

Supporting Information

Design of Schiff base complex of copper coated on epoxy modified core-shell MNPs as an environmentally friendly and novel catalyst for the one-pot synthesis of various chromene-annulated heterocycles

Sobhan Rezayati^a, Ali Ramazani^{a,b*}, Sami Sajjadifar^c, Hamideh Aghahosseini^a, Aram Rezaei^d

^a*Department of Chemistry, Faculty of Science, University of Zanjan, Zanjan 45371-38791, Iran*

^b*Department of Biotechnology, Research Institute of Modern Biological Techniques (RIMBT), University of Zanjan, Zanjan 45371-38791, Iran*

^c*Department of Chemistry, Payame Noor University, PO BOX 19395-4697, Iran, Tehran*

^d*Nano Drug Delivery Research Center, Health Technology Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran*

Corresponding author :aliramazani@znu.ac.ir; aliramazani@gmail.com

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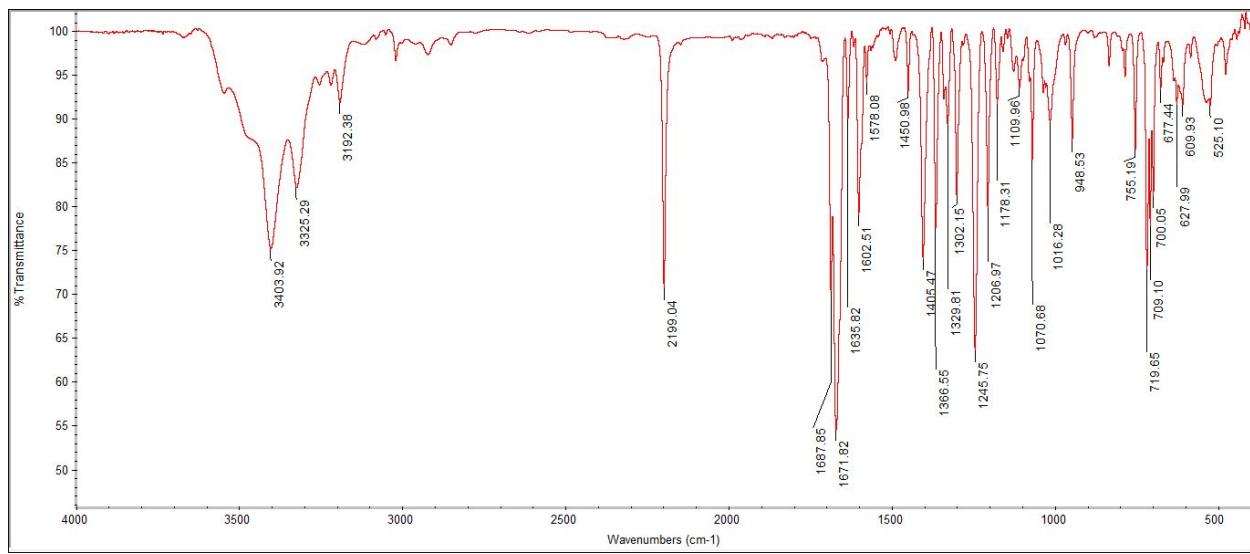


Figure S1. FT-IR spectrum of 2-amino-4-(phenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

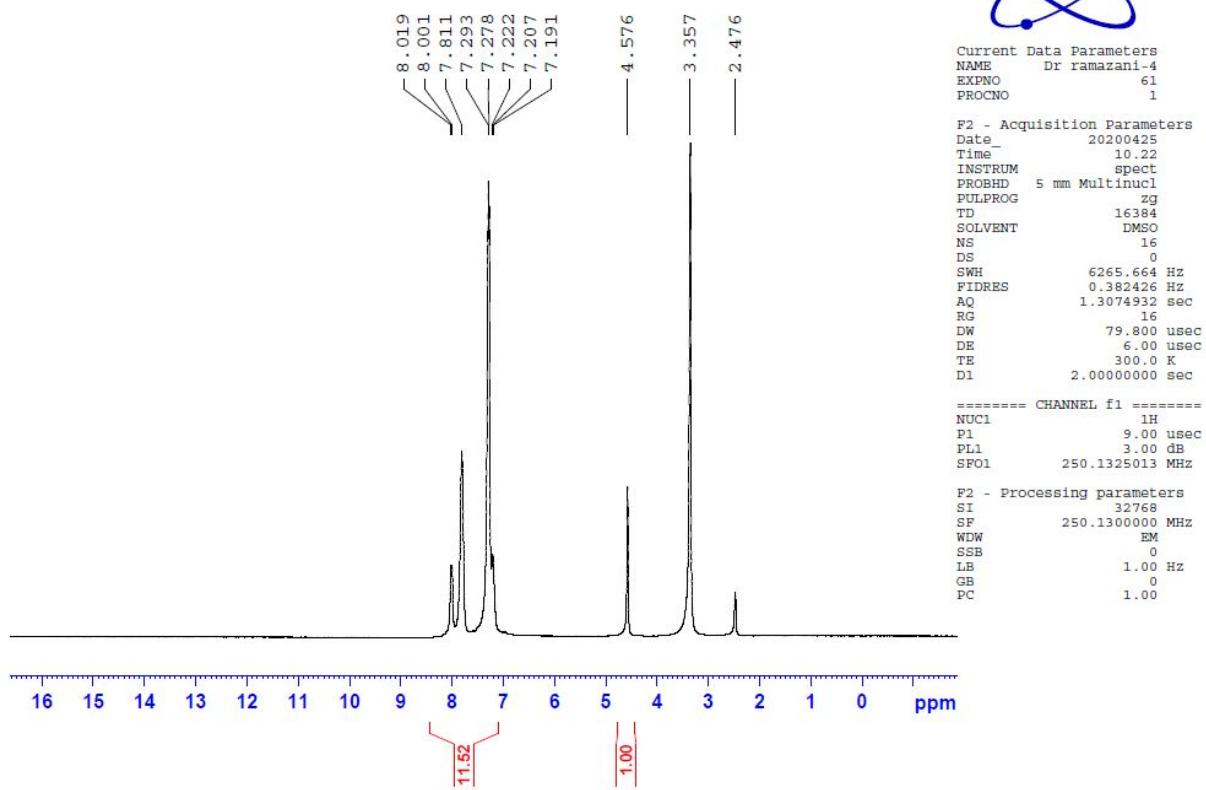


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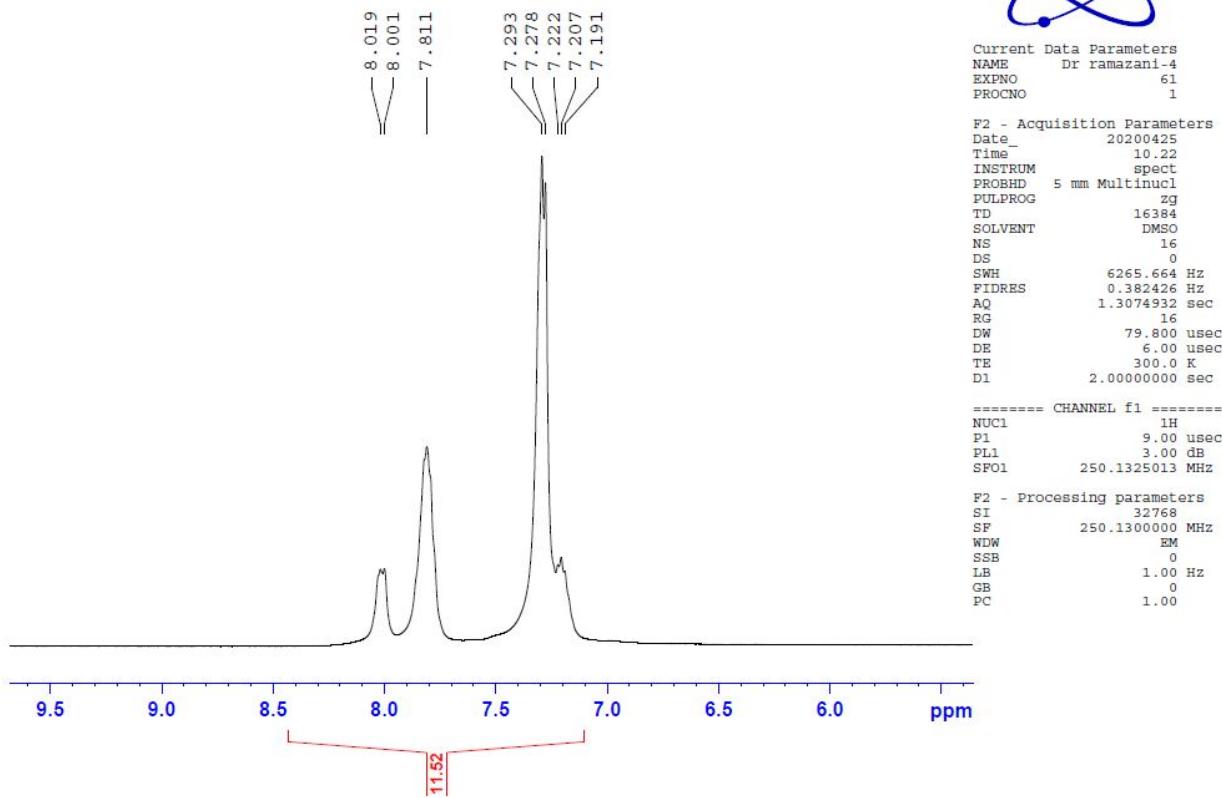


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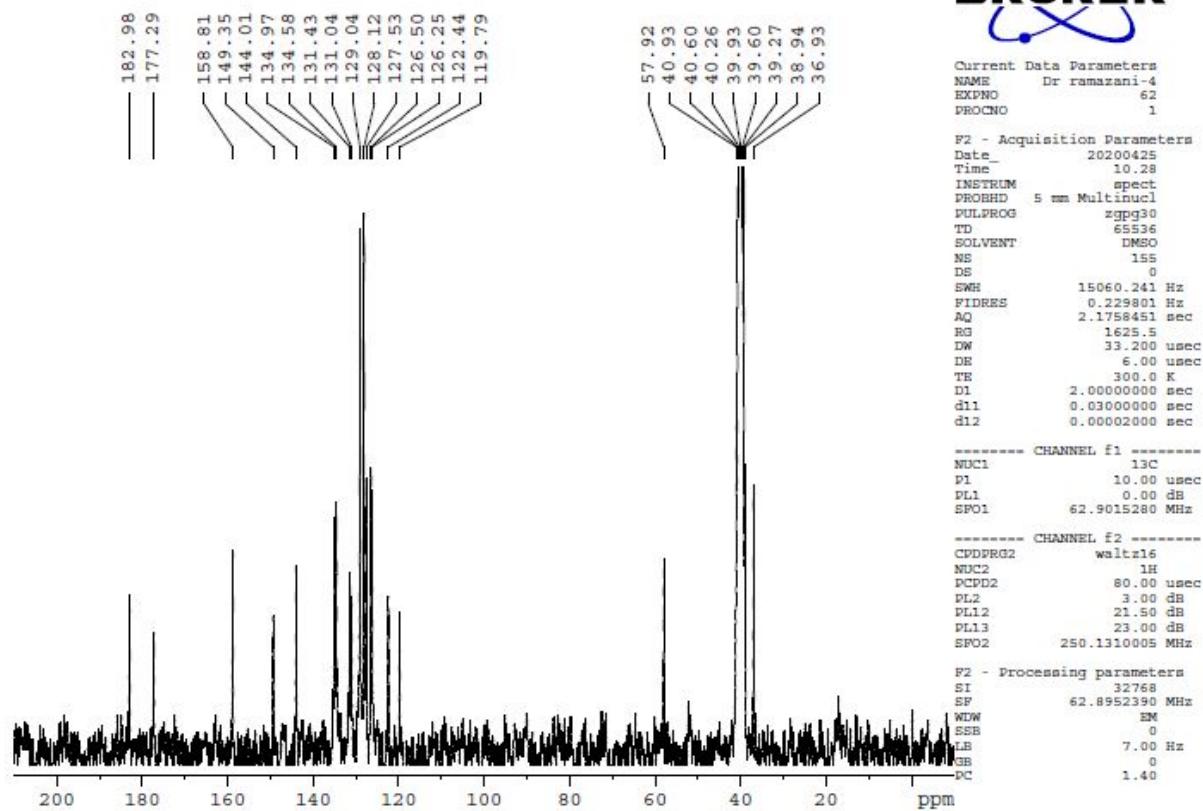


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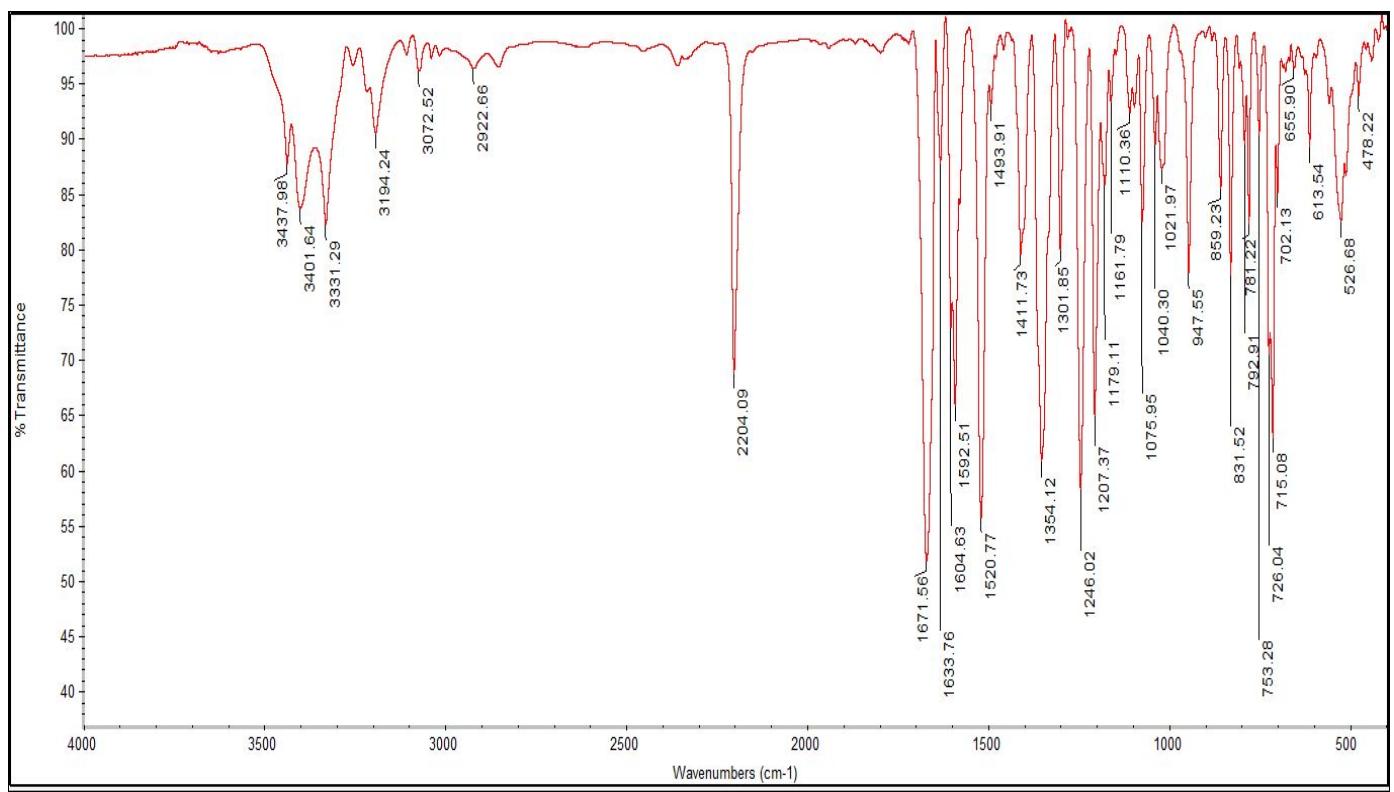


Figure S5. FT-IR spectrum of 2-amino-4-(4-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

