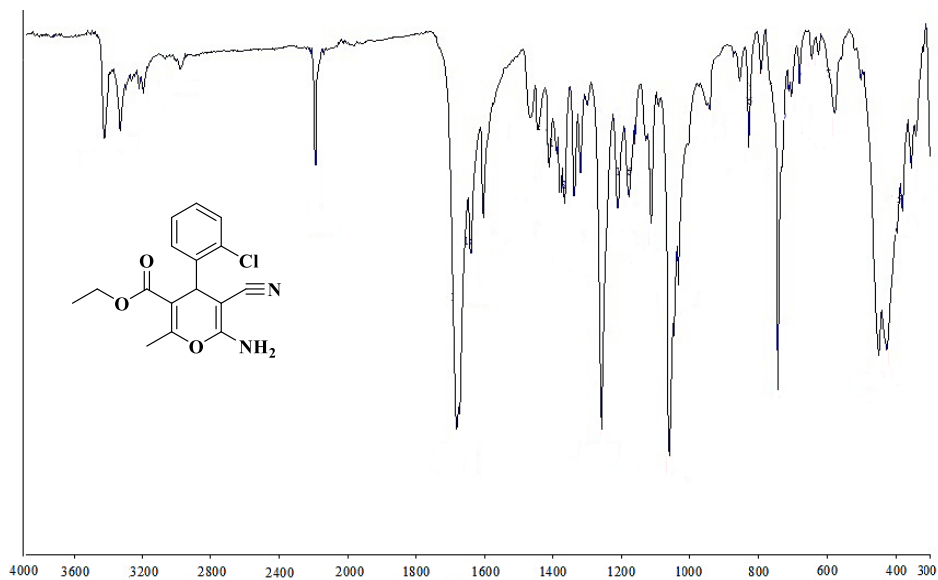
ethyl 6-amino-5-cyano-2-methyl-4-(3-nitrophenyl)-4H-pyran-3-carboxylate (Table 3, entry 9):



ethyl 6-amino-5-cyano-2-methyl-4-(2-nitrophenyl)-4H-pyran-3-carboxylate (Table 3, entry 10):



ethyl 6-amino-4-(2-chlorophenyl)-5-cyano-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 11):



7.144
7.132
7.126
7.115
7.108
7.099
7.088
7.007
6.997
6.990
6.987
6.970
6.944
6.748
4.874
3.947
3.920
3.904
3.784
2.334
0.915
0.884
0.847

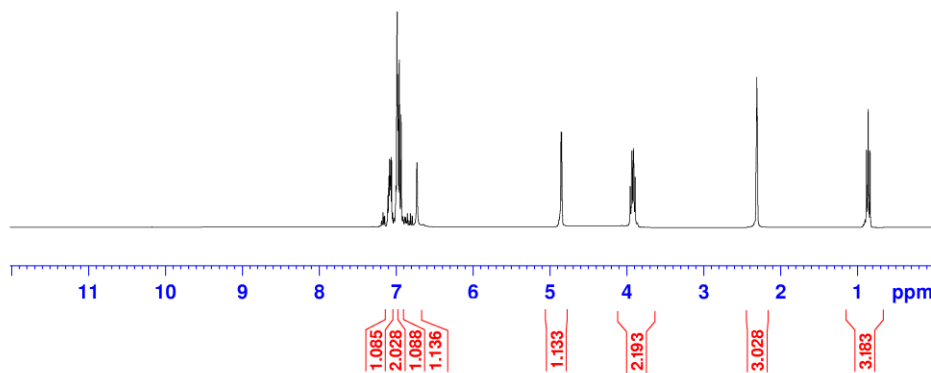


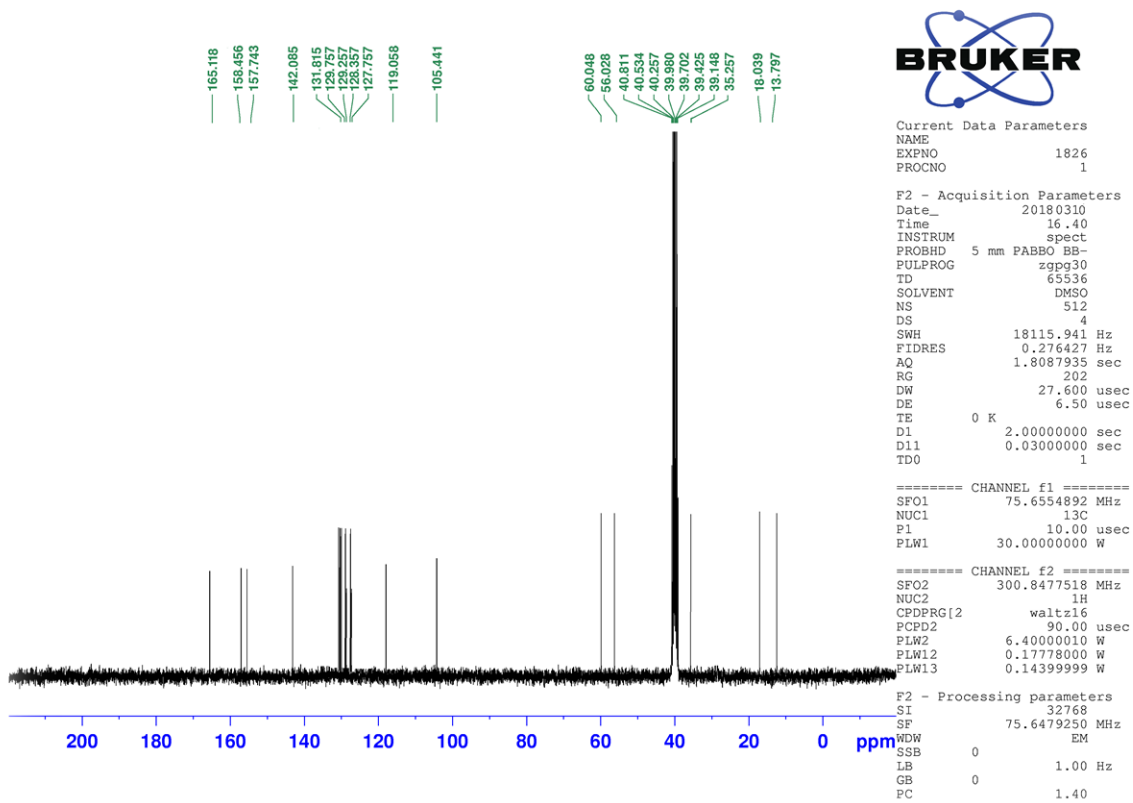
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PROCNO 1

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TD 65536
SOLVENT DMSO
NS 64
DS 2
SWH 6024.096 Hz
FIDRES 0.091920 Hz
AQ 5.4394879 sec
RG 158.22
DW 83.000 usec
DE 6.50 usec
TE 0 K
D1 1.00000000 sec
TD0 1

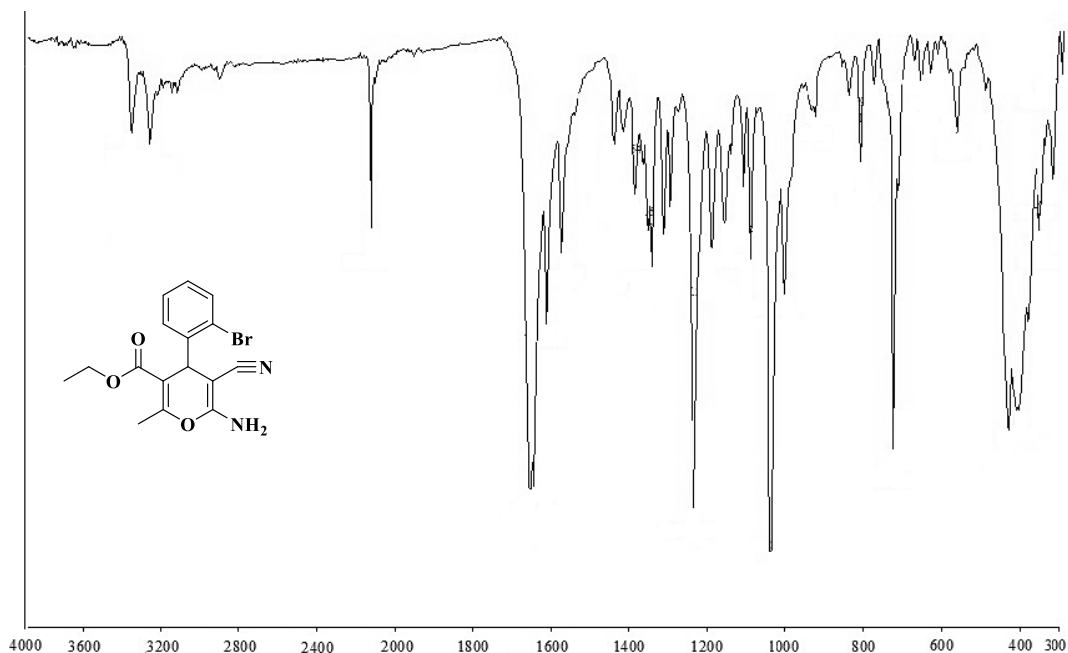
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PLW1 6.40000010 W

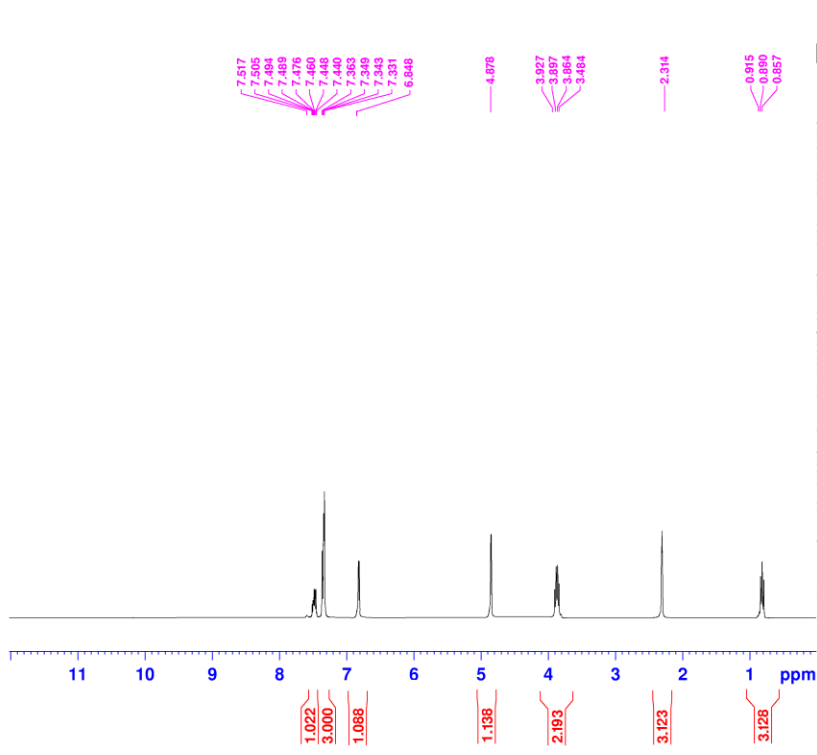
F2 - Processing parameters
SI 65536
SF 300.8465480 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00





ethyl 6-amino-4-(2-bromophenyl)-5-cyano-2-methyl-4H-pyran-3-carboxylate (Table 3, entry 12):



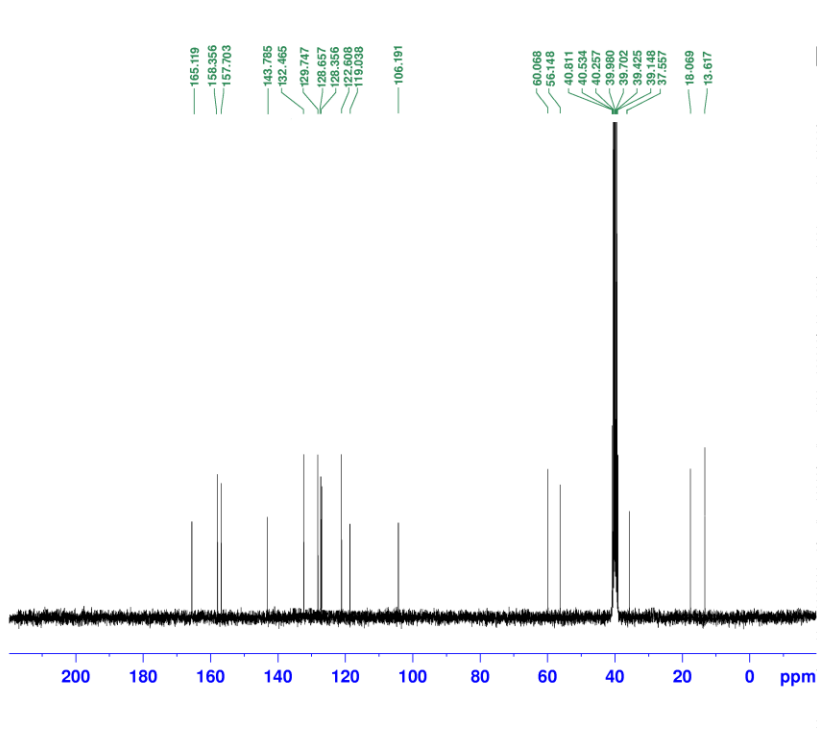


Current Data Parameters
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 EXPNO 1367
 PROCNO 1

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 PULPROG zg30
 TD 65536
 SOLVENT DMSO
 NS 64
 DS 2
 SWH 6024.096 Hz
 FIDRES 0.091920 Hz
 AQ 5.4394879 sec
 RG 158.22
 DW 83.000 usec
 DE 6.50 usec
 TE 0 K
 D1 1.0000000 sec
 TD0 1

==== CHANNEL f1 =====
 SFO1 300.8484063 MHz
 NUC1 1H
 P1 15.00 usec
 PLW1 6.40000010 W

F2 - Processing parameters
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 SF 300.8465480 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00



Current Data Parameters
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 EXPNO 1826
 PROCNO 1

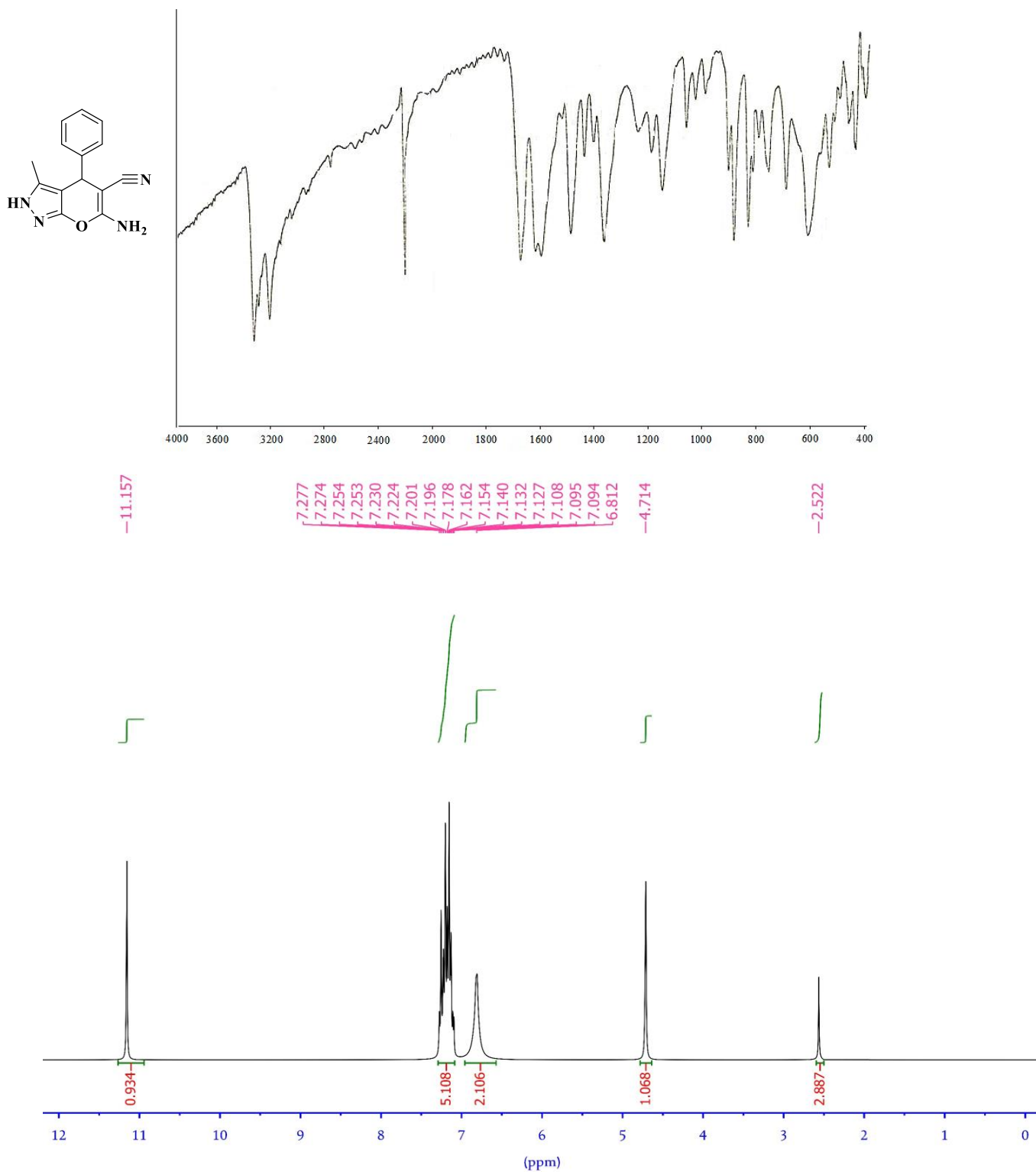
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 PULPROG zgpg30
 TD 65536
 SOLVENT DMSO
 NS 512
 DS 4
 SWH 18115.941 Hz
 FIDRES 0.276427 Hz
 AQ 1.8087935 sec
 RG 202
 DW 27.600 usec
 DE 6.50 usec
 TE 0 K
 D1 2.0000000 sec
 D11 0.0300000 sec
 TD0 1

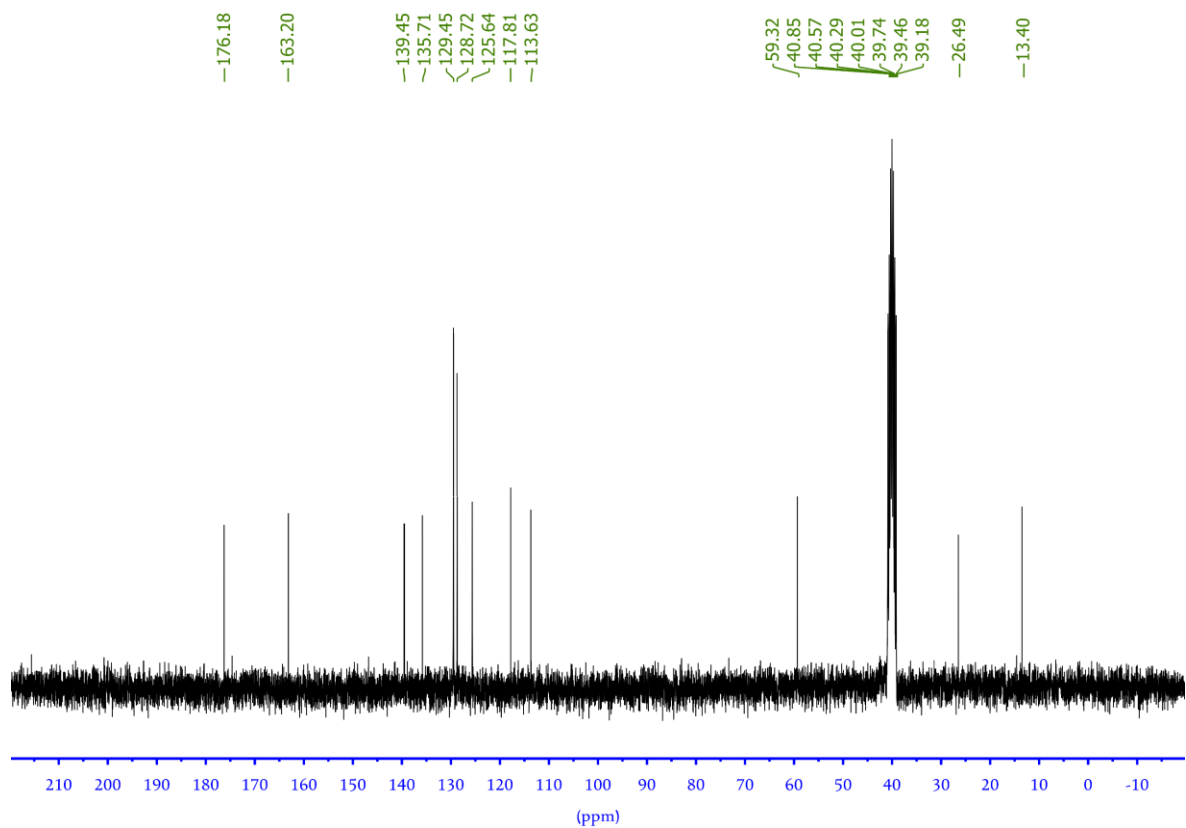
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 NUC1 13C
 P1 10.00 usec
 PLW1 30.00000000 W

==== CHANNEL f2 =====
 SFO2 300.8477518 MHz
 NUC2 1H
 CPDPRG2 waltz16
 PCPD2 90.00 usec
 PLW2 6.40000010 W
 PLW12 0.17778000 W
 PLW13 0.14399999 W