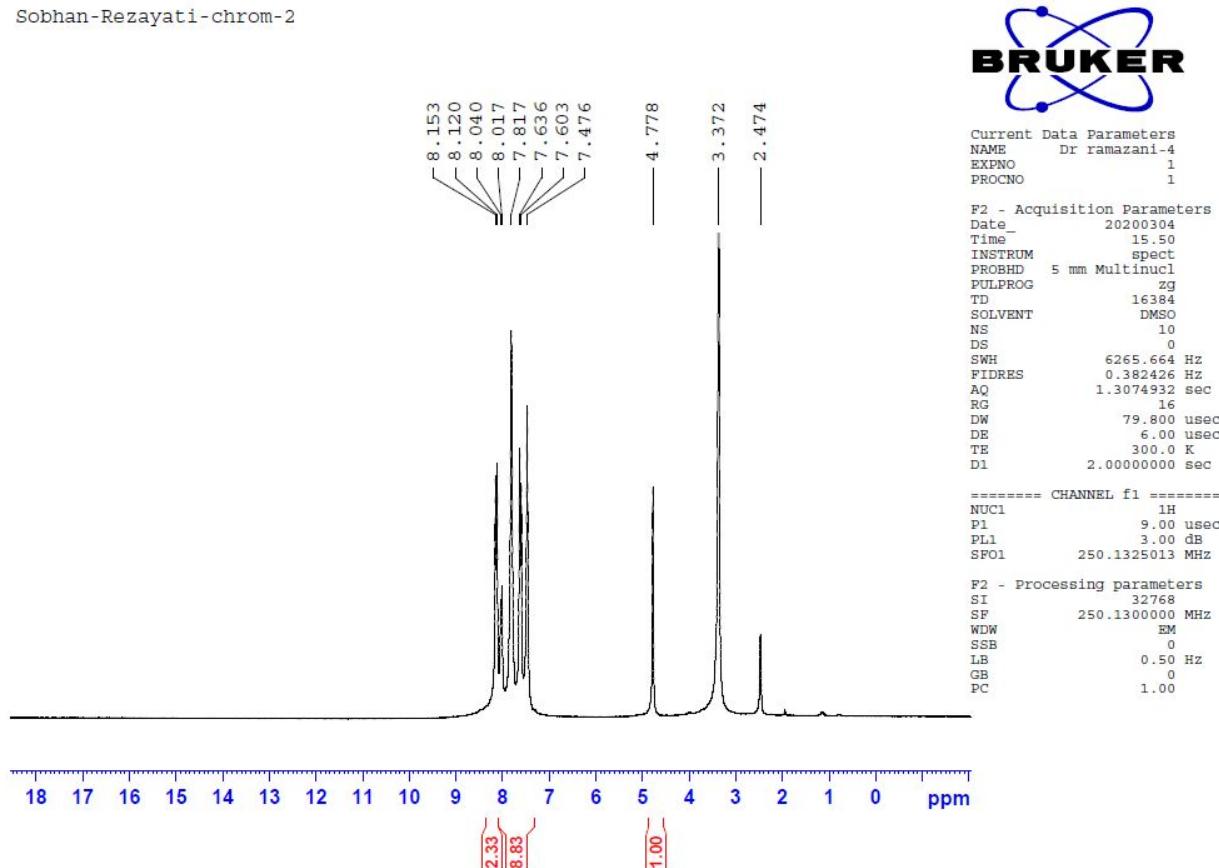


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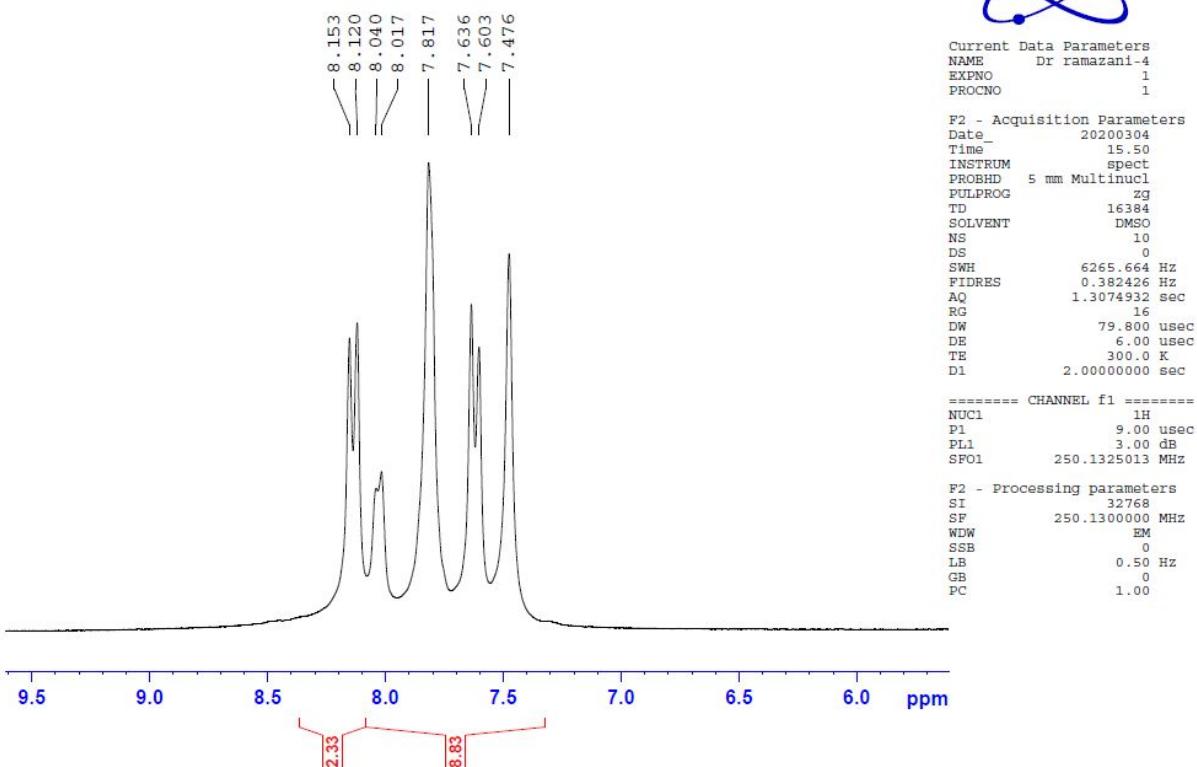


Figure S7. The expanded ^1H NMR spectrum of 2-amino-4-(4-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

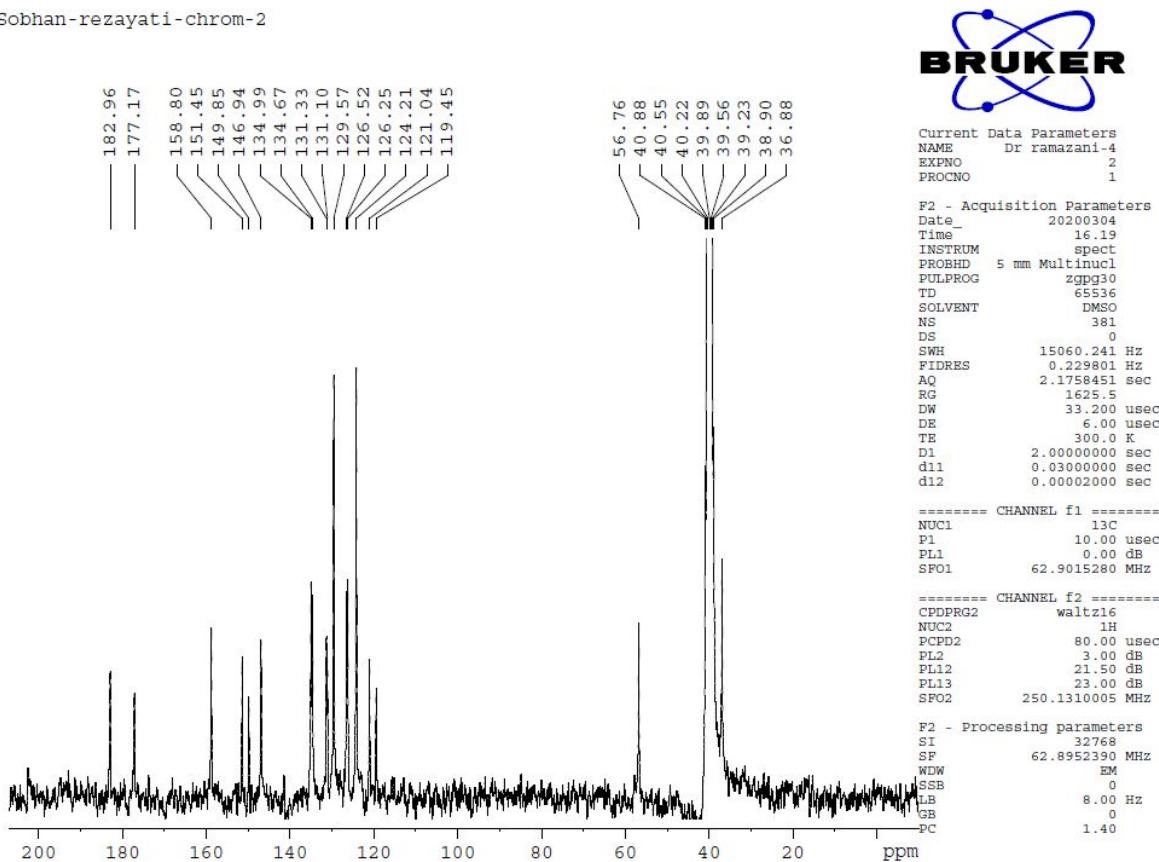


Figure S8. ^{13}C NMR spectrum of 2-amino-4-(4-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

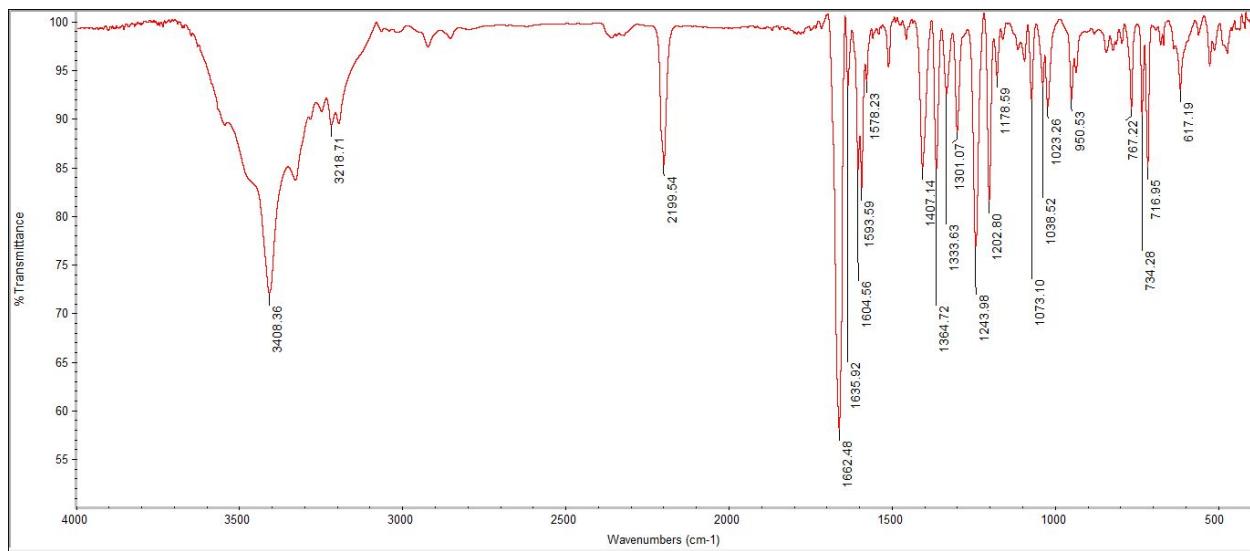


Figure S9. FT-IR spectrum of 2-amino-4-(4-methylphenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile



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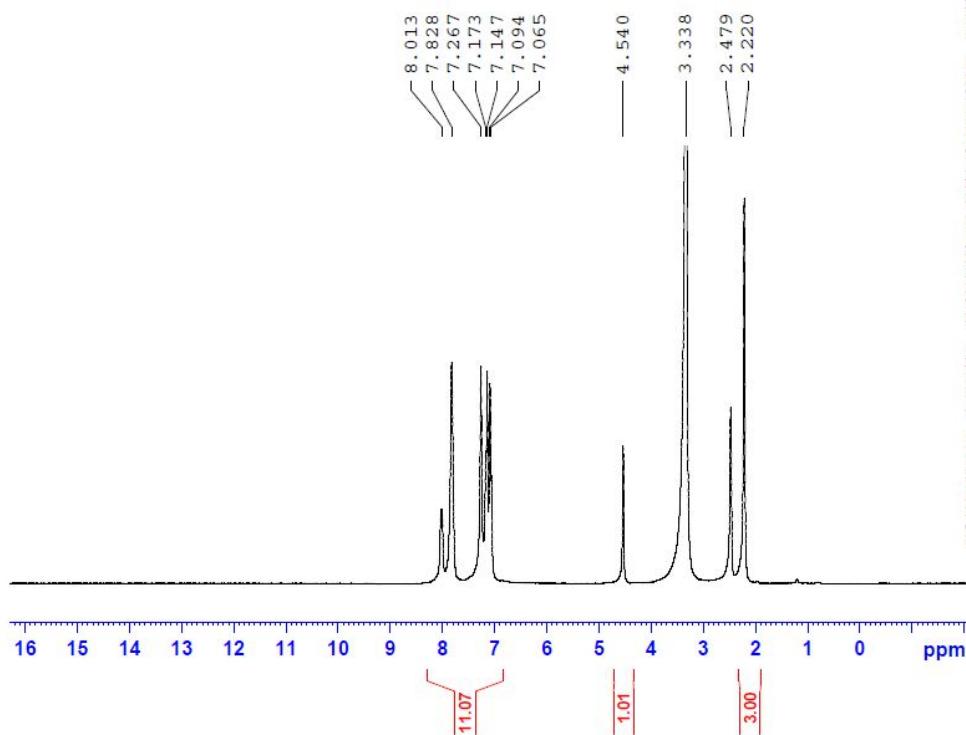


Figure S10. ^1H NMR spectrum of 2-amino-4-(4-methylphenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile



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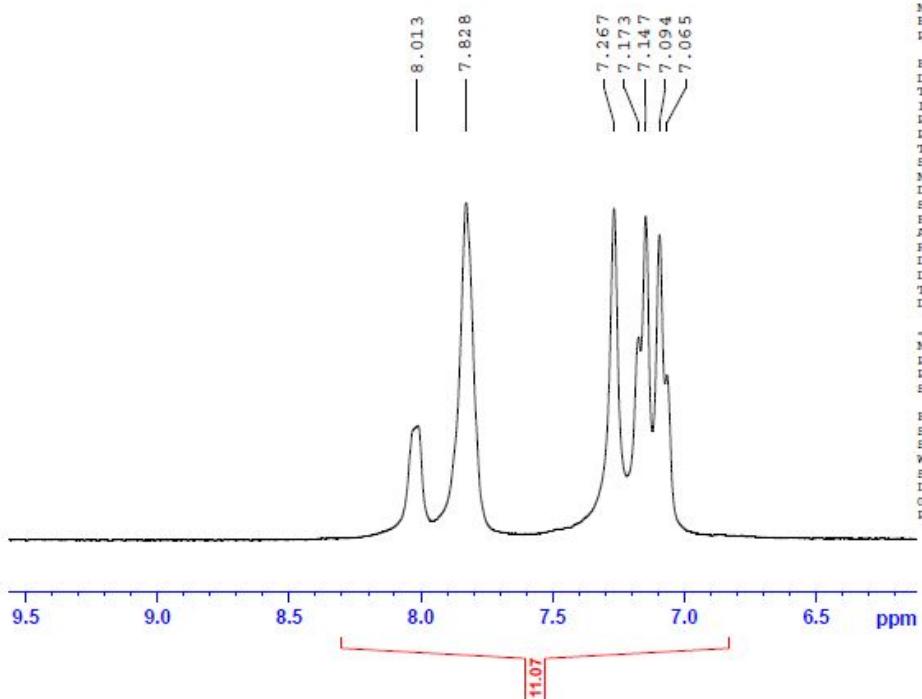


Figure S11. The expanded ^1H NMR spectrum of 2-amino-4-(4-methylphenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