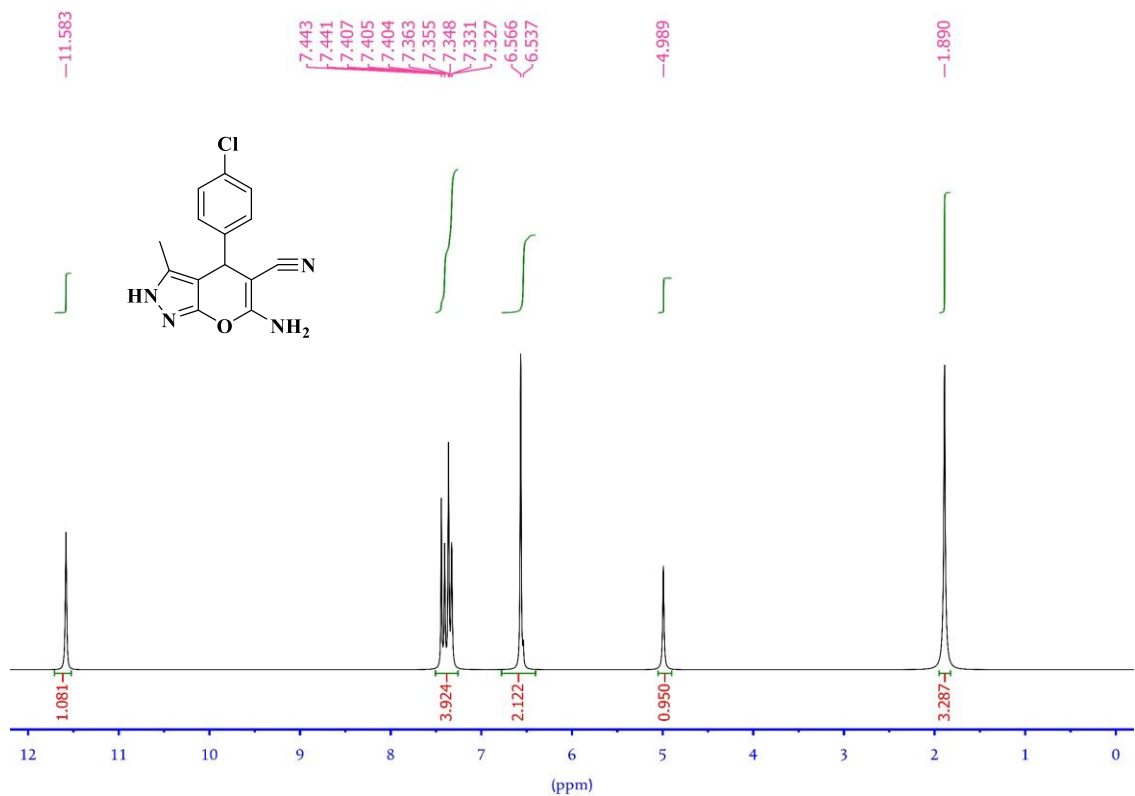
F2 - Processing parameters
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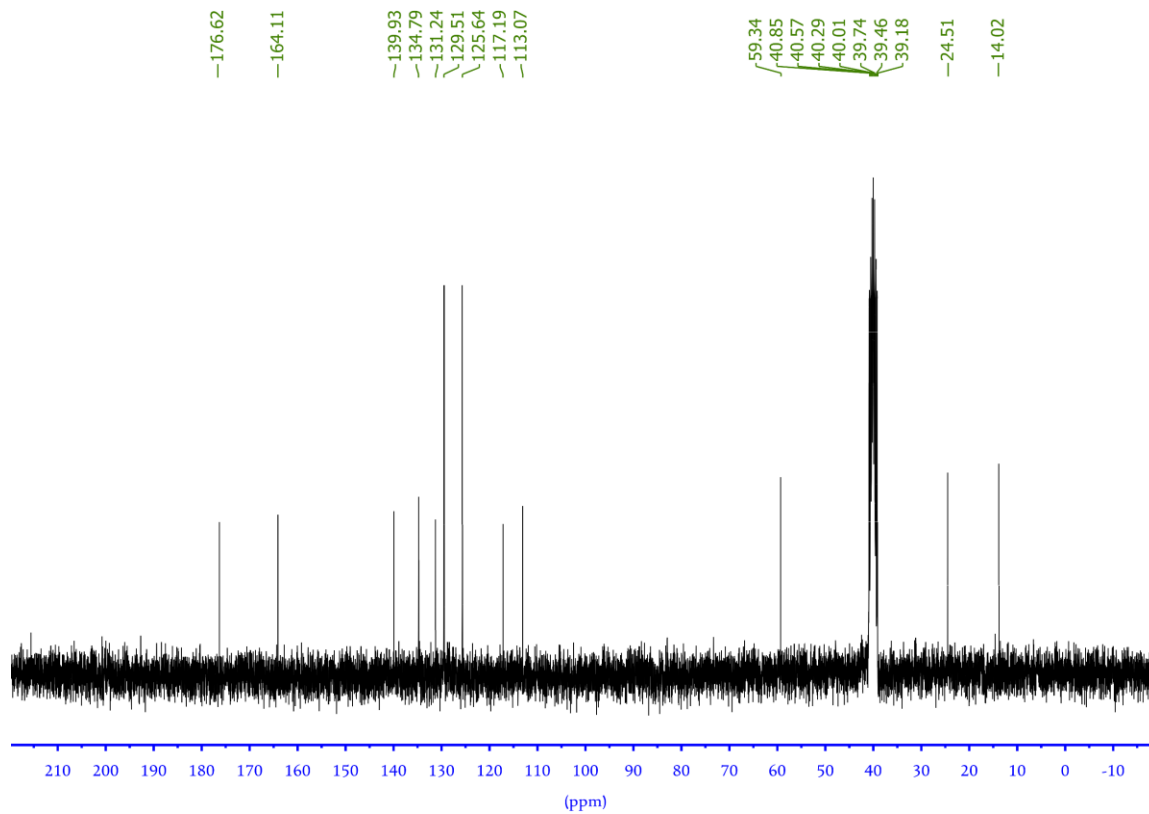
amino-3-methyl-4-phenyl-2,4-dihydropyrano[2,3-c] pyrazole-5-carbonitrile (Table 3, entry 13):



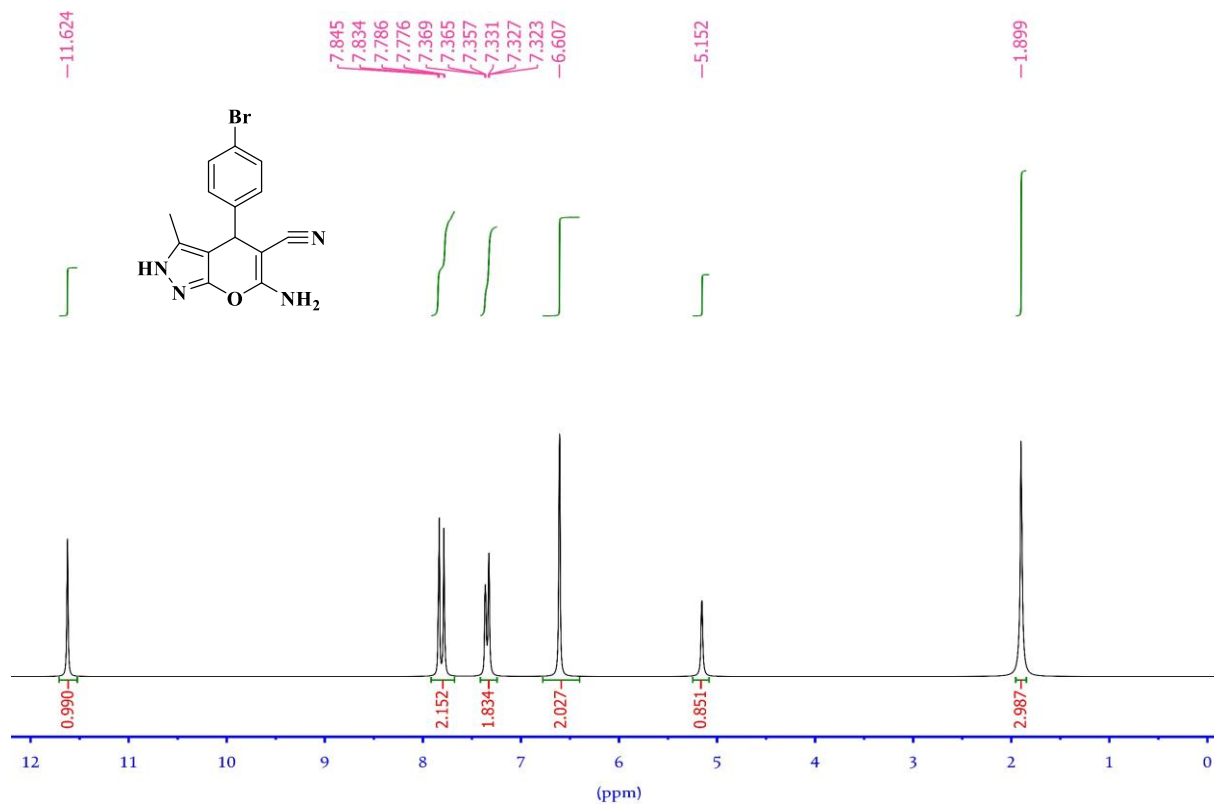


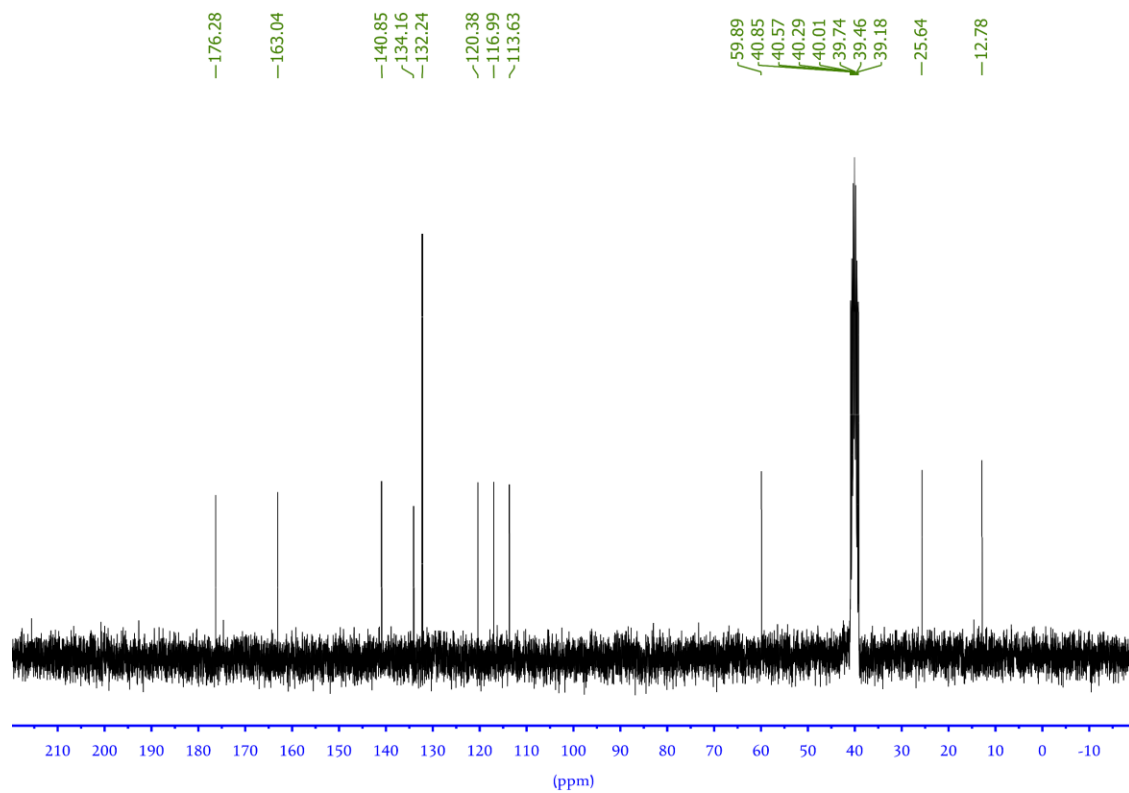
6-amino-4-(4-chlorophenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 14):



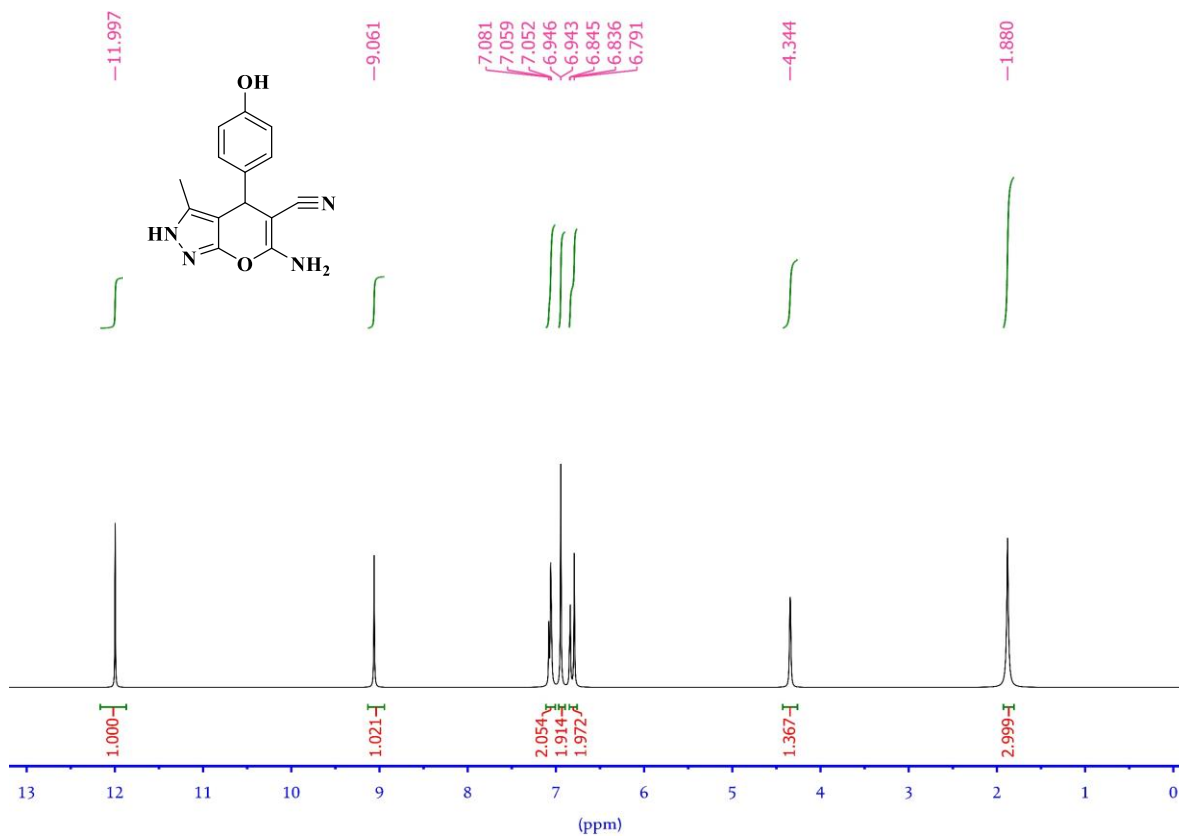


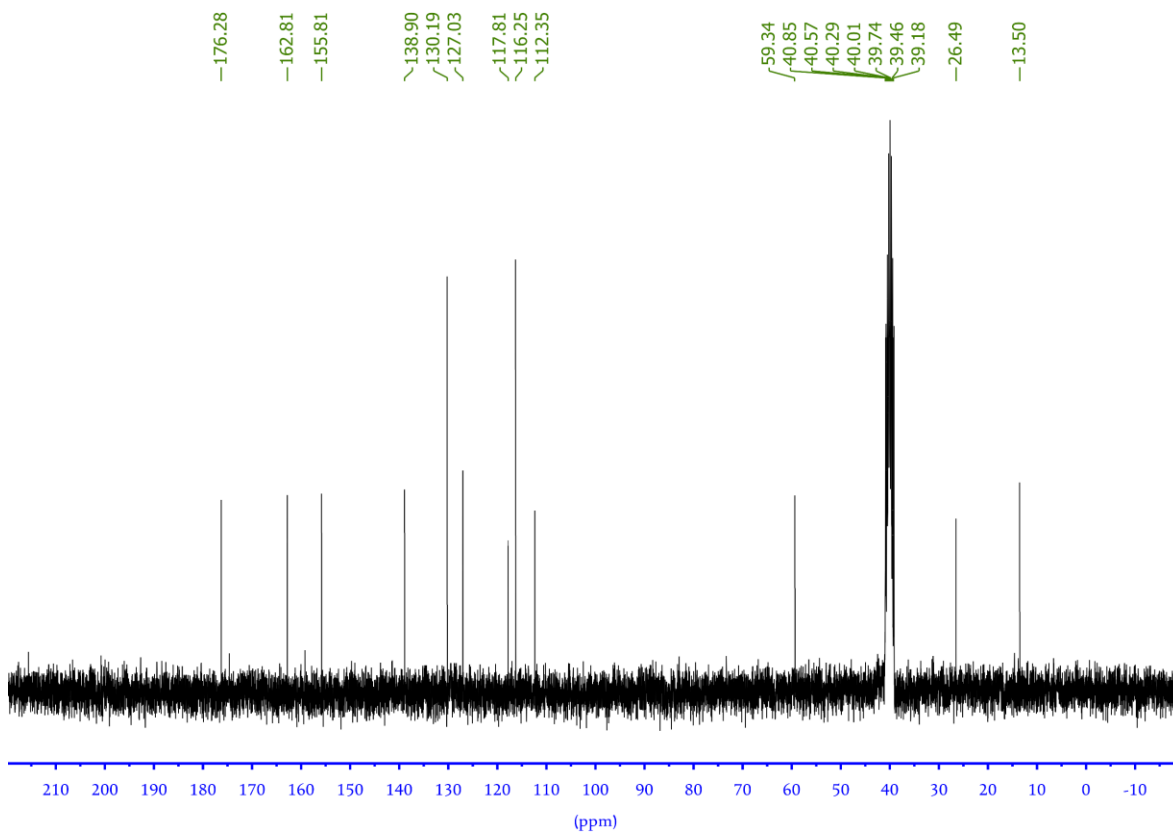
6-amino-4-(4-bromophenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 15):