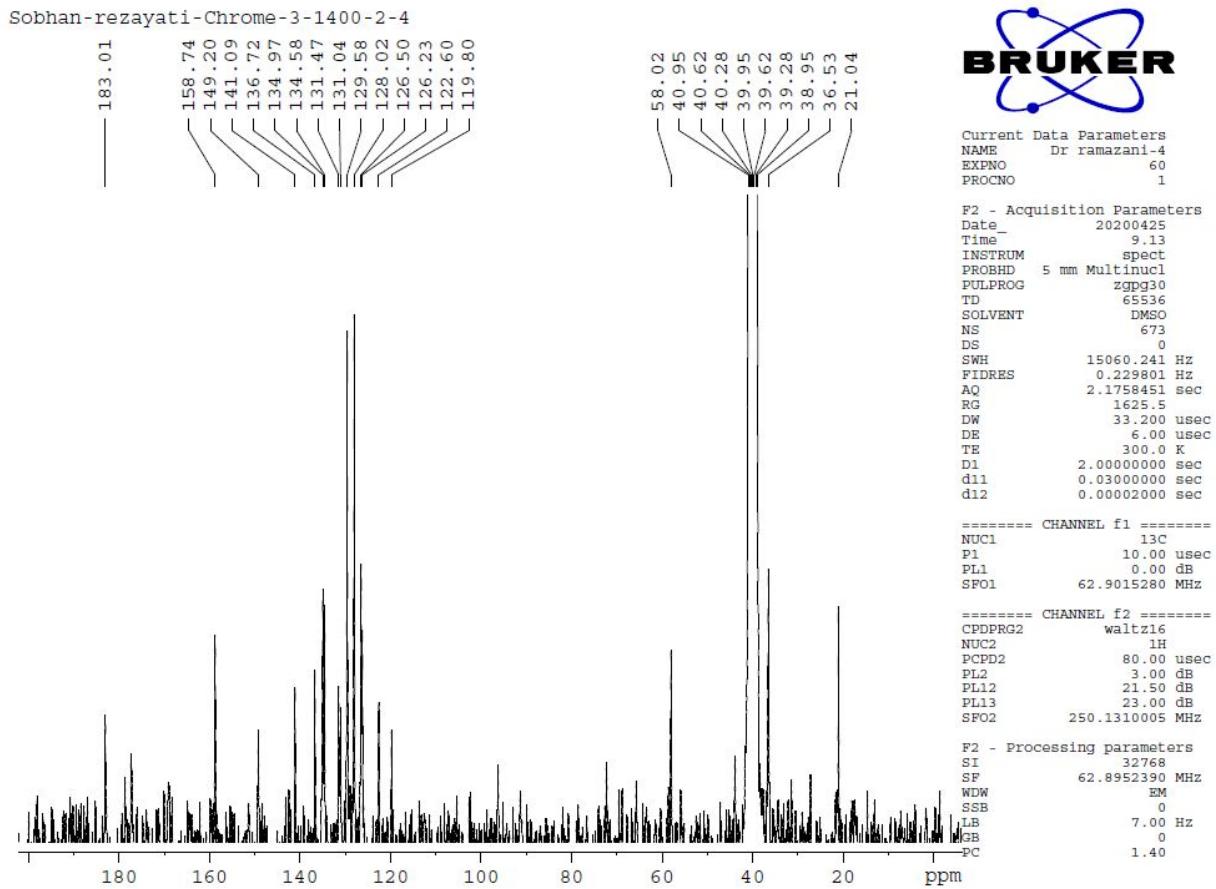


Figure S12. ^{13}C NMR spectrum of 2-amino-4-(4-methylphenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[g]chromene-3-carbonitrile

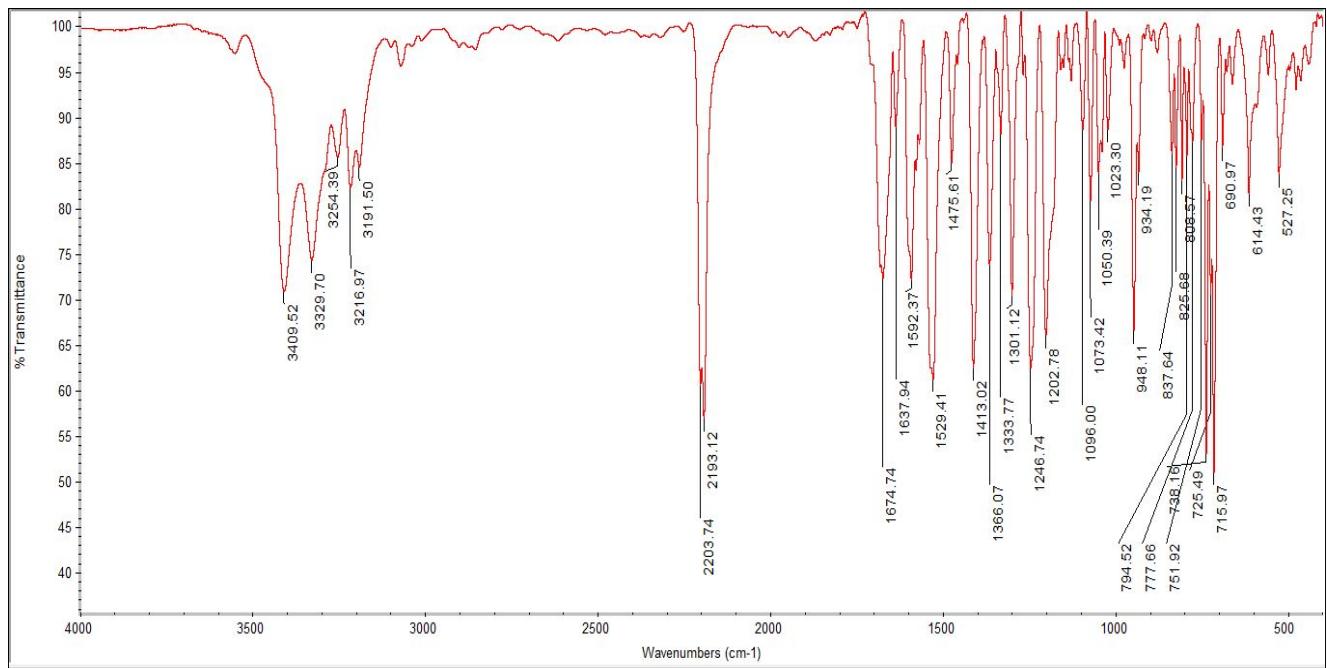


Figure S13. FT-IR spectrum of 2-amino-4-(4-chloro-3-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile



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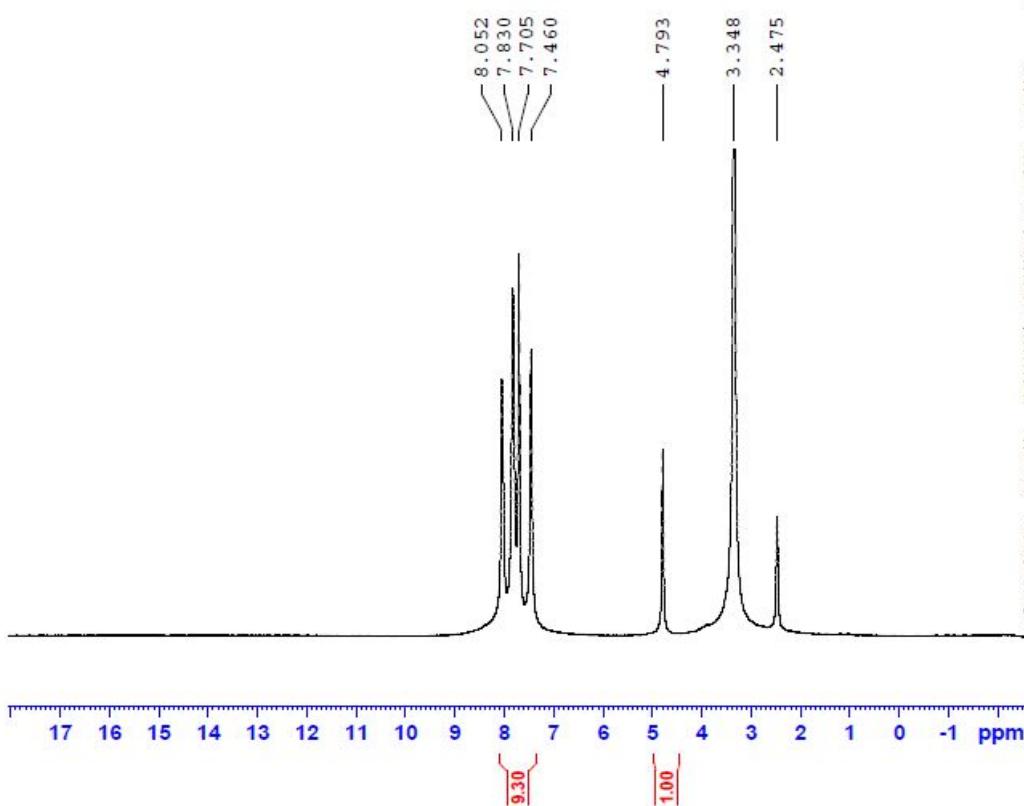


Figure S14. ¹H NMR spectrum of 2-amino-4-(4-chloro-3-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

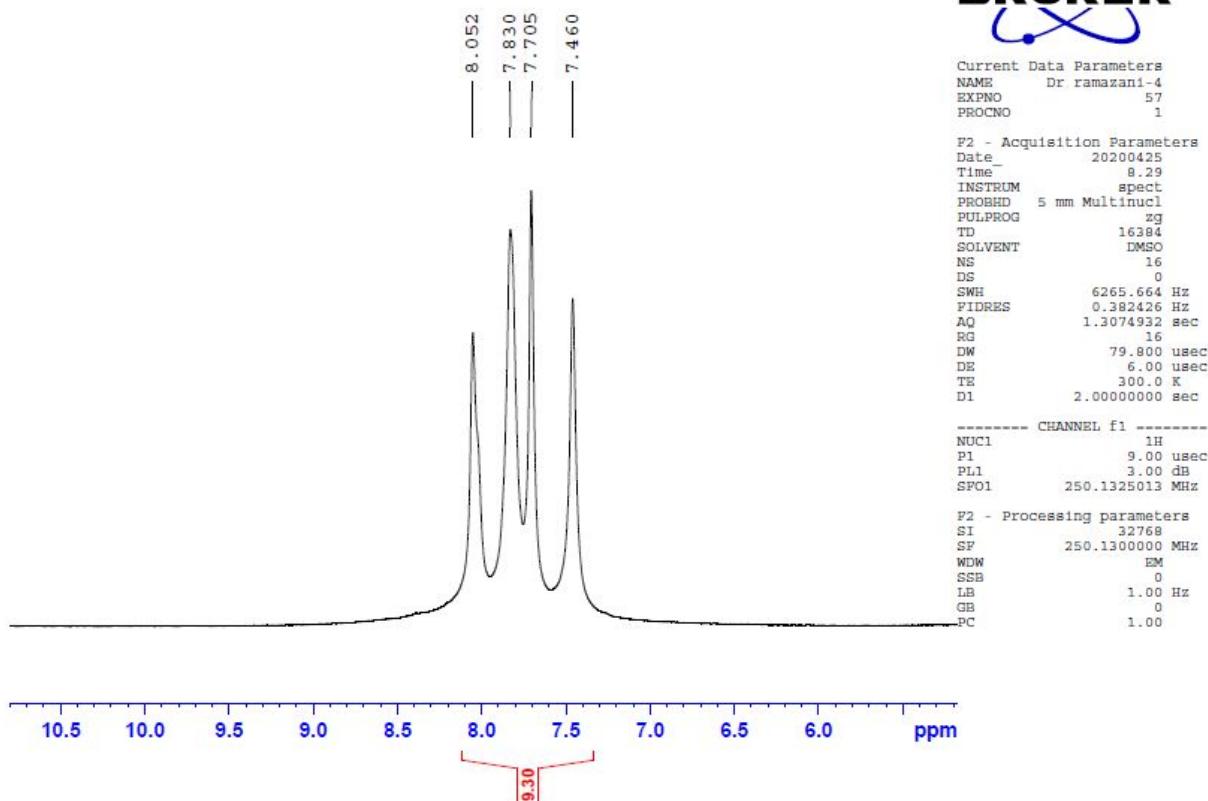


Figure S15. The expanded ^1H NMR spectrum of 2-amino-4-(4-chloro-3-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

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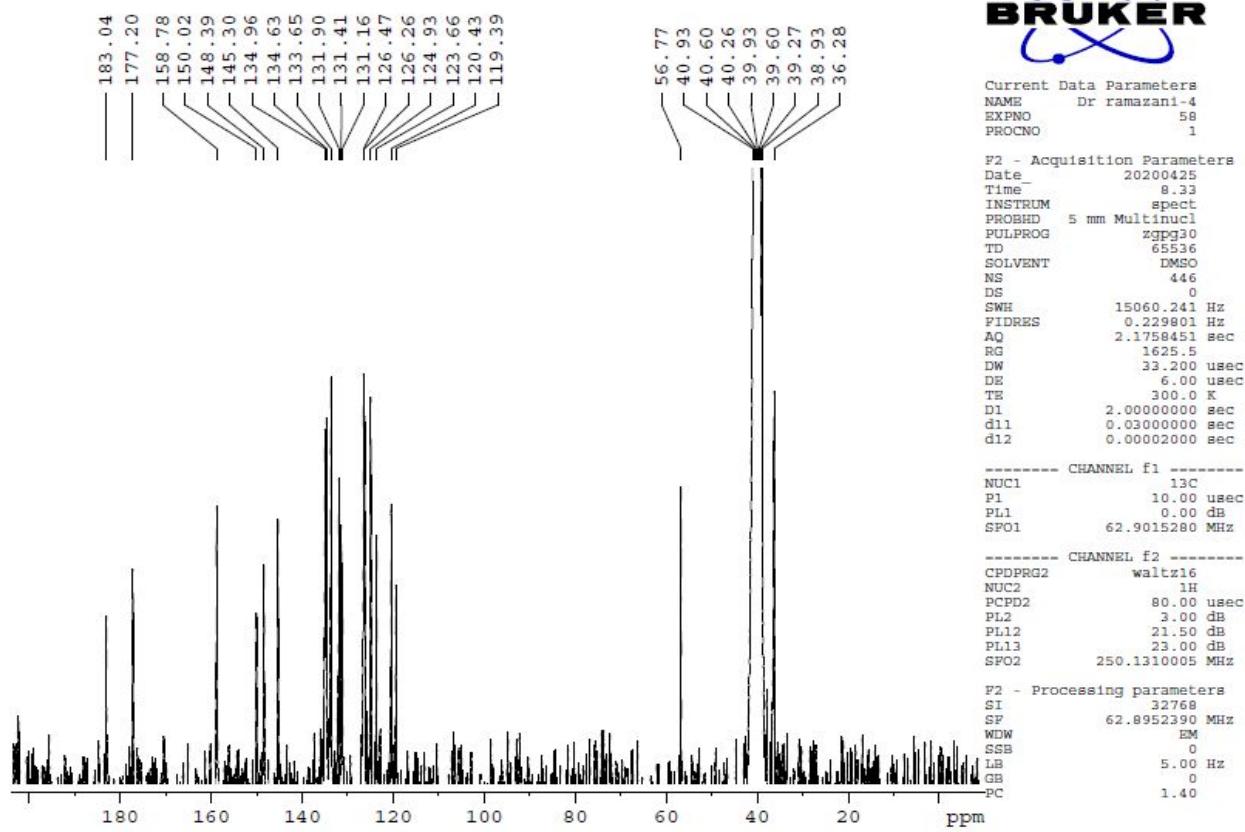


Figure S16. ^{13}C NMR spectrum of 2-amino-4-(4-chloro-3-nitrophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[g]chromene-3-carbonitrile