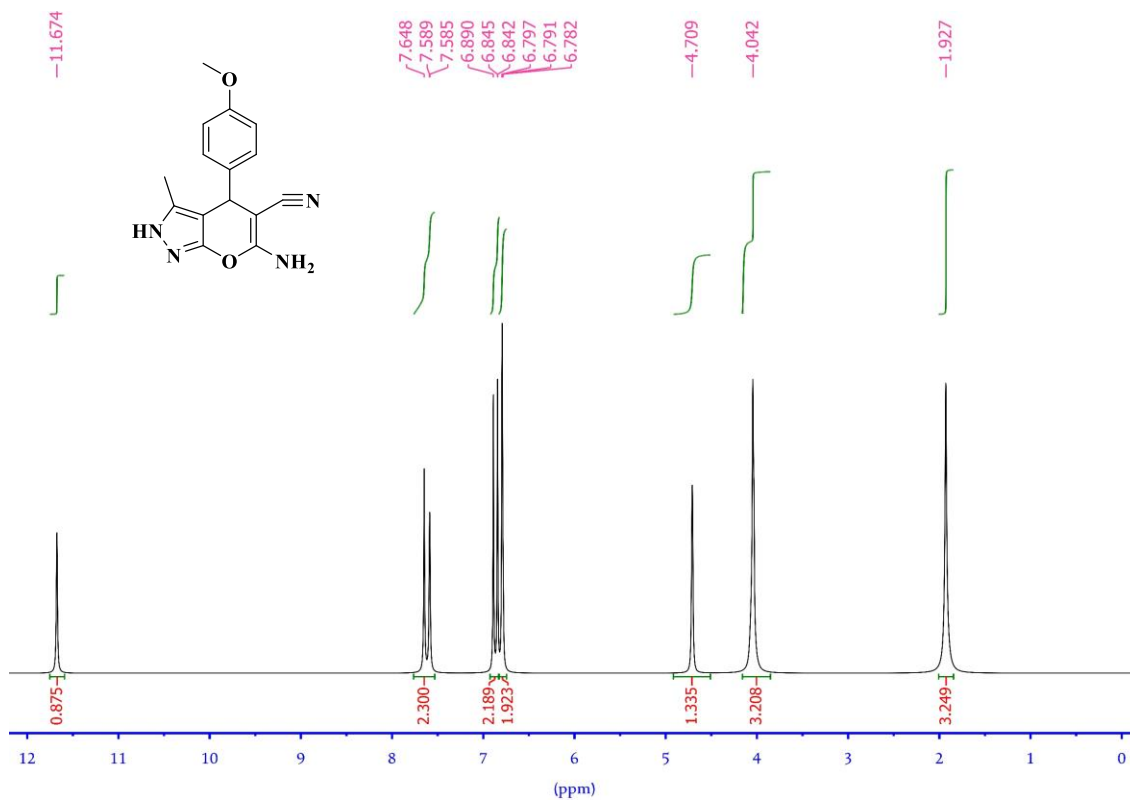


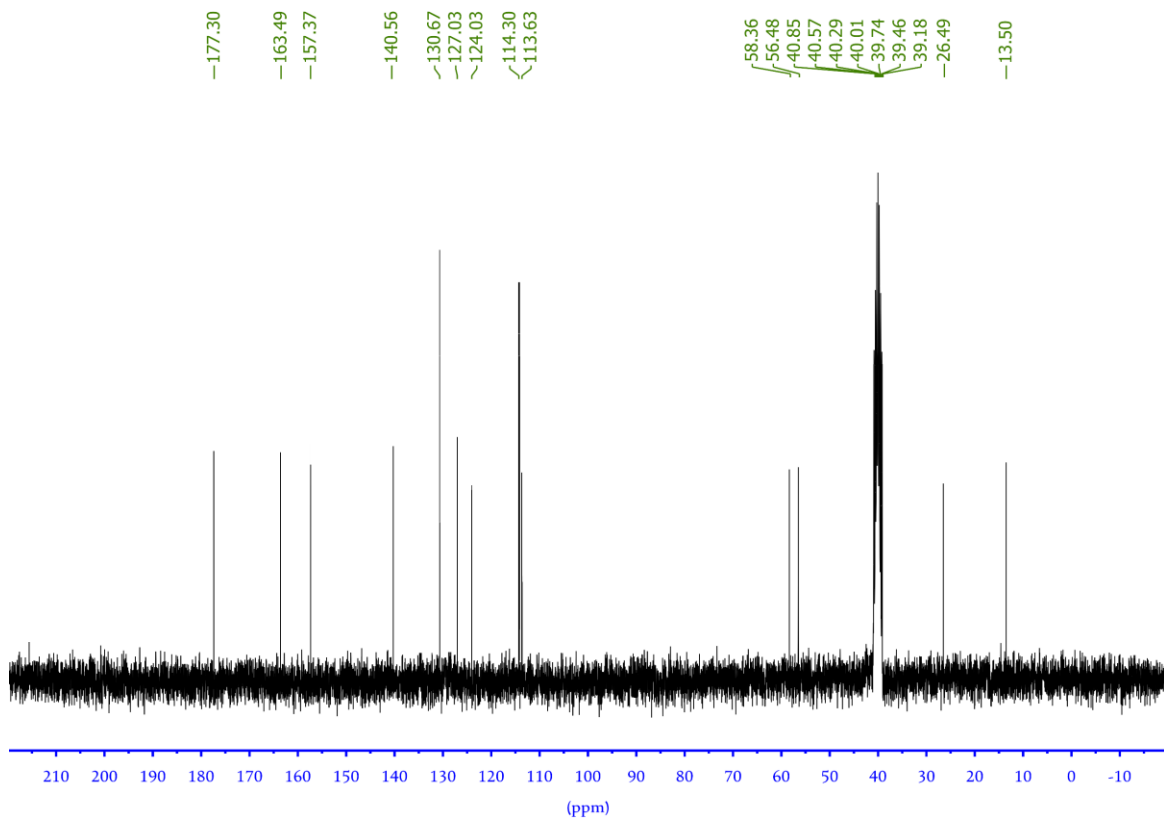
6-amino-4-(4-hydroxyphenyl)-3-methyl-2,4-dihydroprano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 16):



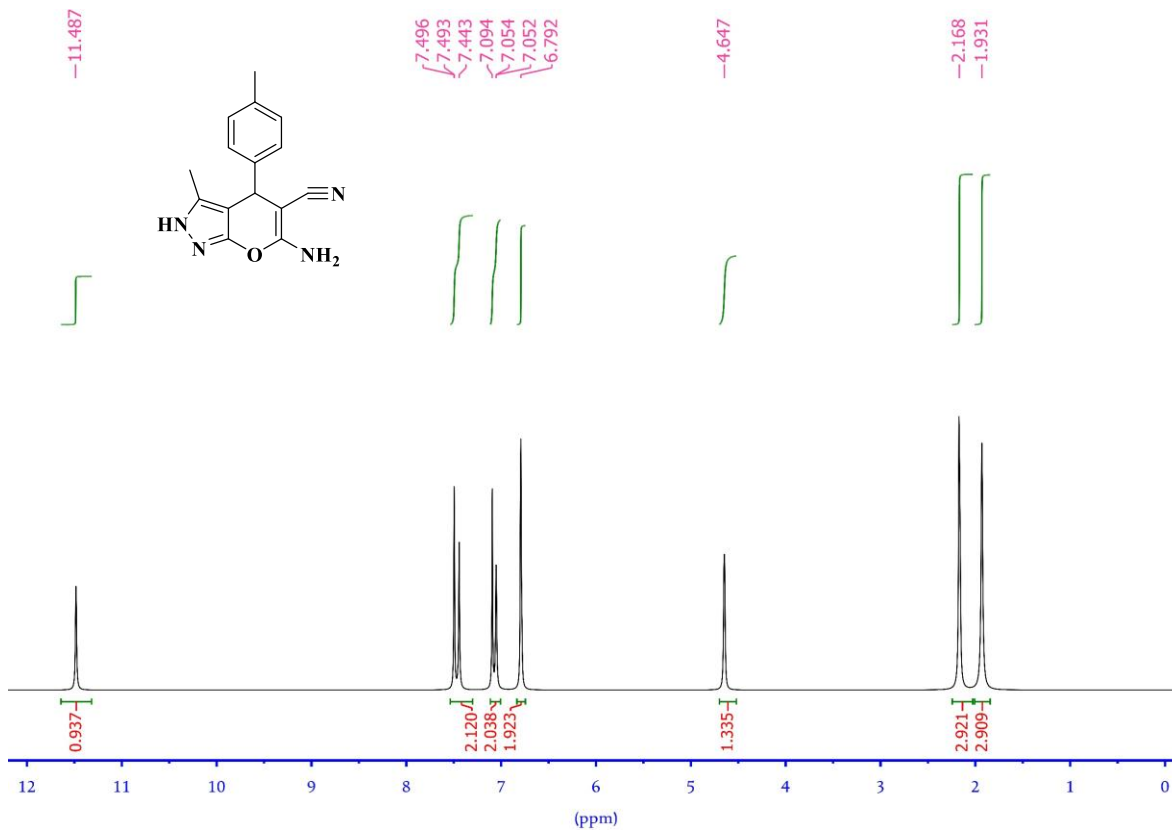


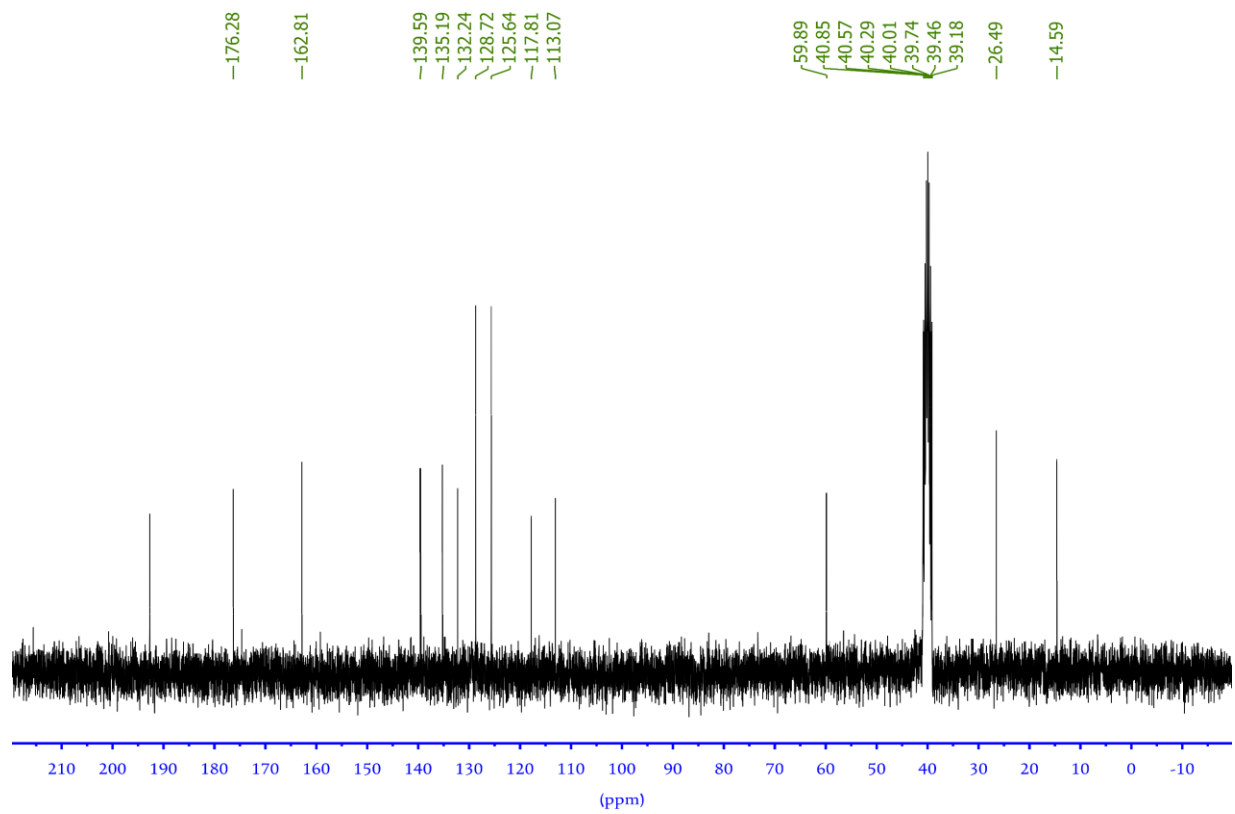
6-amino-4-(4-methoxyphenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 17):