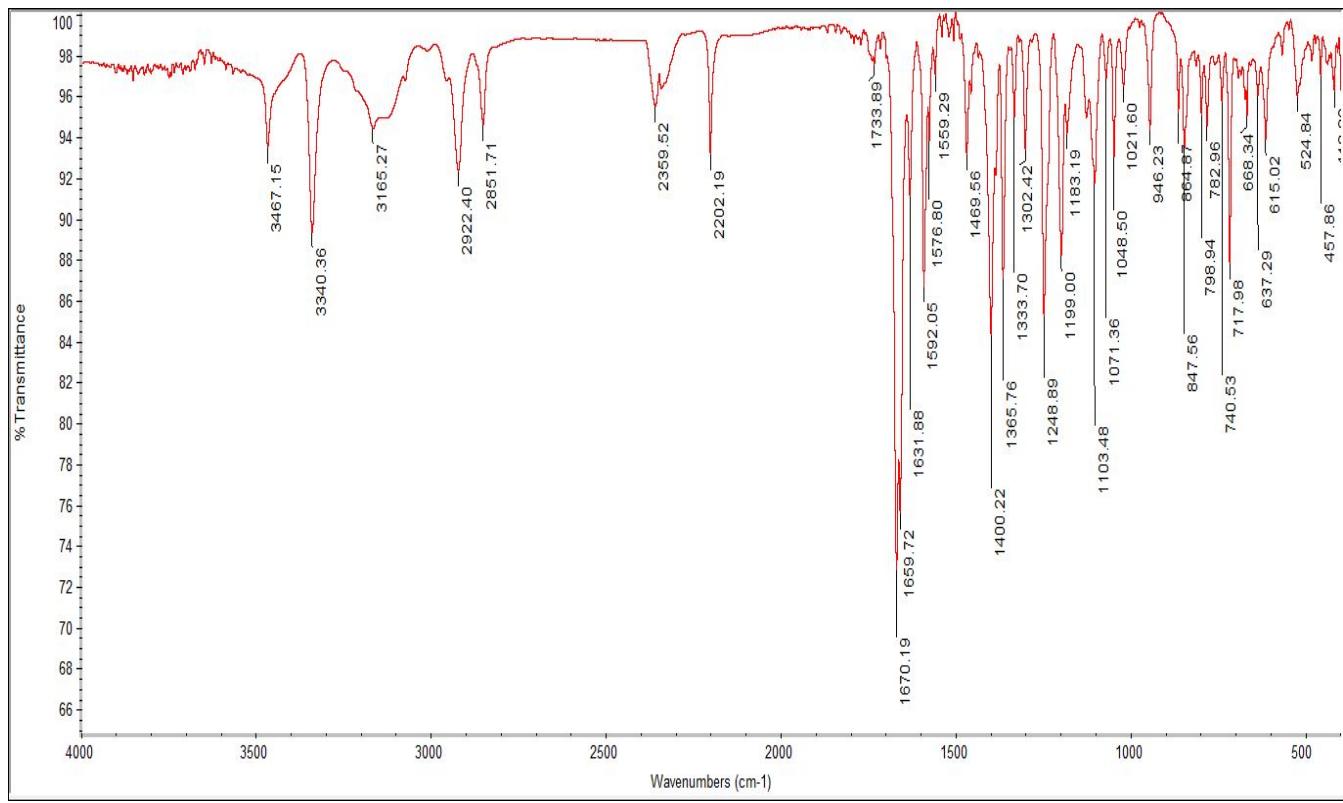


Figure S17. FT-IR spectrum of 2-amino-4-(2,4-dichlorophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3 carbonitrile

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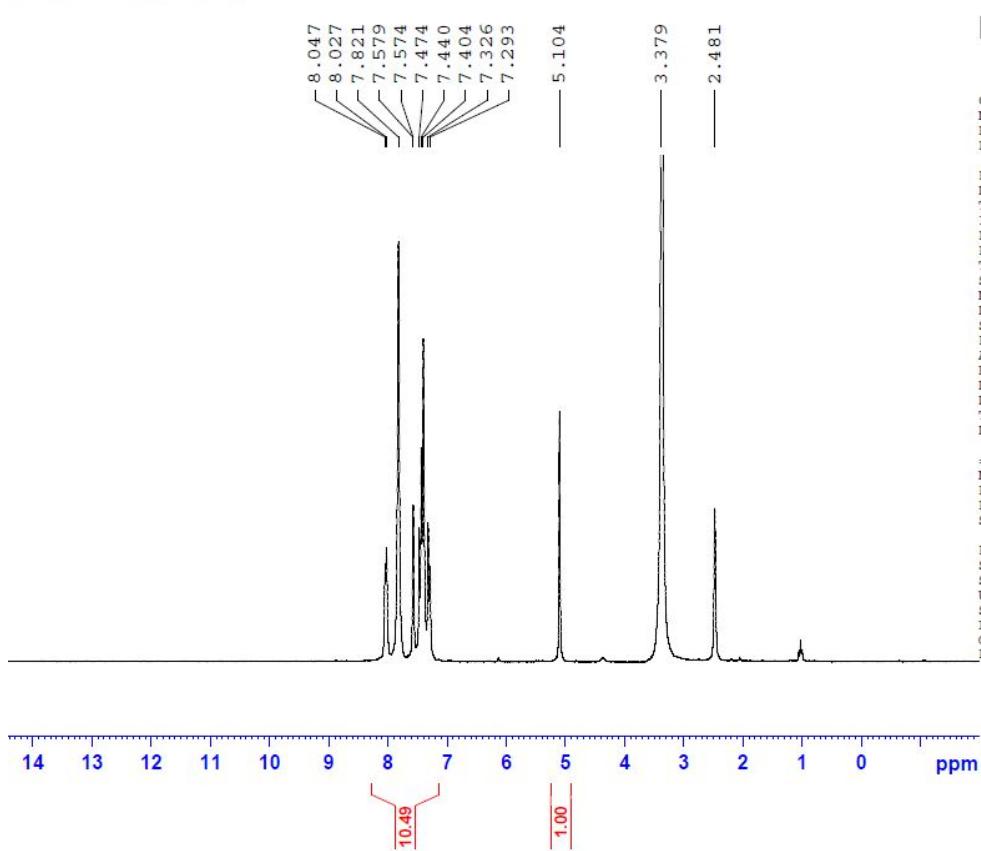
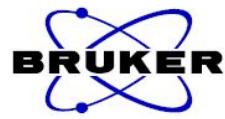


Figure S18. ¹H NMR spectrum of 2-amino-4-(2,4-dichlorophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3 carbonitrile



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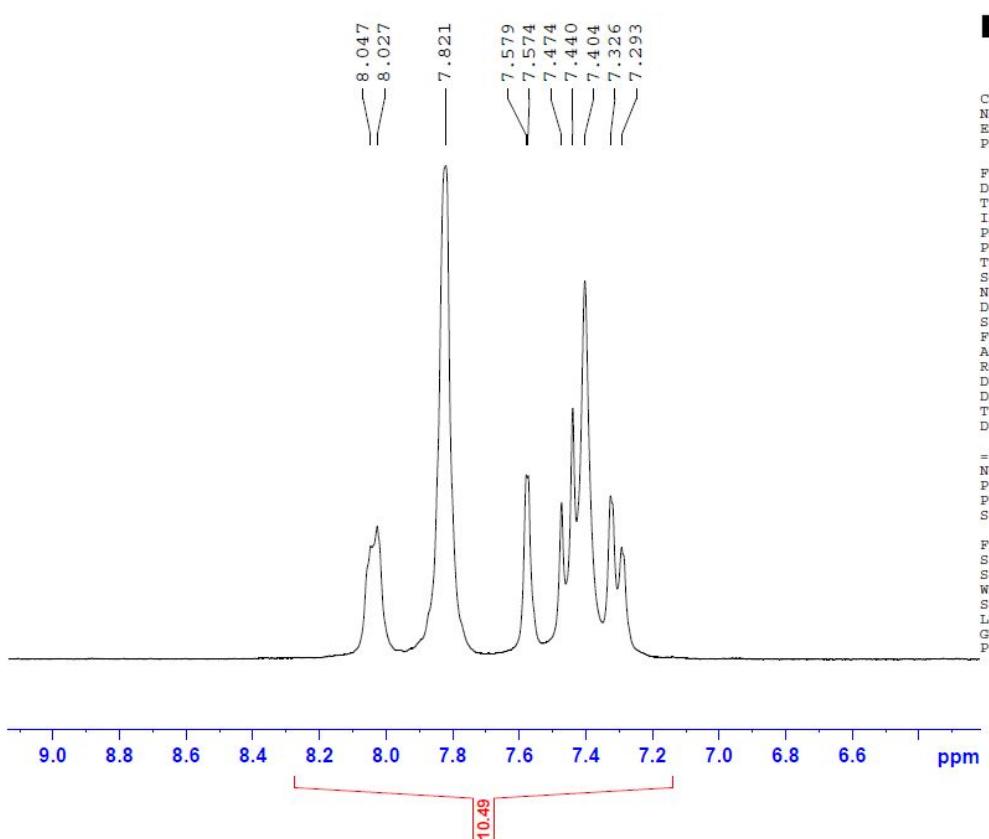


Figure S19. The expanded ^1H NMR spectrum of 2-amino-4-(2,4-dichlorophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3 carbonitrile

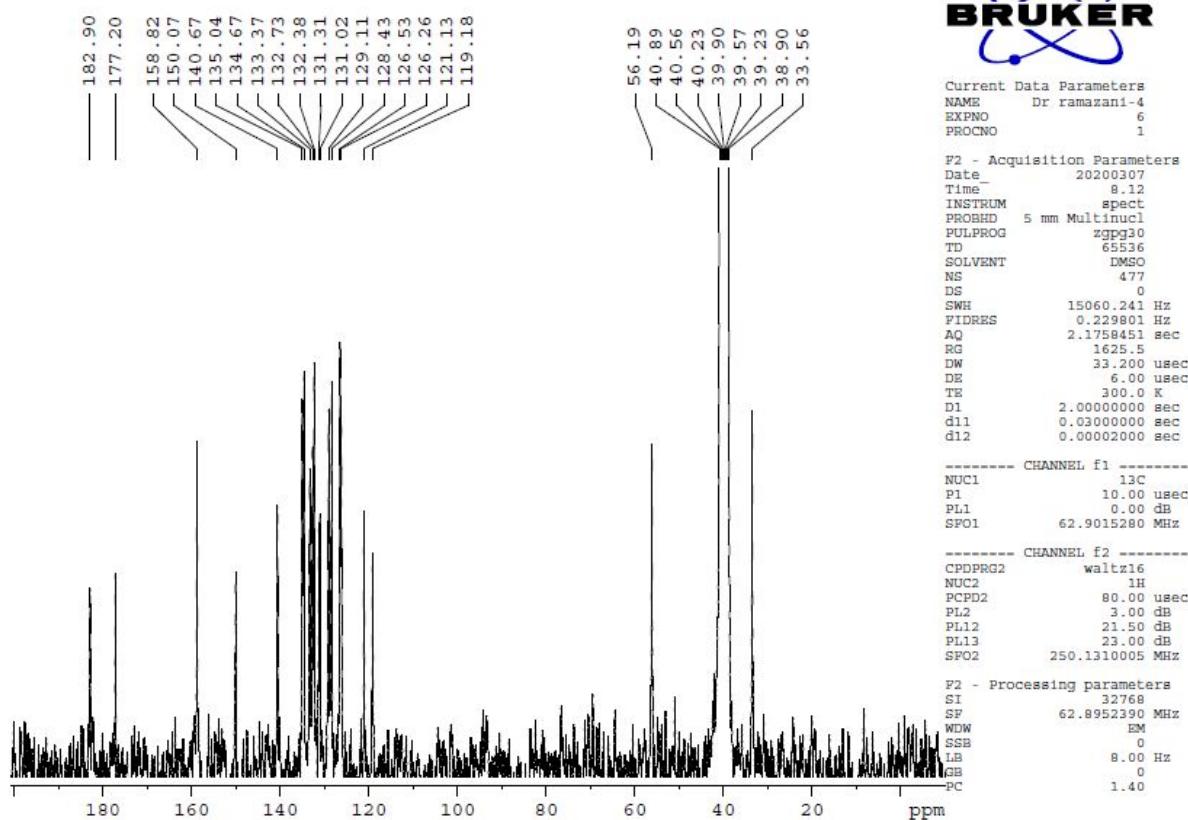


Figure S20. ^{13}C NMR spectrum of 2-amino-4-(2,4-dichlorophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3 carbonitrile

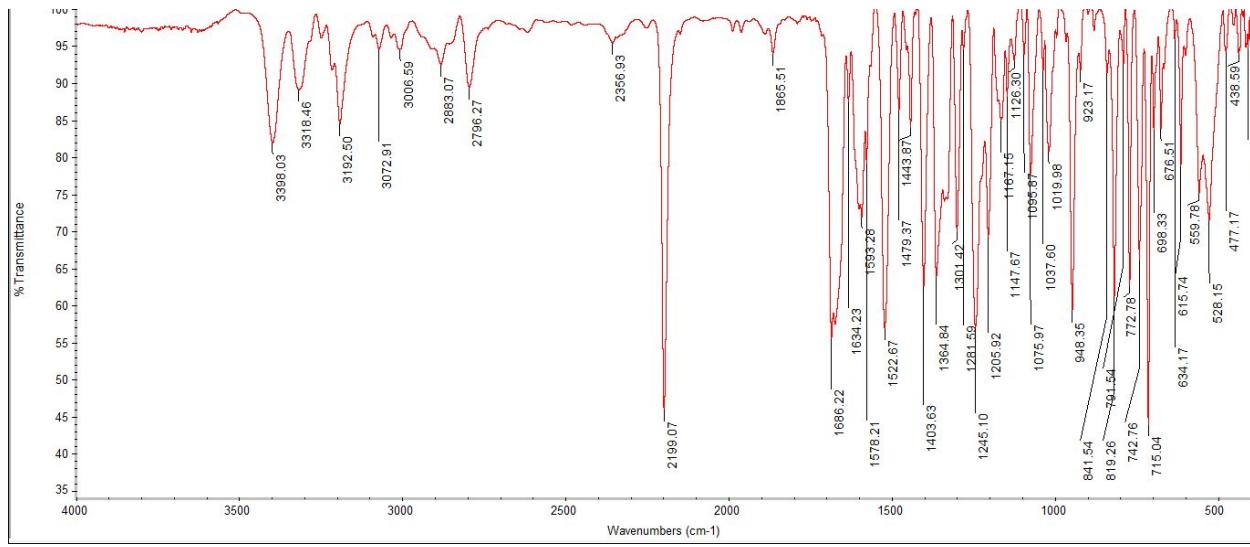


Figure S21. FT-IR spectrum of 2-amino-4-(4-(dimethylamino) phenyl)-5,10-dioxo-5,10-dihydro-4*H*benzo[*g*]chromene-3-carbonitrile



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 EXPNO 37
 PROCNO 1

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 RG 16
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 D1 2.0000000 sec

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 PL1 3.00 dB
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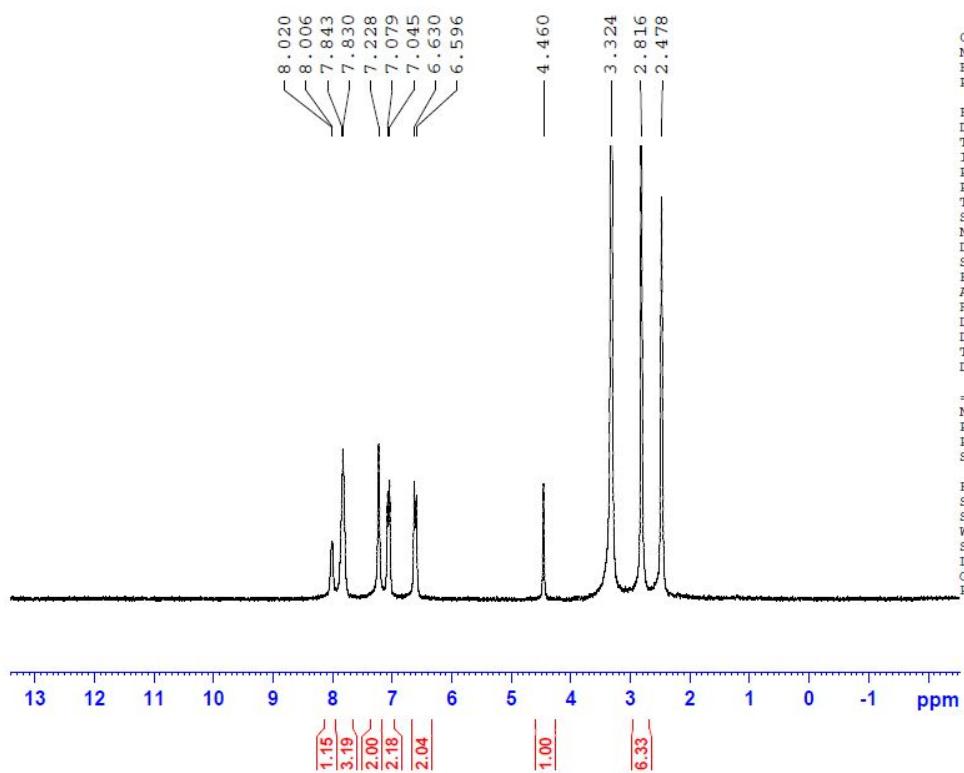