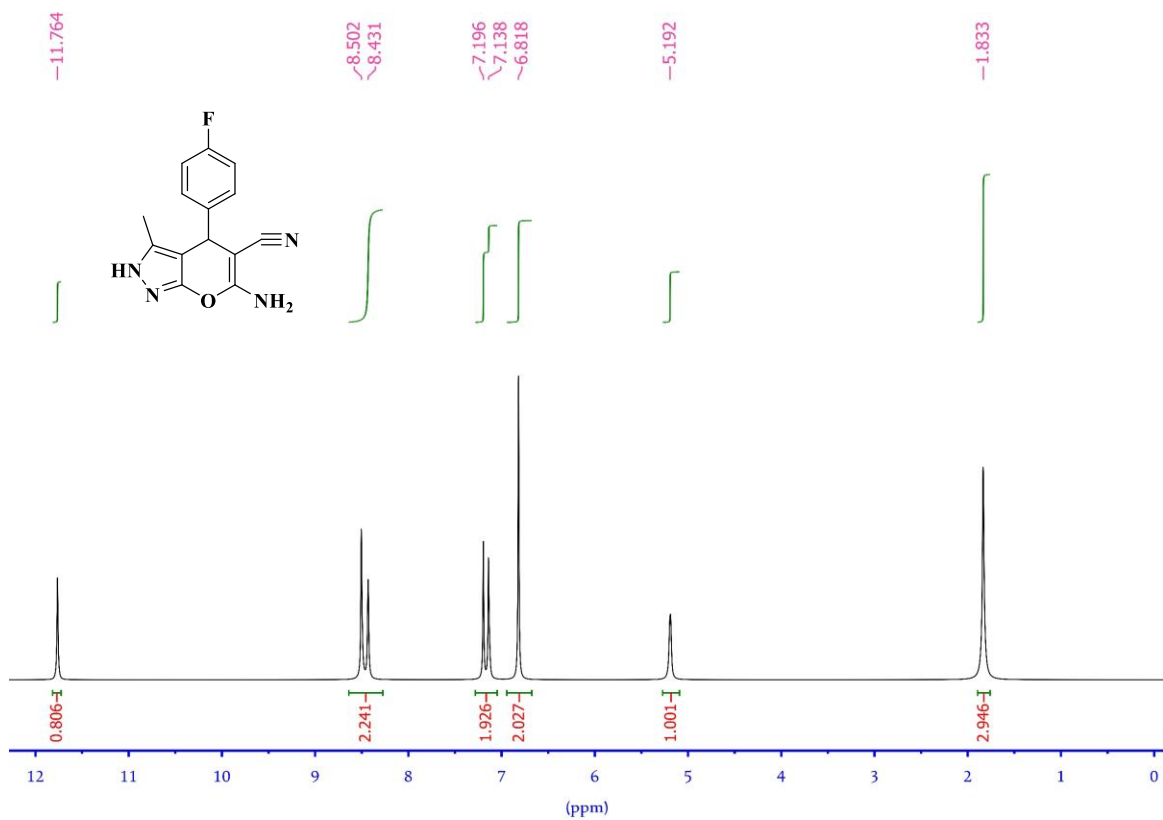


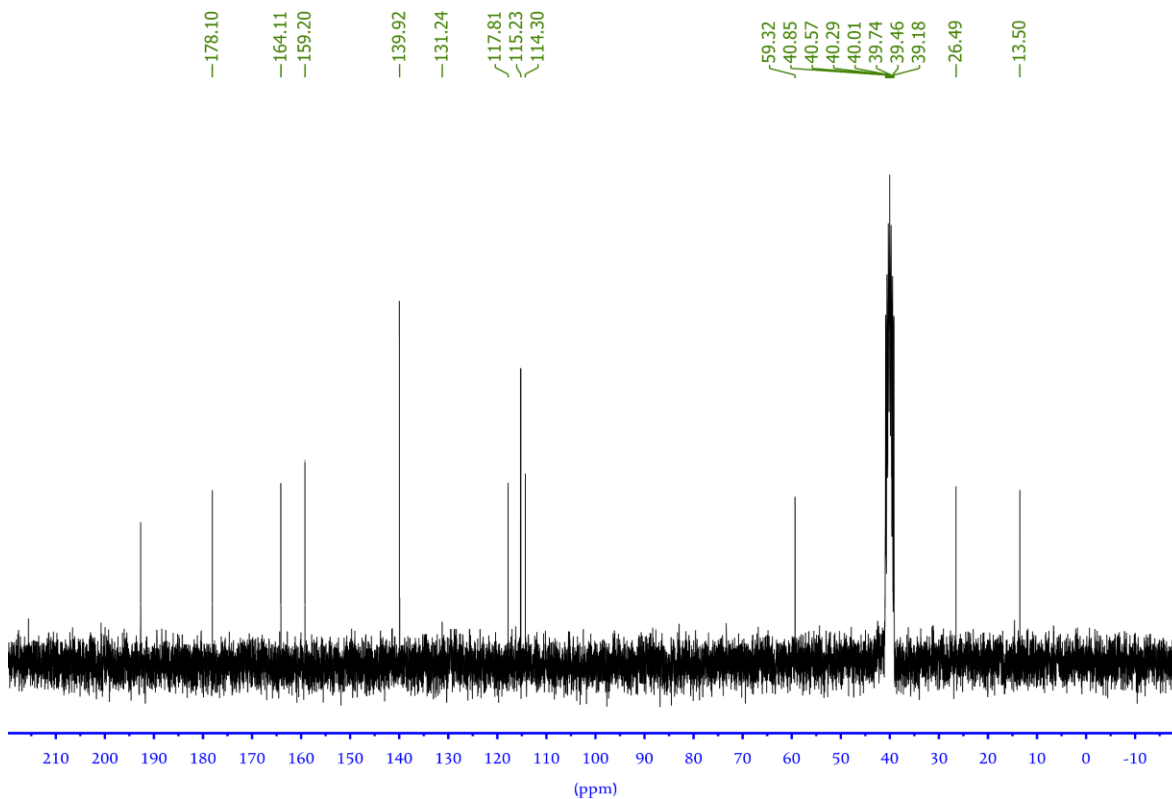
6-amino-3-methyl-4-(p-tolyl)-2,4-dihydropyran[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 18):



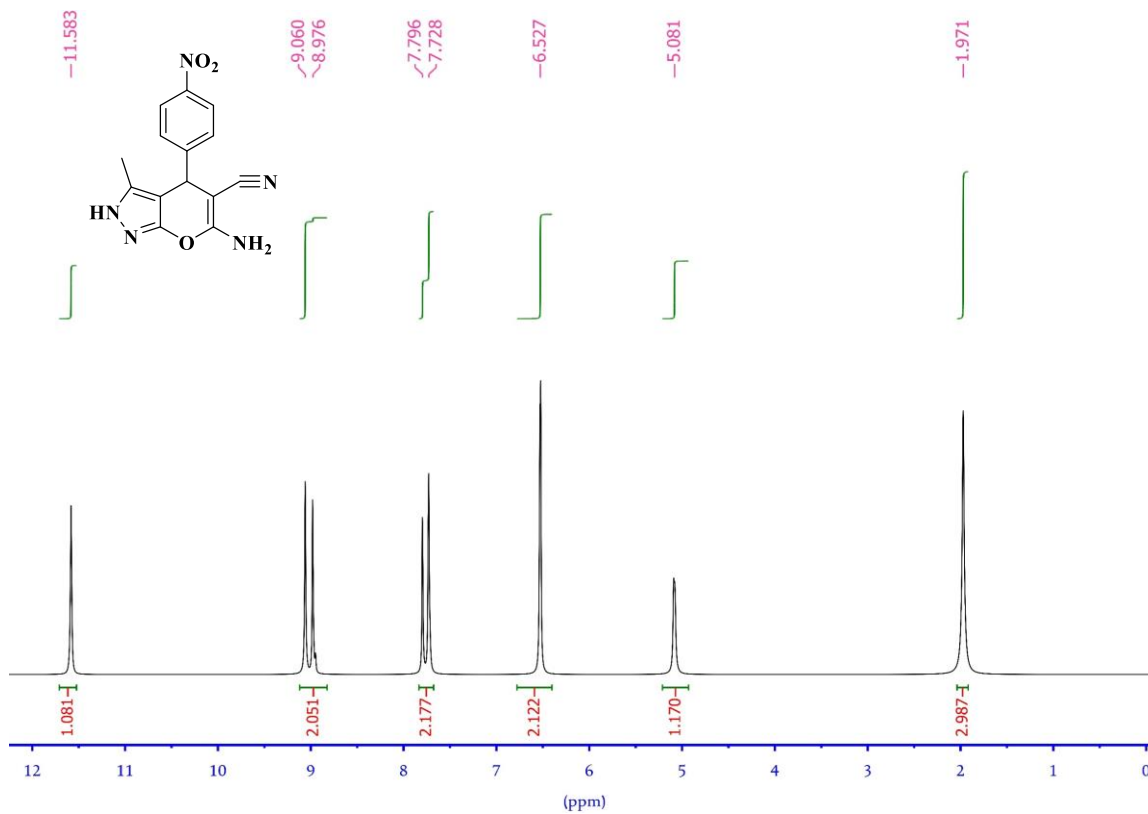


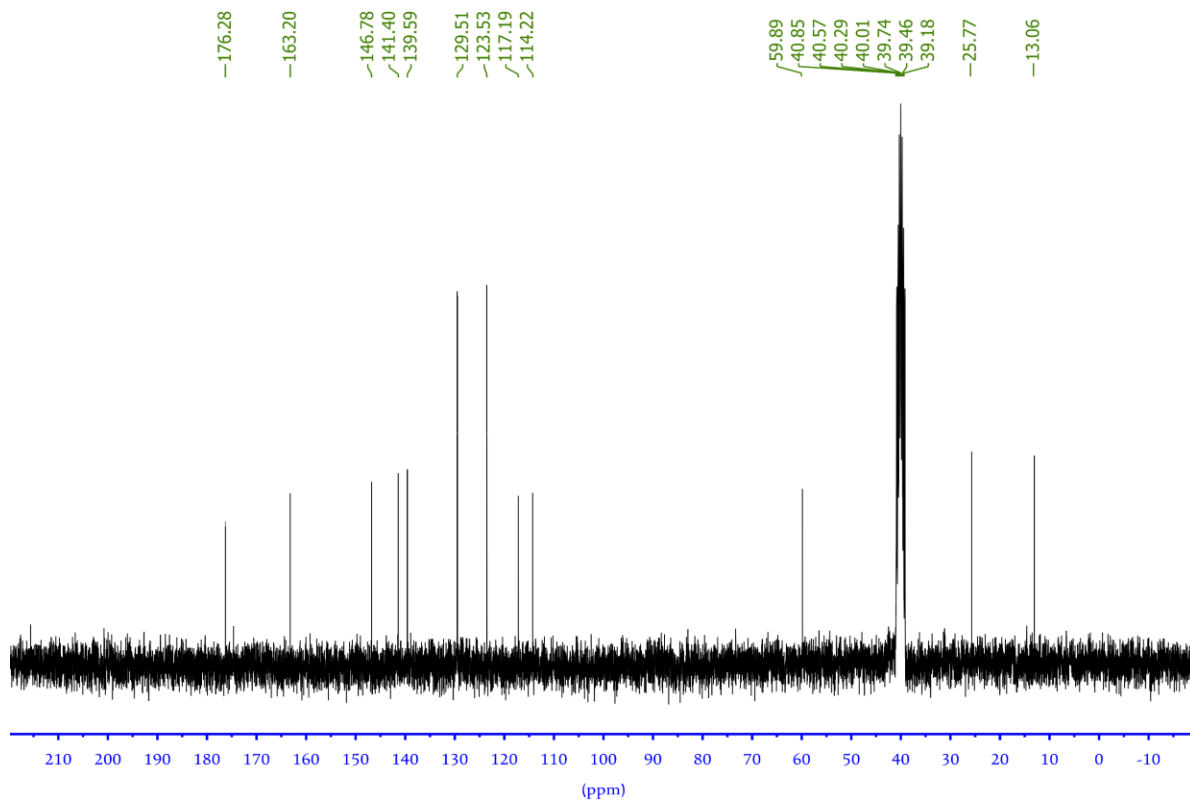
6-amino-4-(4-fluorophenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 19):