Figure S22. ^1H NMR spectrum of 2-amino-4-(4-(dimethylamino) phenyl)-5,10-dioxo-5,10-dihydro-4*H*benzo[*g*]chromene-3-carbonitrile

sobhan-Rezayati-chrom-7-99-12-18

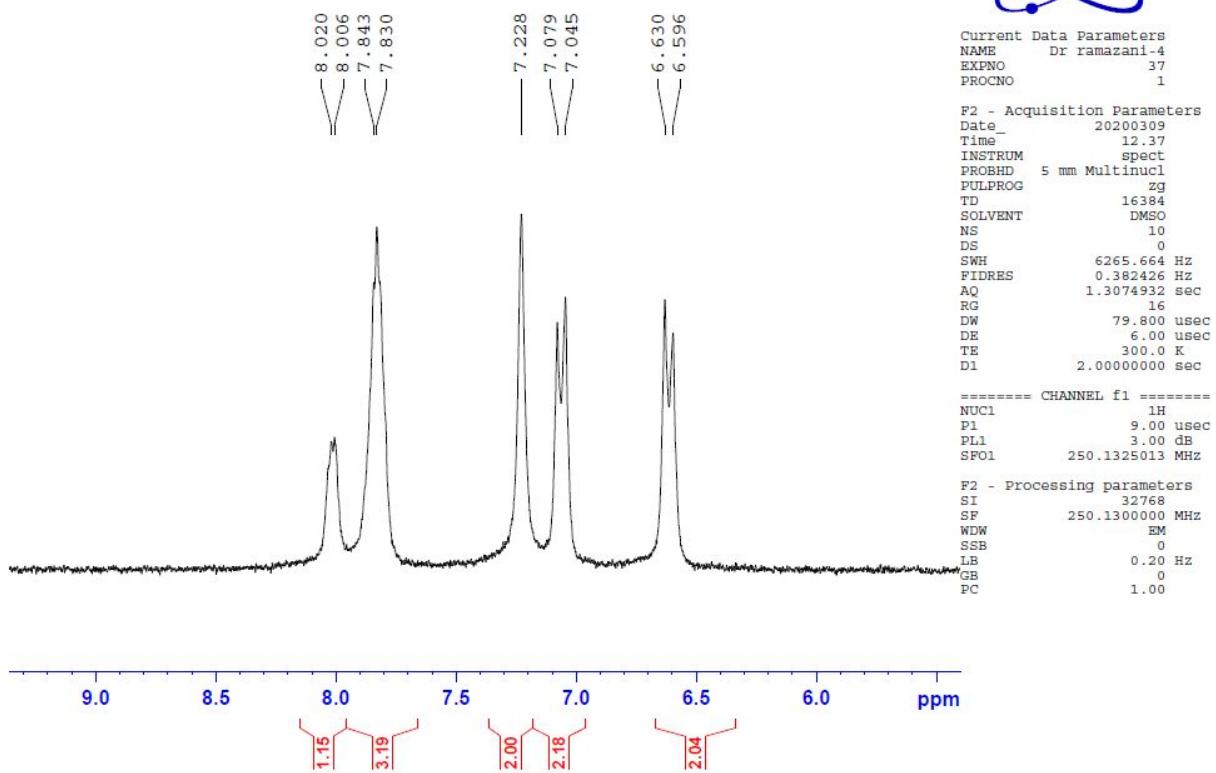


Figure S23. The expanded ^1H NMR of 2-amino-4-(4-(dimethylamino) phenyl)-5,10-dioxo-5,10-dihydro-4*H*benzo[*g*]chromene-3-carbonitrile

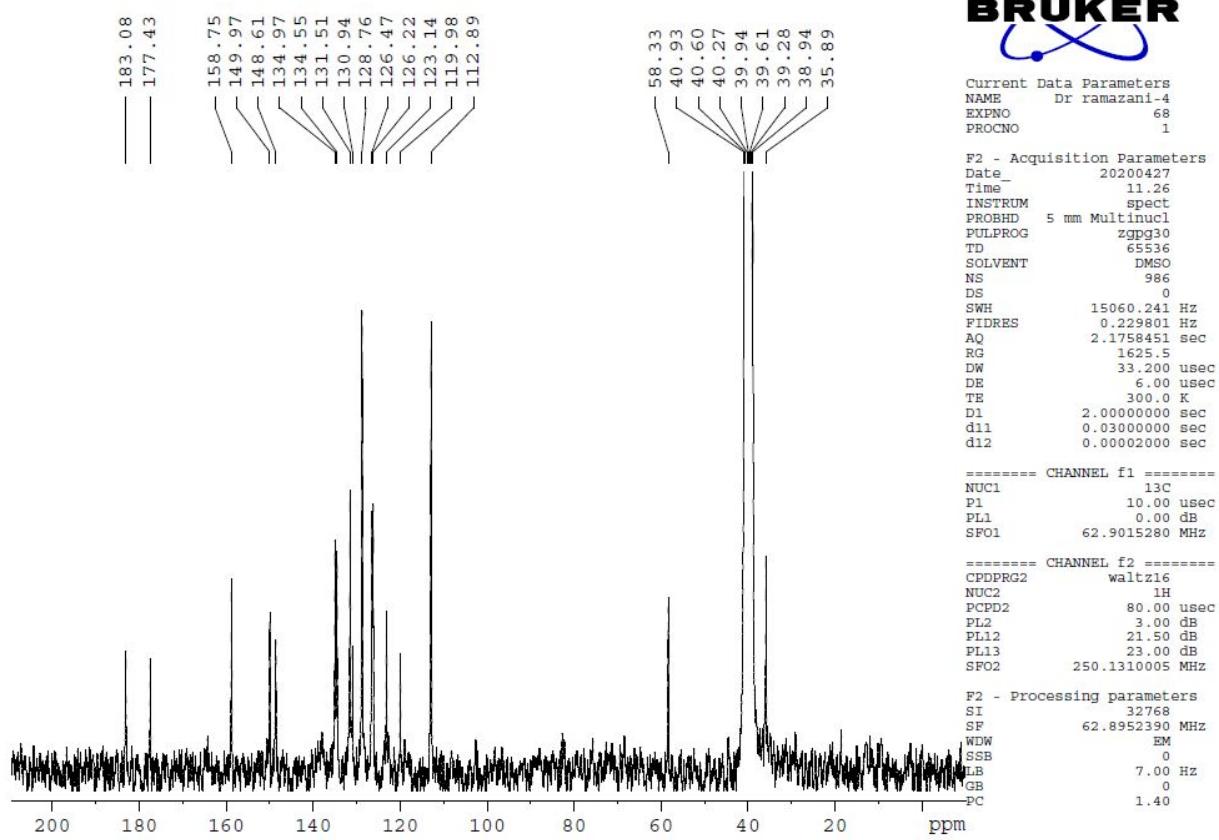


Figure S24. ^{13}C NMR spectrum of 2-amino-4-(4-(dimethylamino) phenyl)-5,10-dioxo-5,10-dihydro-4*H*benzo[*g*]chromene-3-carbonitrile

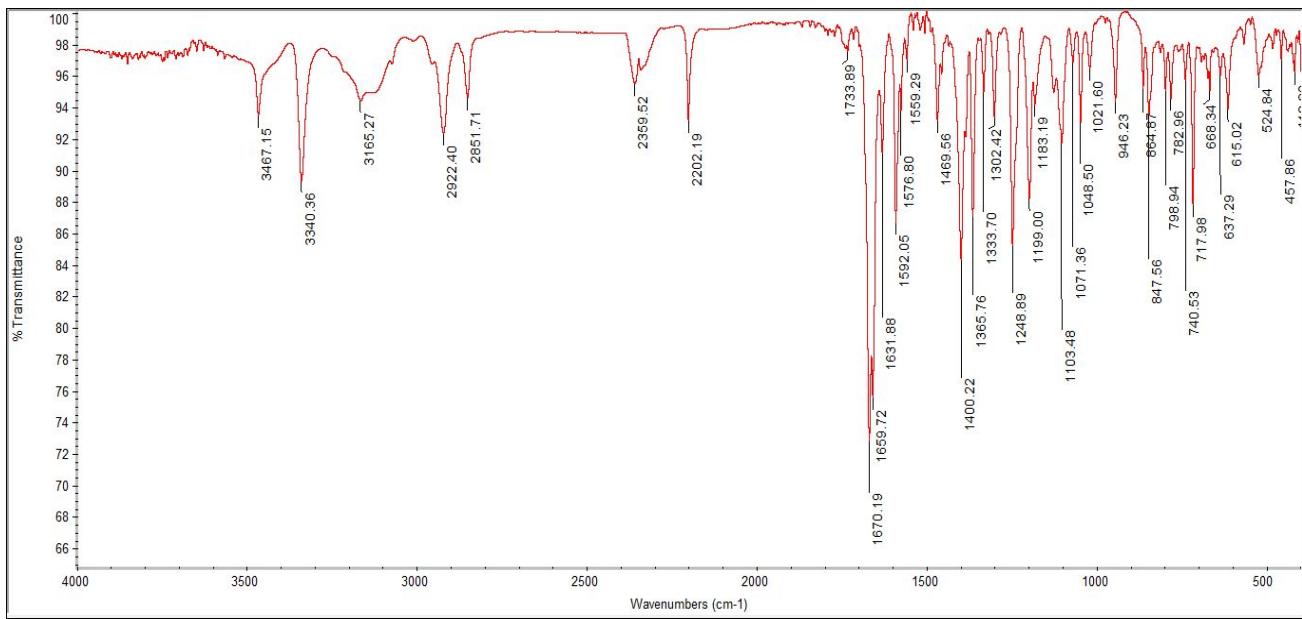


Figure S25. FT-IR spectrum of 2-amino-4-(furan-2-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

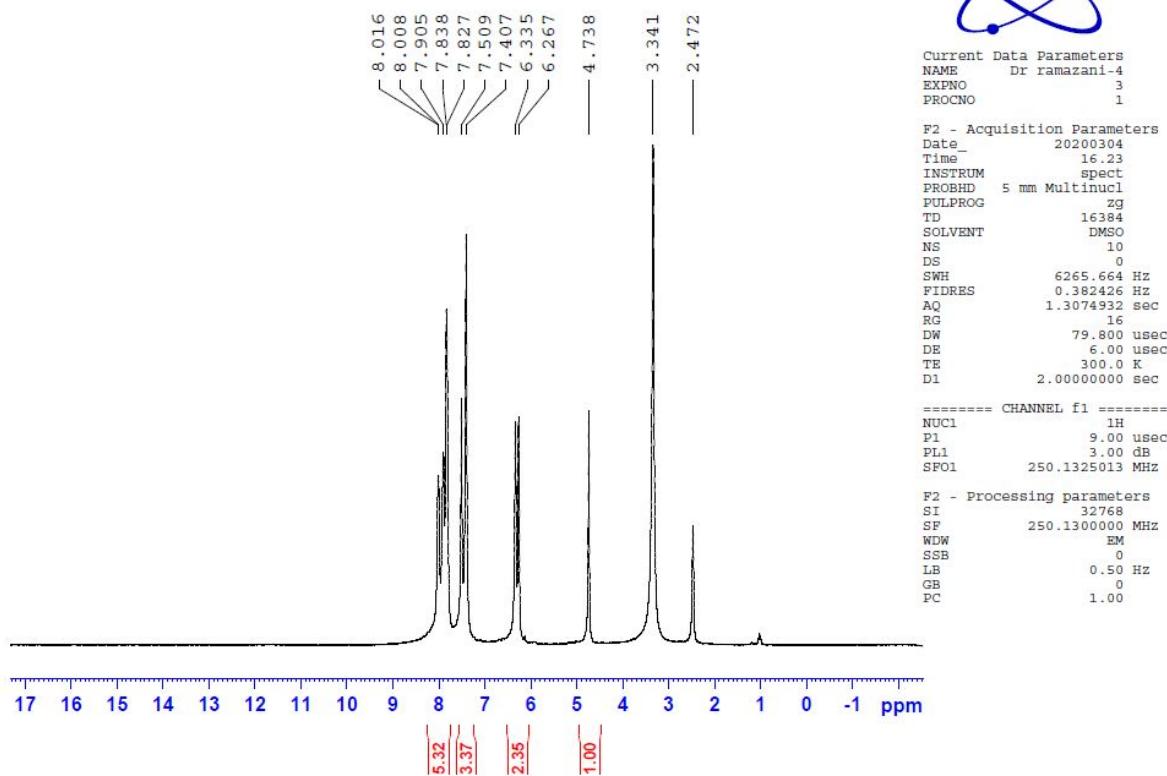


Figure S26. ^1H NMR spectrum of 2-amino-4-(furan-2-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

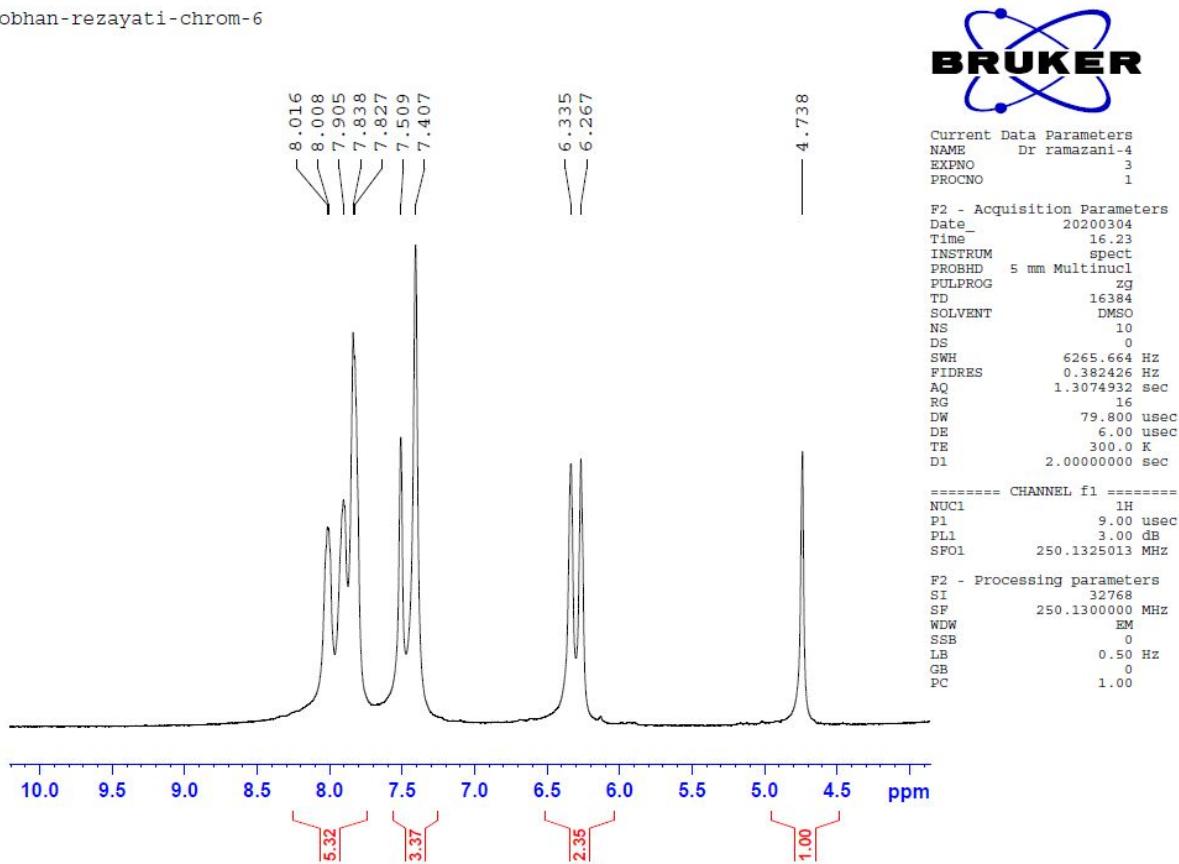


Figure S27. The expanded ^1H NMR spectrum of 2-amino-4-(furan-2-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

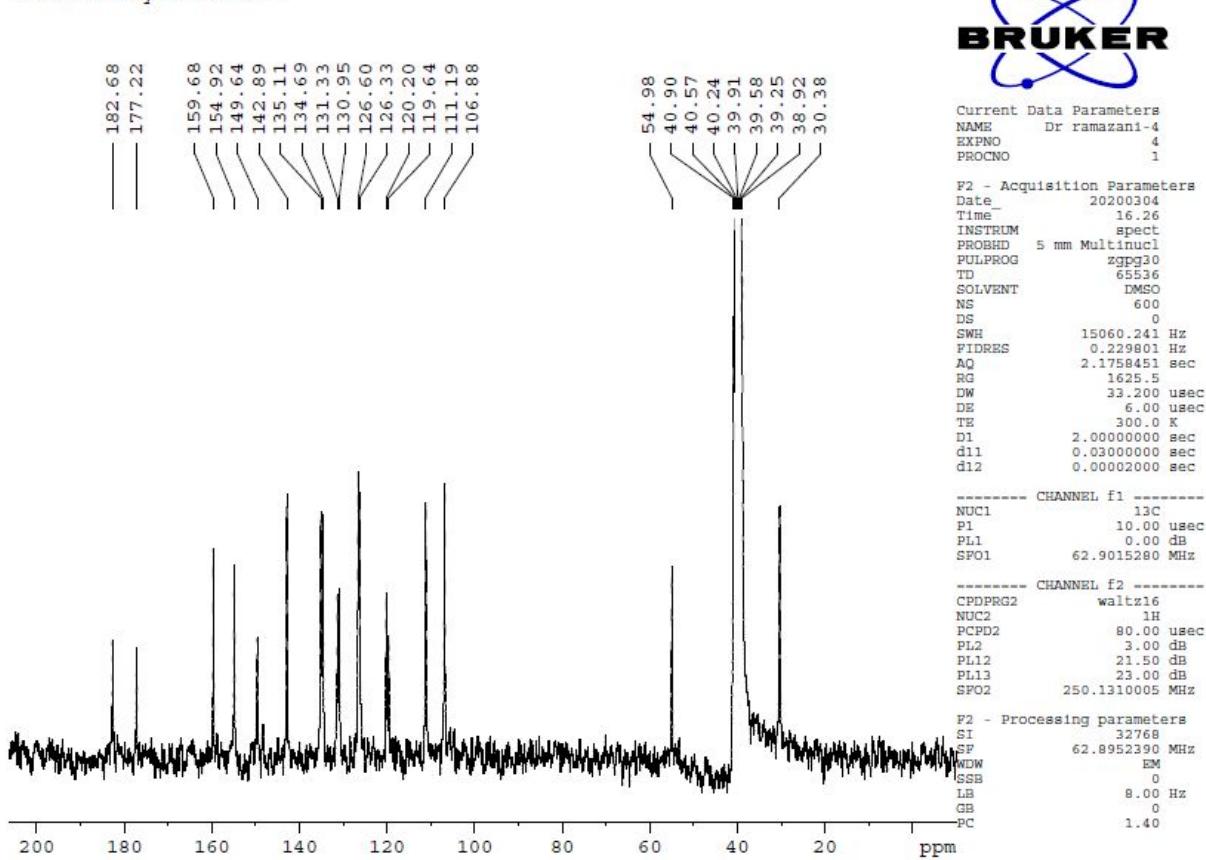


Figure S28. ^{13}C NMR spectrum of 2-amino-4-(furan-2-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

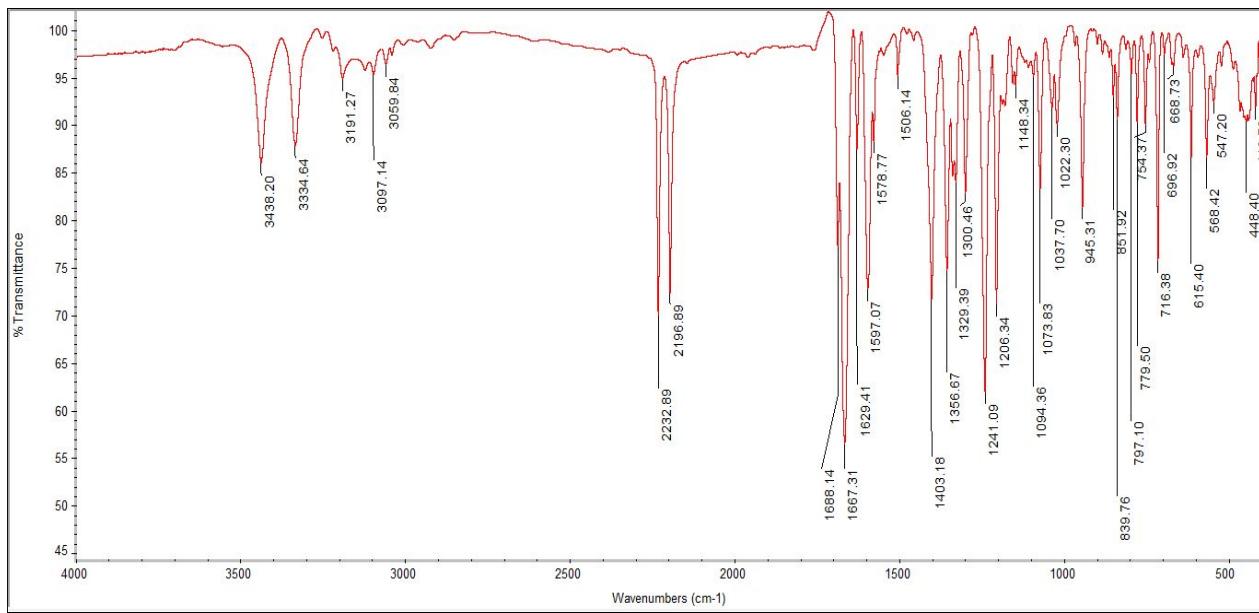


Figure S29. FT-IR spectrum of 2-amino-4-(4-cyanophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

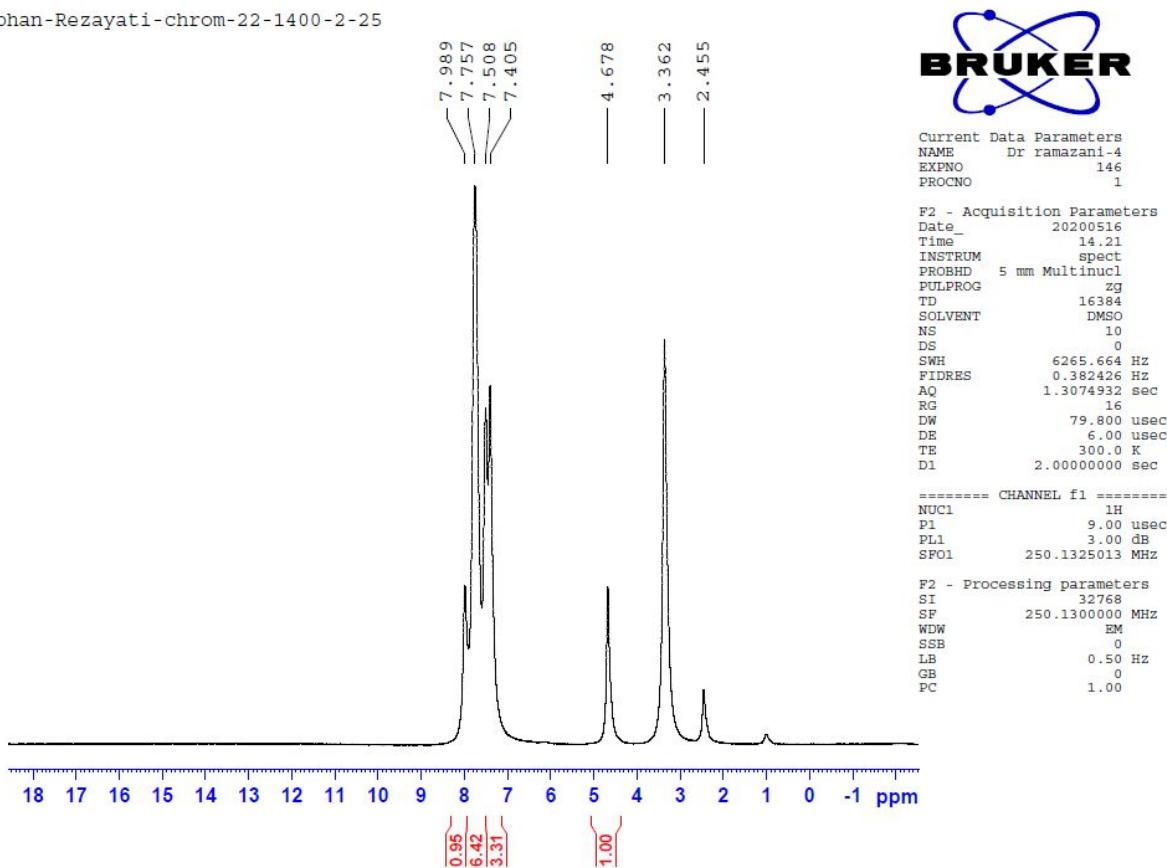


Figure S30. ^1H NMR spectrum of 2-amino-4-(4-cyanophenyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

Sobhan-Rezayati-chrom-22-1400-2-25

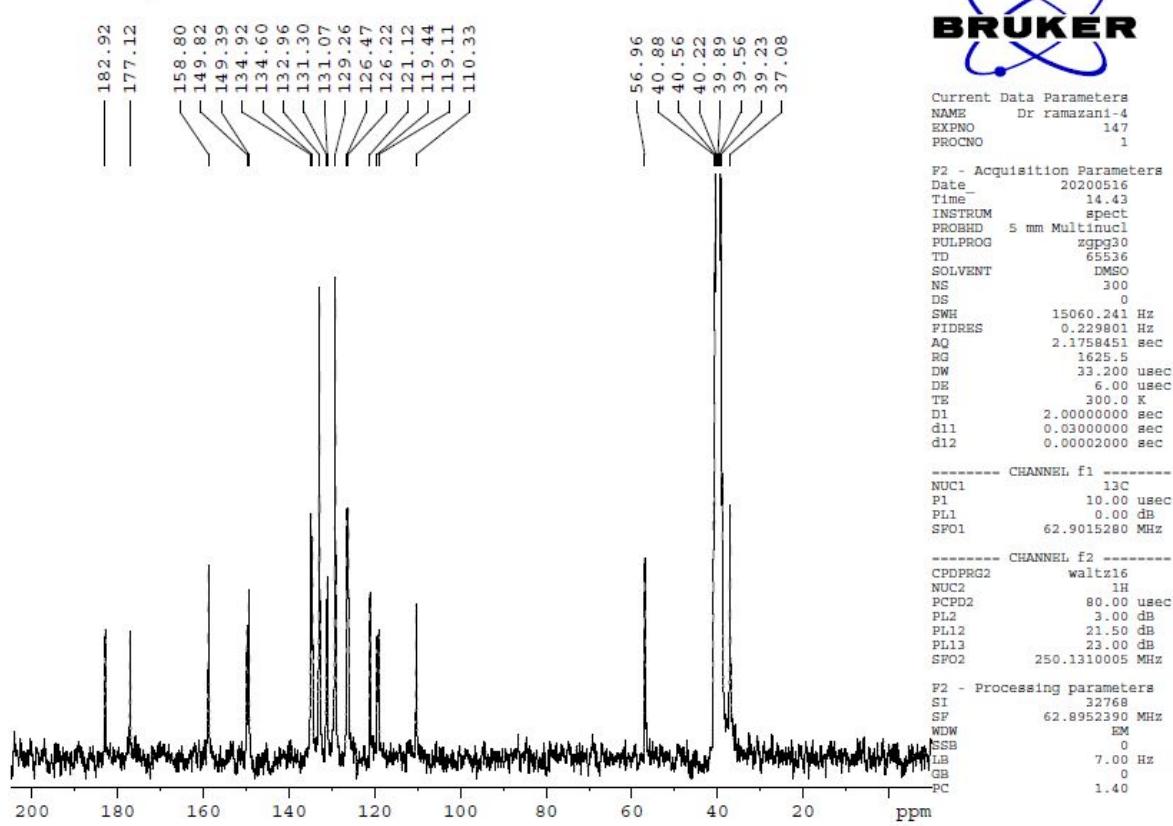


Figure S31. ¹³C NMR spectrum of 2-amino-4-(4-cyanophenyl)-5,10-dioxo-5,10-dihydro-4H-benzo[g]chromene-3-carbonitrile

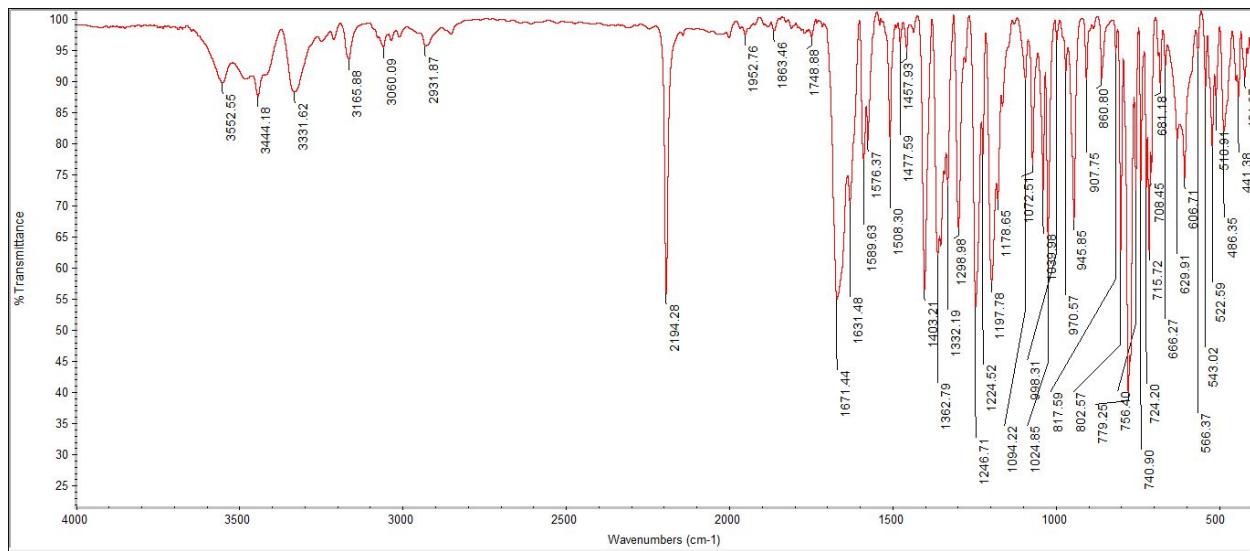


Figure S32. FT-IR spectrum of 2-amino-4-(1-naphthyl)-5,10-dioxo-5,10-dihydro-4H-benzo[g]chromene-3-carbonitrile



Current Data Parameters
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 PROCNO 1

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 SOLVENT DMSO
 NS 16
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 FIDRES 0.382426 Hz
 AQ 1.3074932 sec
 RG 16
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 DE 6.00 usec
 TE 300.0 K
 D1 2.0000000 sec