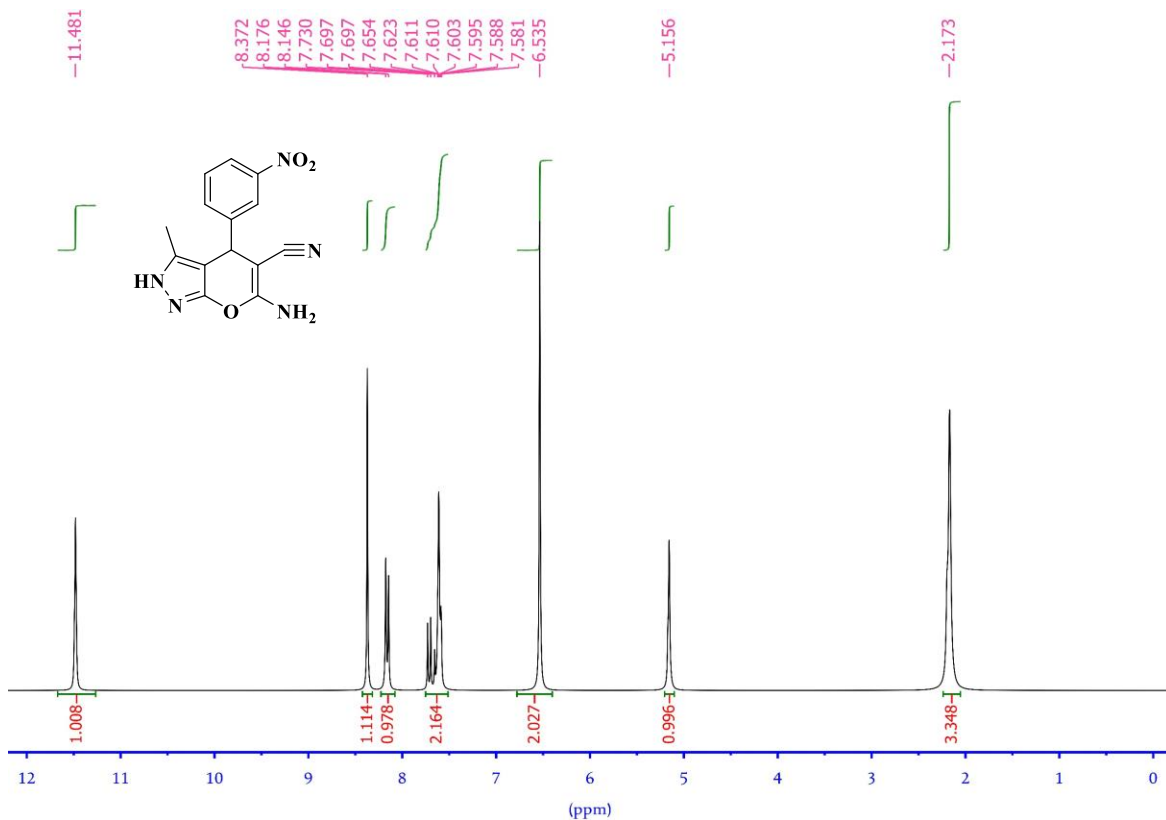


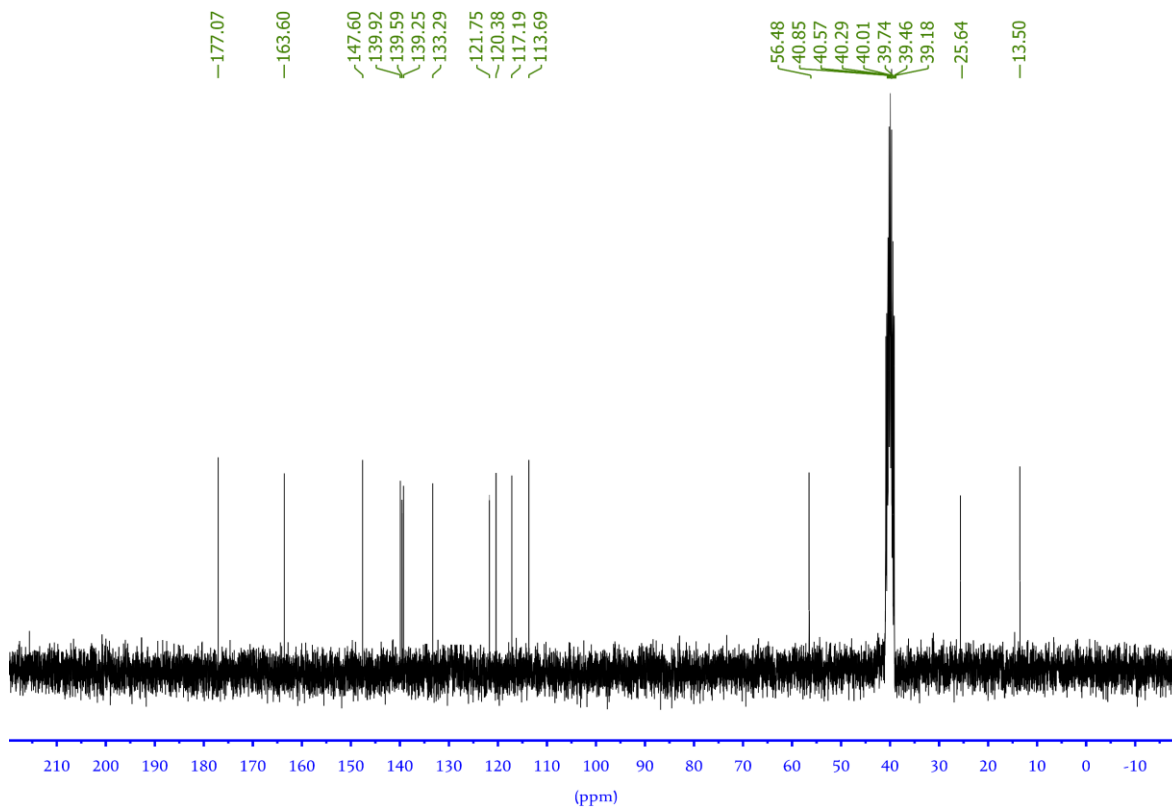
6-amino-3-methyl-4-(4-nitrophenyl)-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 20):



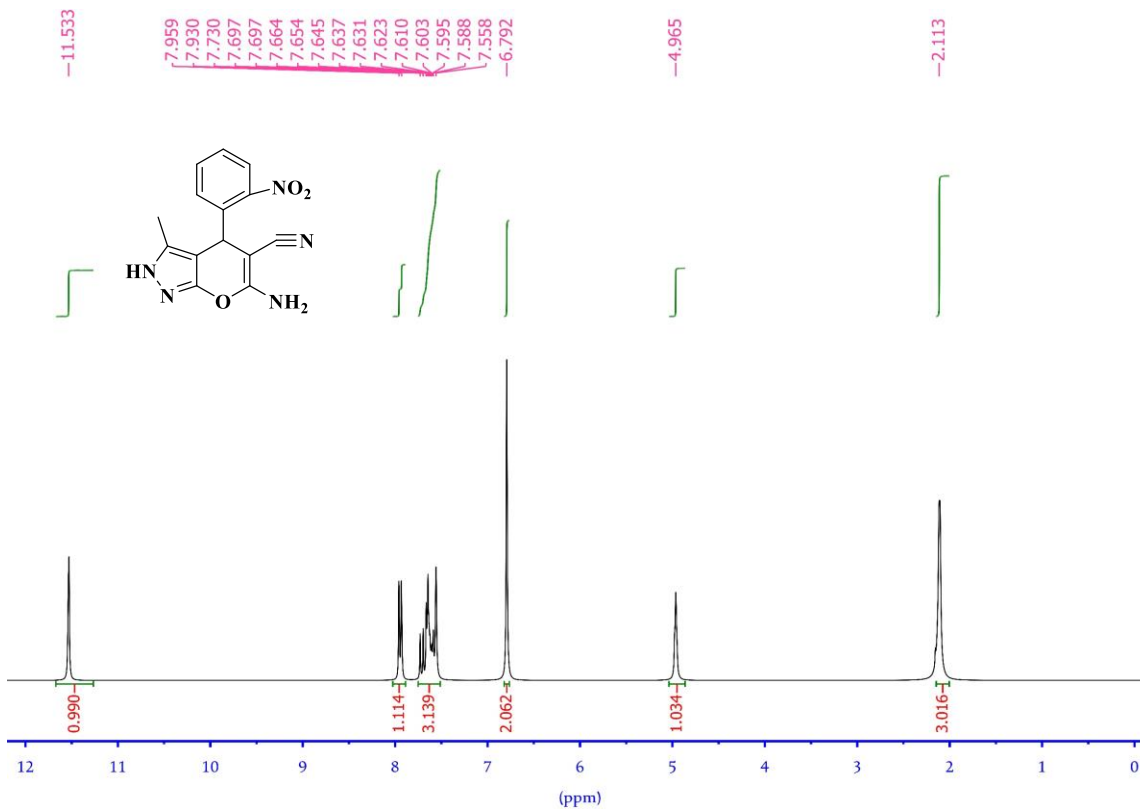


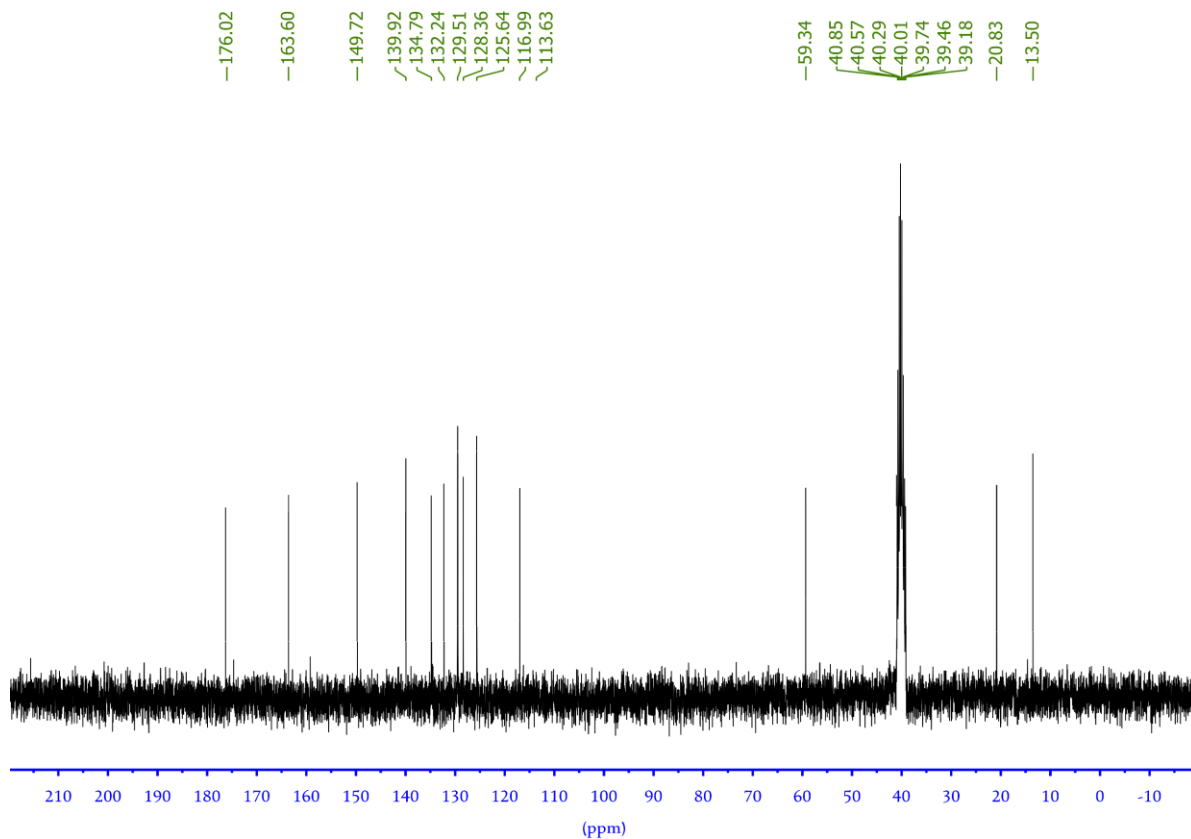
6-amino-3-methyl-4-(3-nitrophenyl)-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 21):