===== CHANNEL f1 =====
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 PL1 3.00 dB
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F2 - Processing parameters
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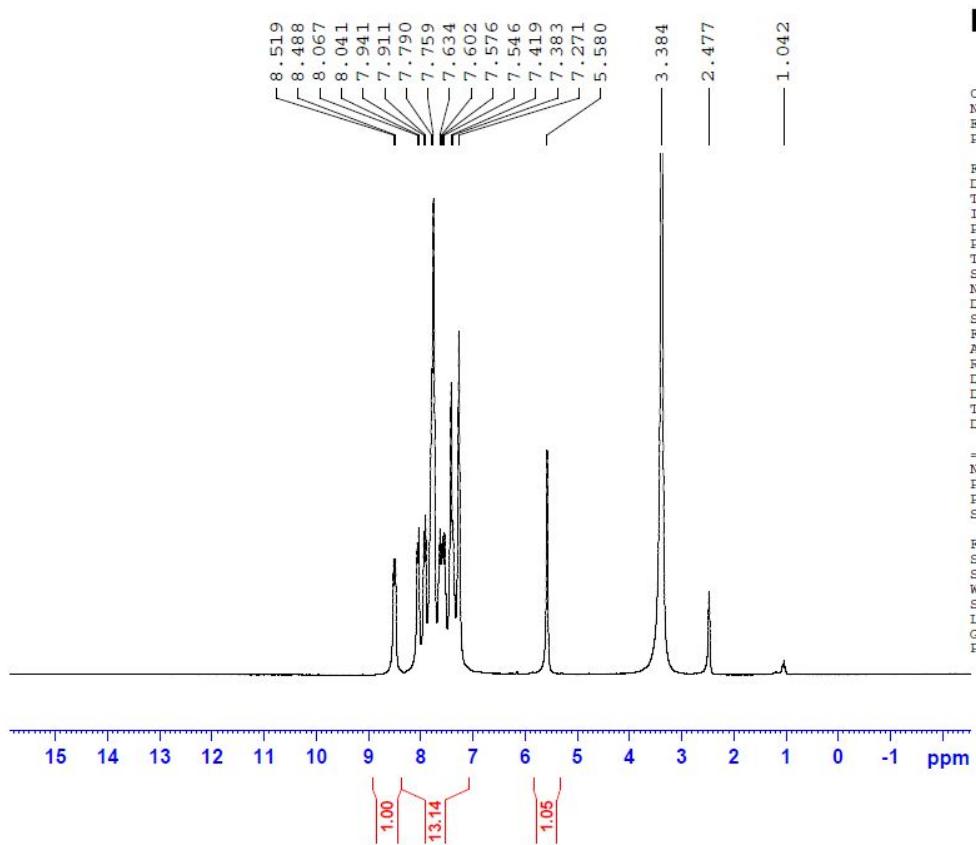


Figure S33. ^1H NMR spectrum of 2-amino-4-(1-naphthyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile



Current Data Parameters
 NAME Dr ramazani_4
 EXPNO 64
 PROCNO 1

F2 - Acquisition Parameters
 Date 20200427
 Time 9.00
 INSTRUM spect
 PROBHD 5 mm Multinucl
 PULPROG zg
 TD 16384
 SOLVENT DMSO
 NS 16
 DS 0
 SWH 6265.664 Hz
 FIDRES 0.382426 Hz
 AQ 1.3074932 sec
 RG 16
 DW 79.800 usec
 DE 6.00 usec
 TE 300.0 K
 D1 2.00000000 sec

===== CHANNEL f1 =====
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 P1 9.00 usec
 PL1 3.00 dB
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F2 - Processing parameters
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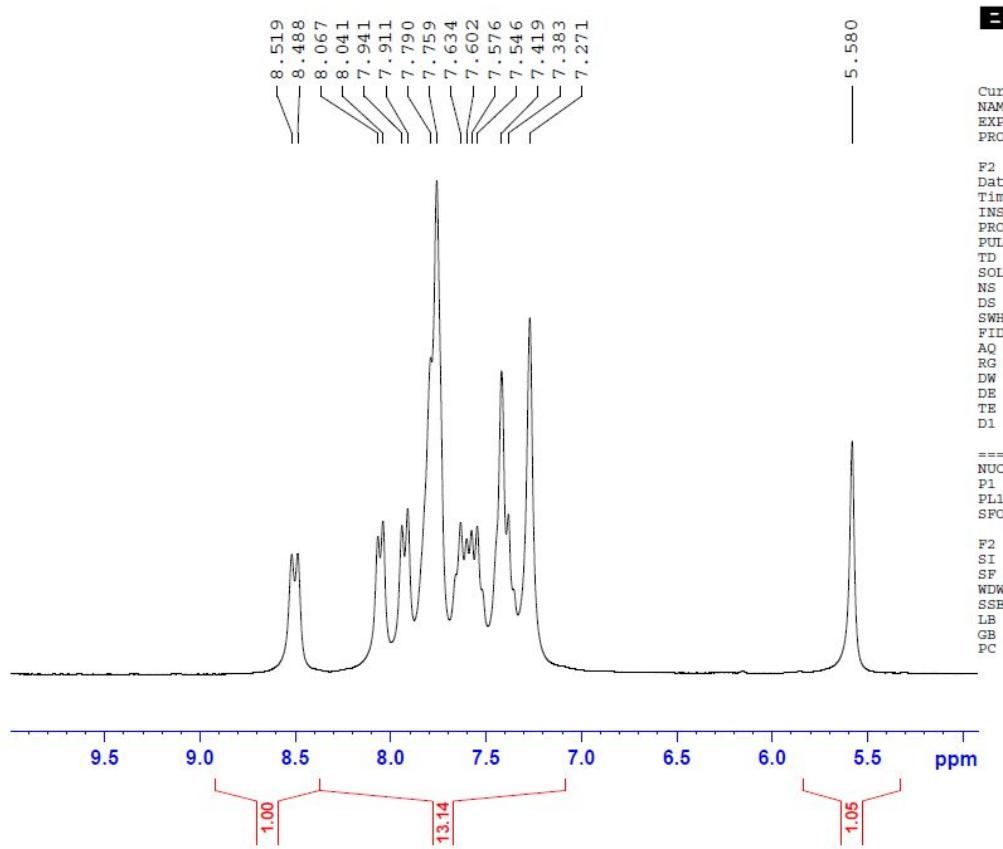


Figure S34. The expanded ¹H NMR spectrum of 2-amino-4-(1-naphthyl)-5,10-dioxo-5,10-dihydro-4H-benzo[g]chromene-3-carbonitrile

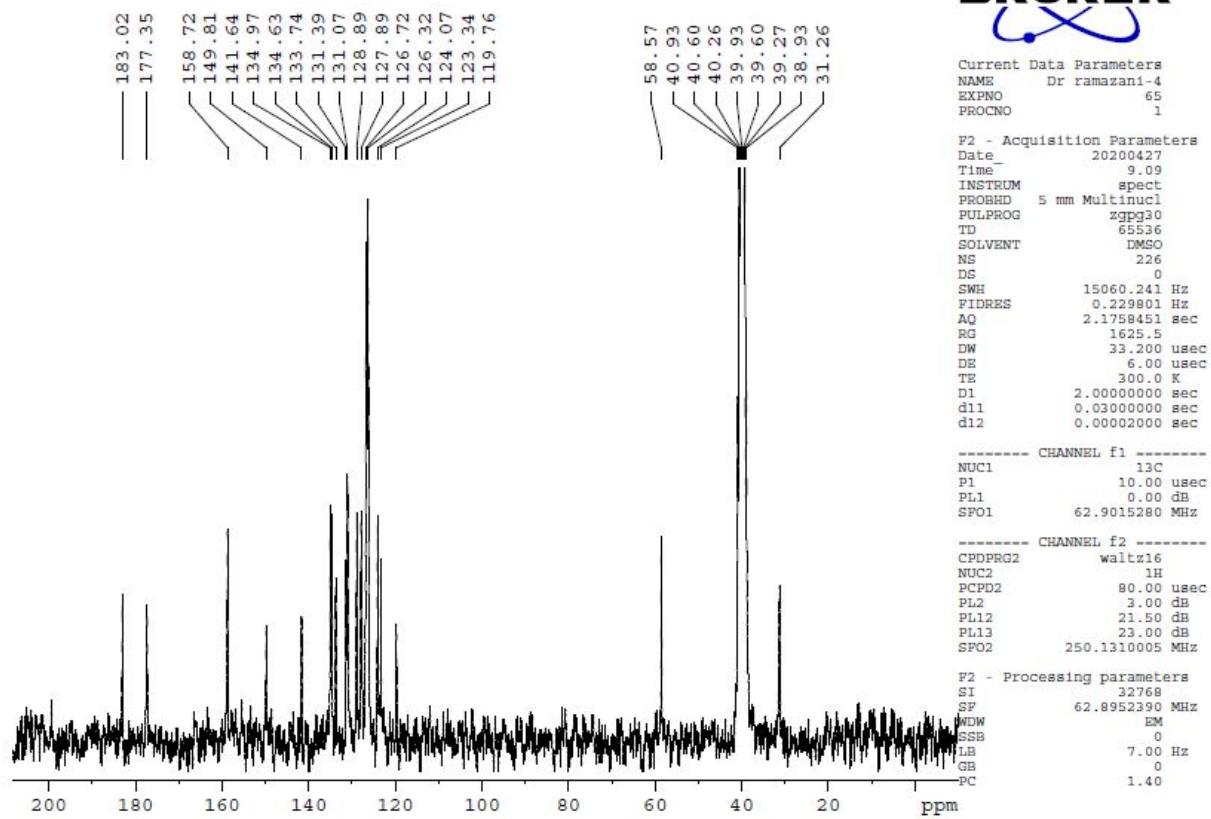


Figure S35. ^{13}C NMR spectrum of 2-amino-4-(1-naphthyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

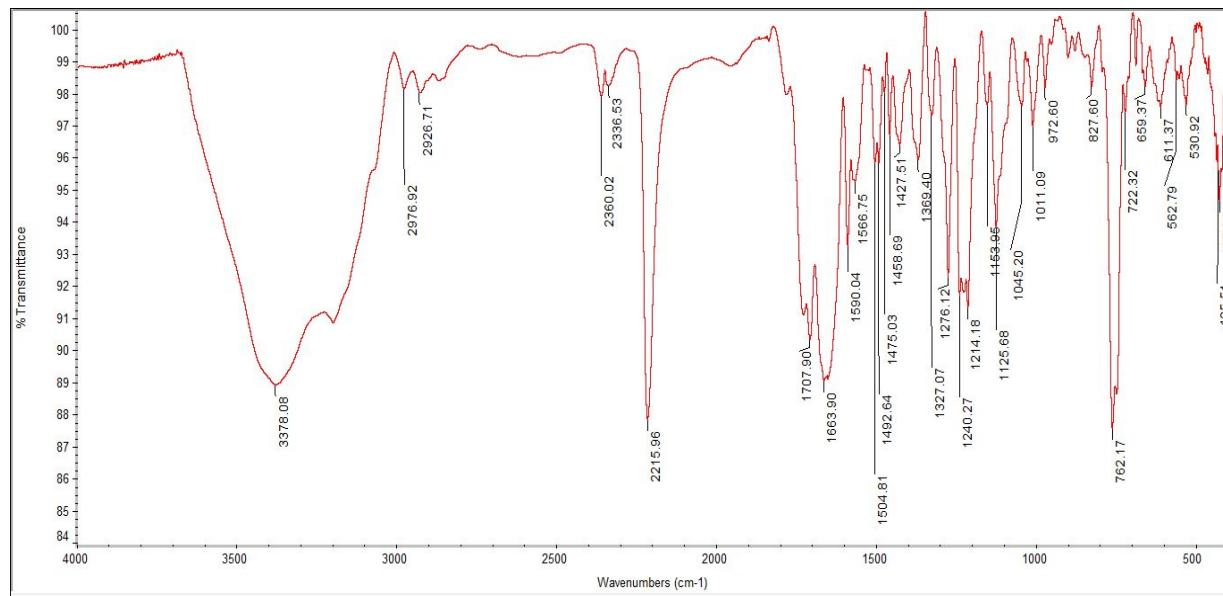


Figure S36. FT-IR spectrum of 2-amino-4-(2-naphthyl)-5,10-dioxo-5,10-dihydro-4H-benzo[g]chromene-3-carbonitrile



Current Data Parameters
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 EXPNO 69
 PROCNO 1

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 PULPROG zg
 TD 16384
 SOLVENT DMSO
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 AQ 1.3074932 sec
 RG 16
 DW 79.800 usec
 DE 6.00 usec
 TE 300.0 K
 D1 2.00000000 sec

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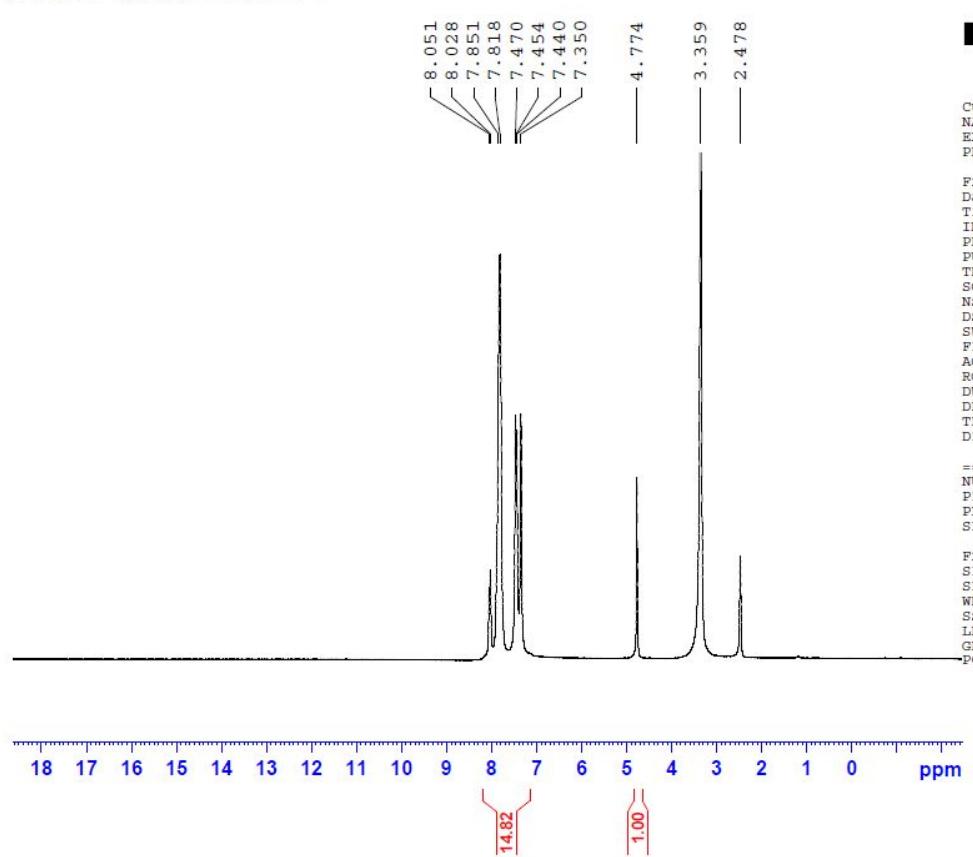


Figure S37. ^1H NMR spectrum of 2-amino-4-(2-naphthyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

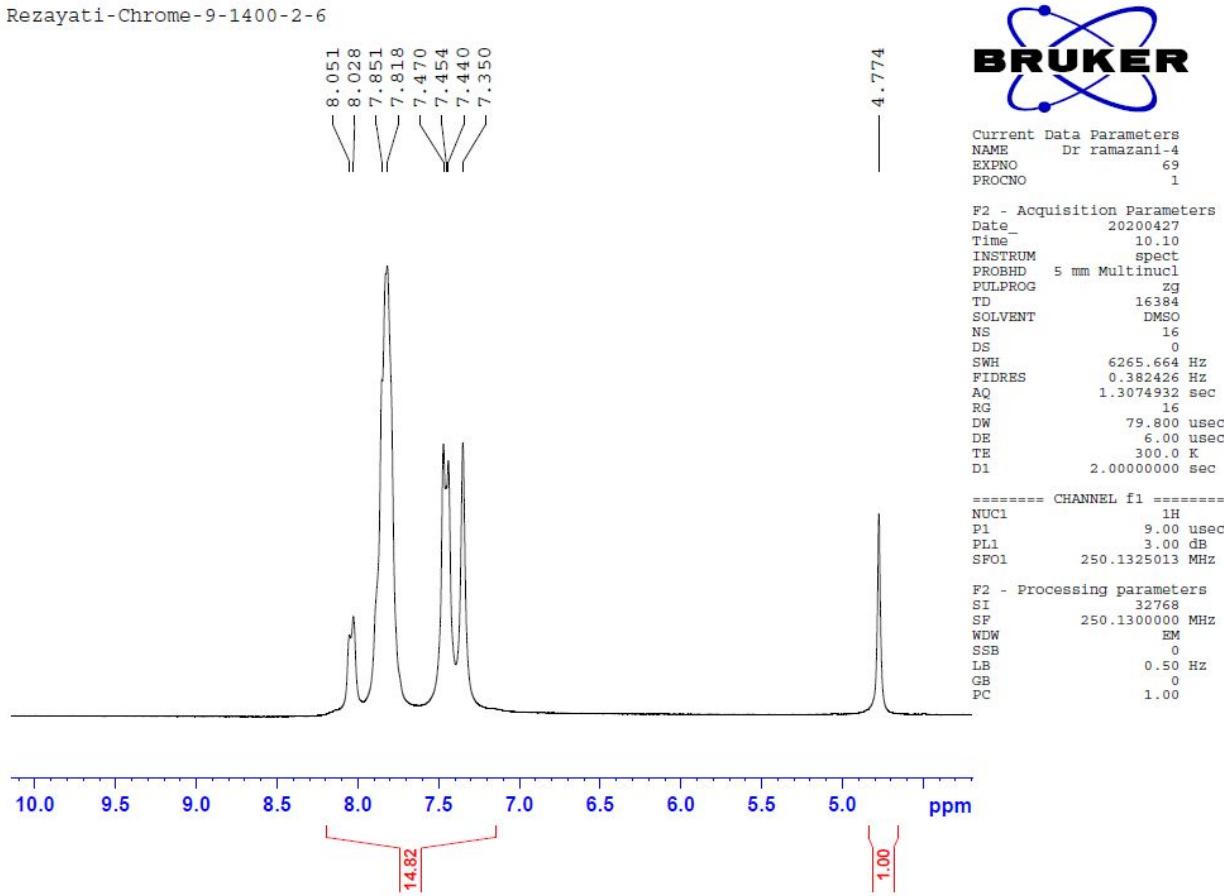


Figure S38. The expanded ^1H NMR spectrum of 2-amino-4-(2-naphthyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile