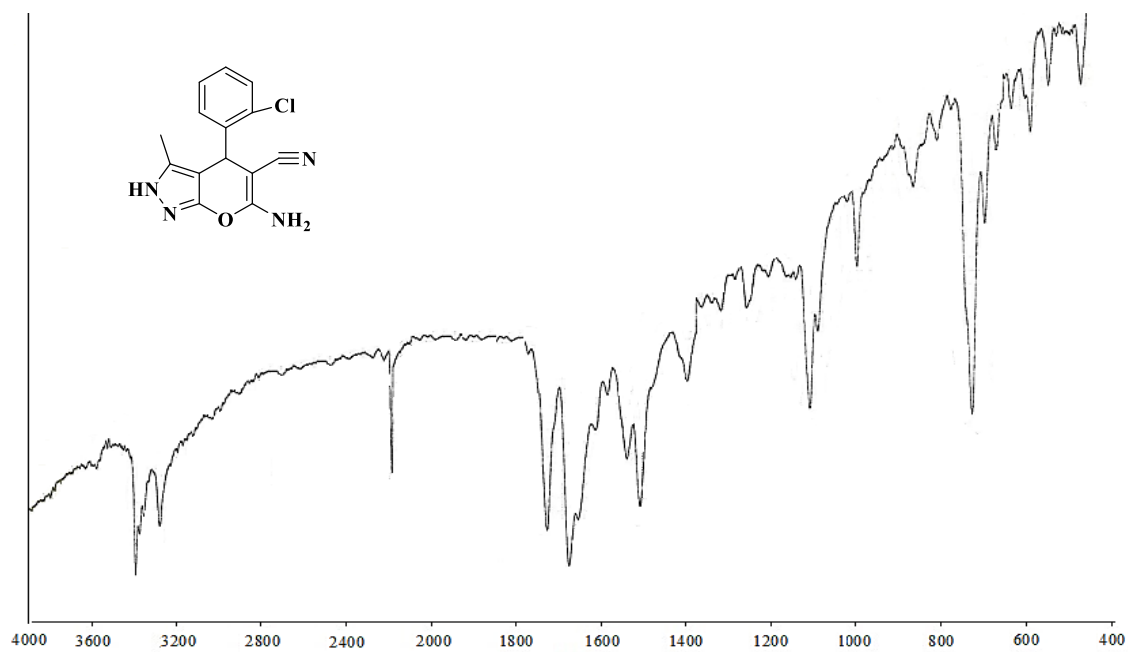


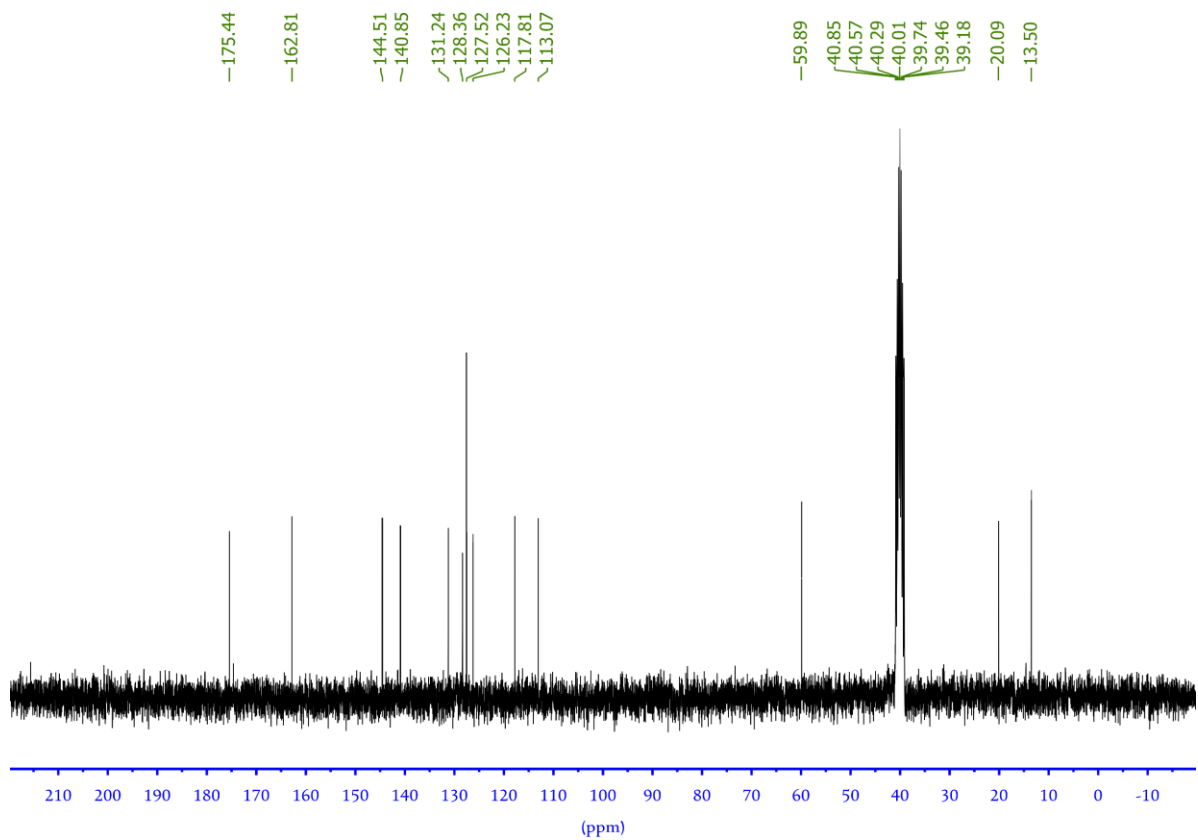
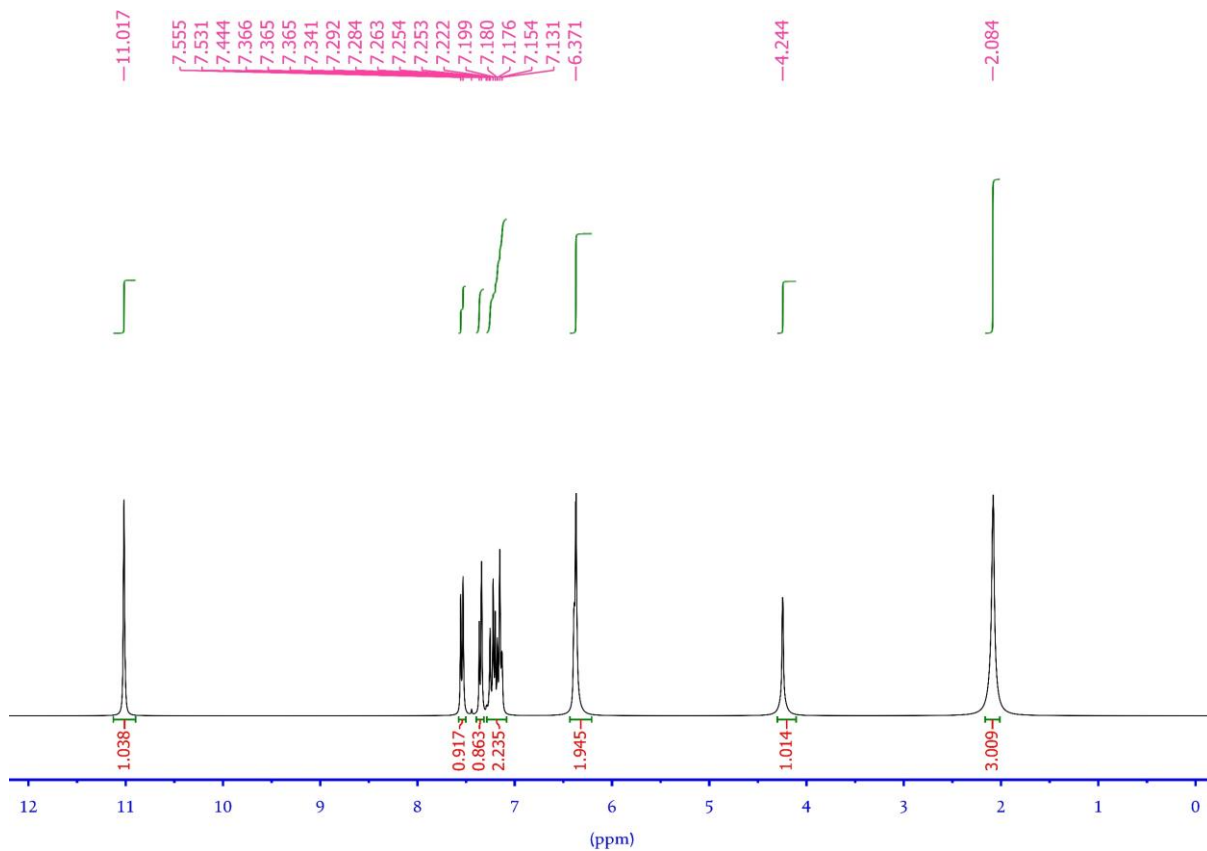
6-amino-3-methyl-4-(2-nitrophenyl)-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 22):





6-amino-4-(2-chlorophenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 23):





6-amino-4-(2-bromophenyl)-3-methyl-2,4-dihydropyrano[2,3-c]pyrazole-5-carbonitrile (Table 3, entry 24):