Current Data Parameters
 NAME Dr ramazani-4
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 PROCNO 1

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 PL13 23.00 dB
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F2 - Processing parameters
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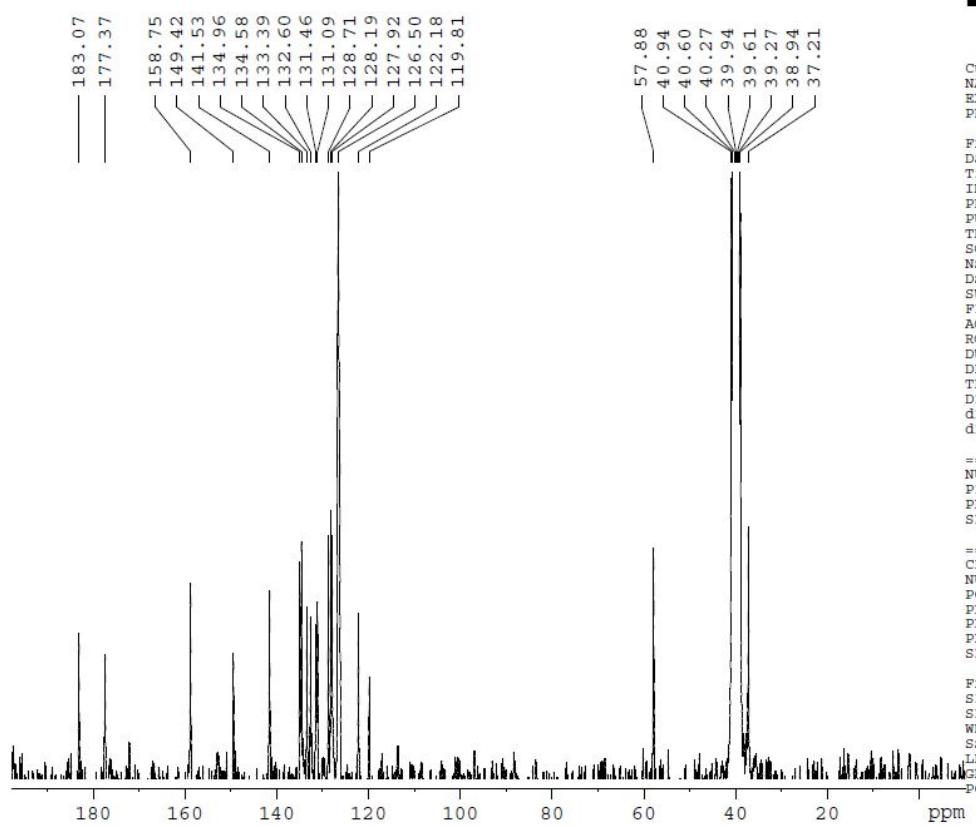


Figure S39. ^{13}C NMR spectrum of 2-amino-4-(2-naphthyl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

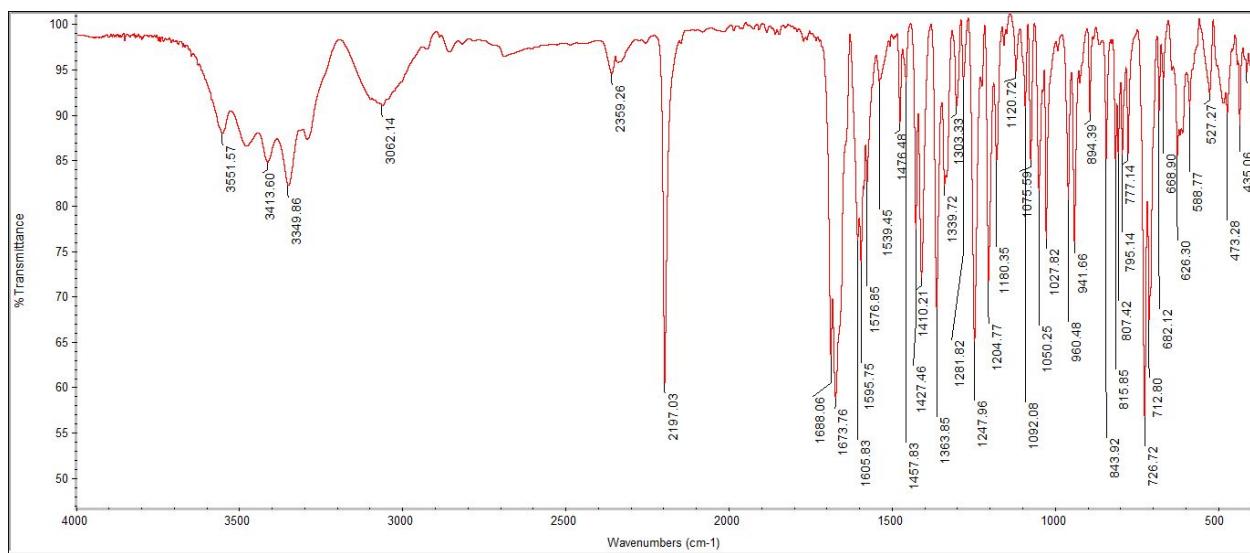


Figure S40. FT-IR spectrum of 2-amino-4-(pyridin-3-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

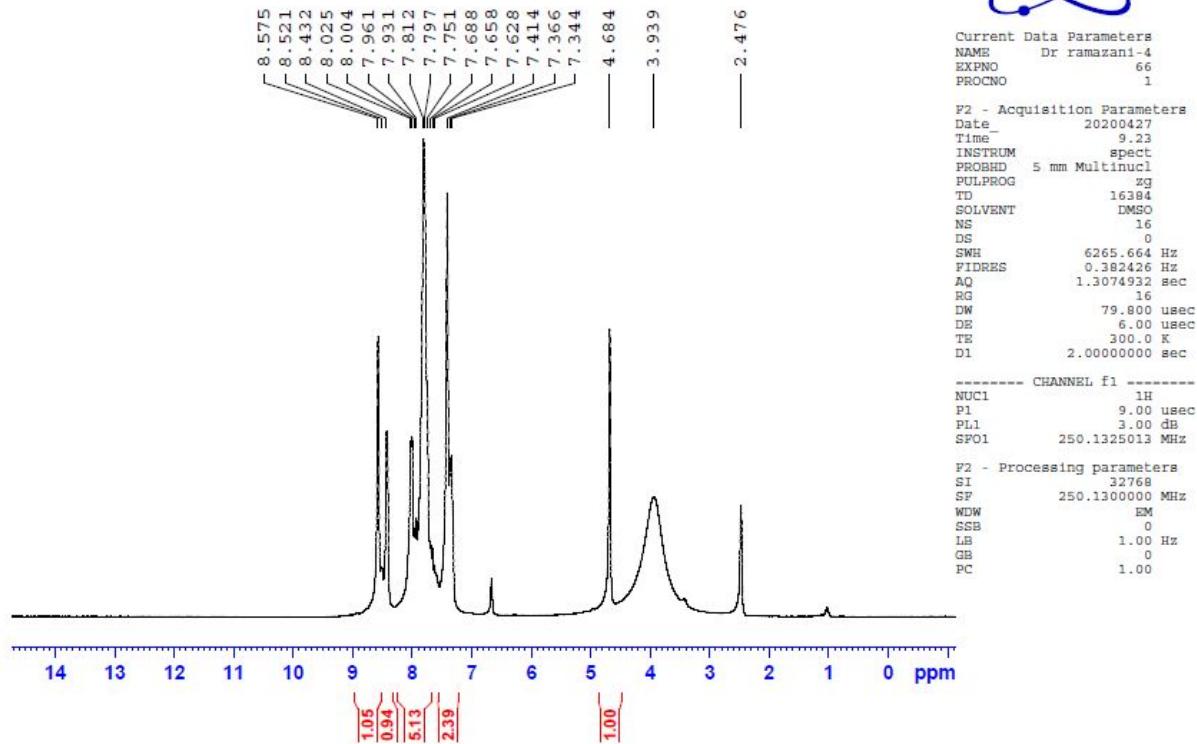


Figure S41. ^1H NMR spectrum of 2-amino-4-(pyridin-3-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

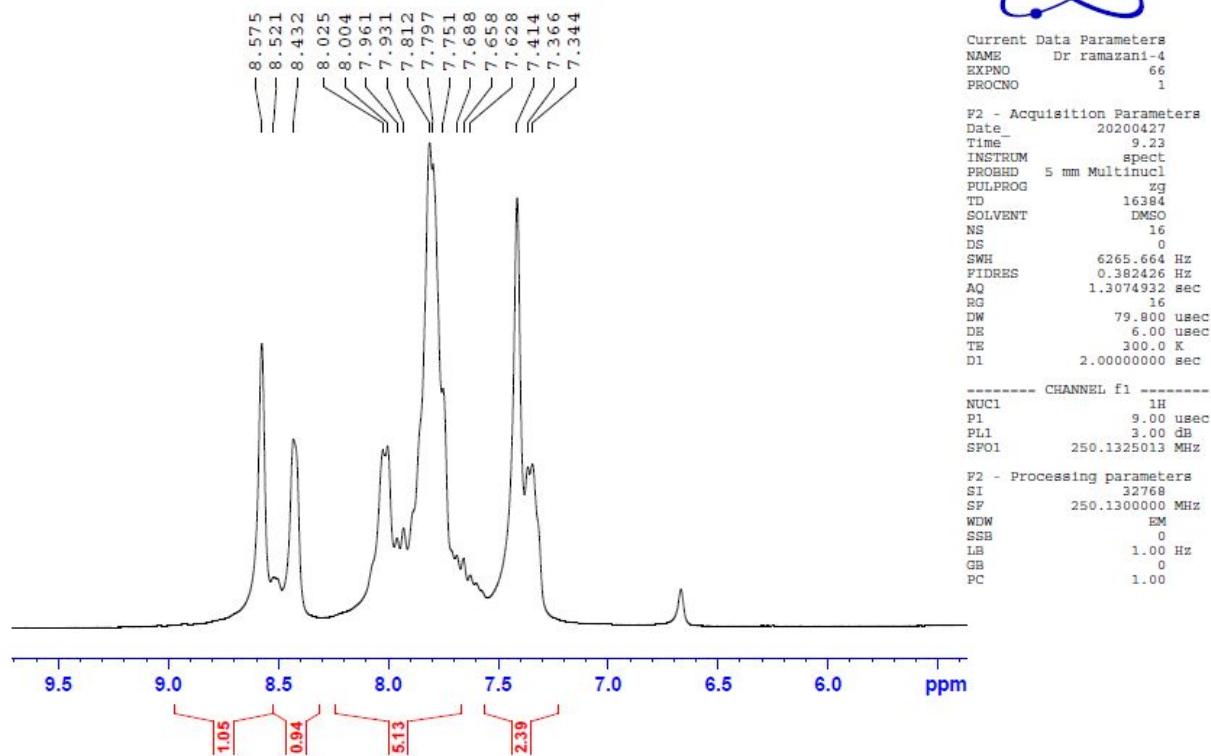


Figure S42. The expanded ^1H NMR spectrum of 2-amino-4-(pyridin-3-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

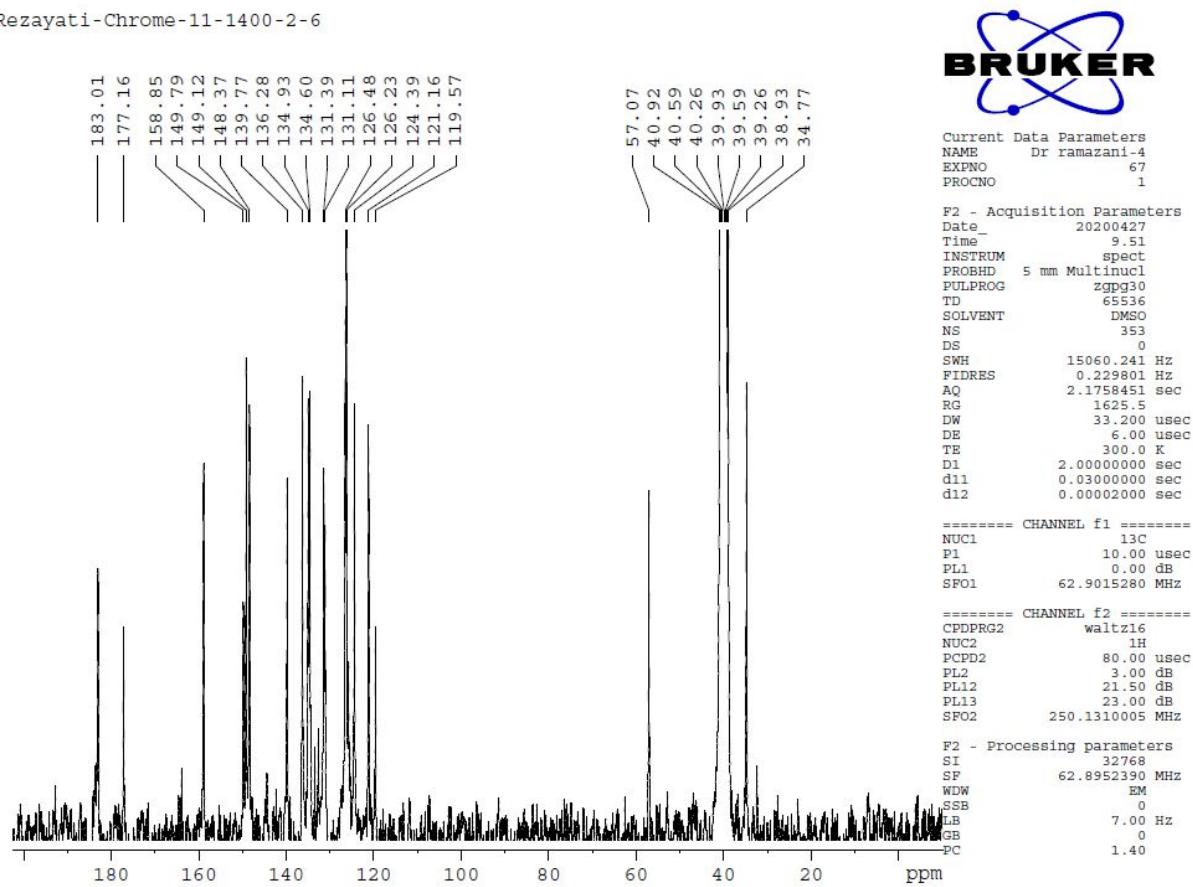


Figure S43. ^{13}C NMR spectrum of 2-amino-4-(pyridin-3-yl)-5,10-dioxo-5,10-dihydro-4*H*-benzo[*g*]chromene-3-carbonitrile

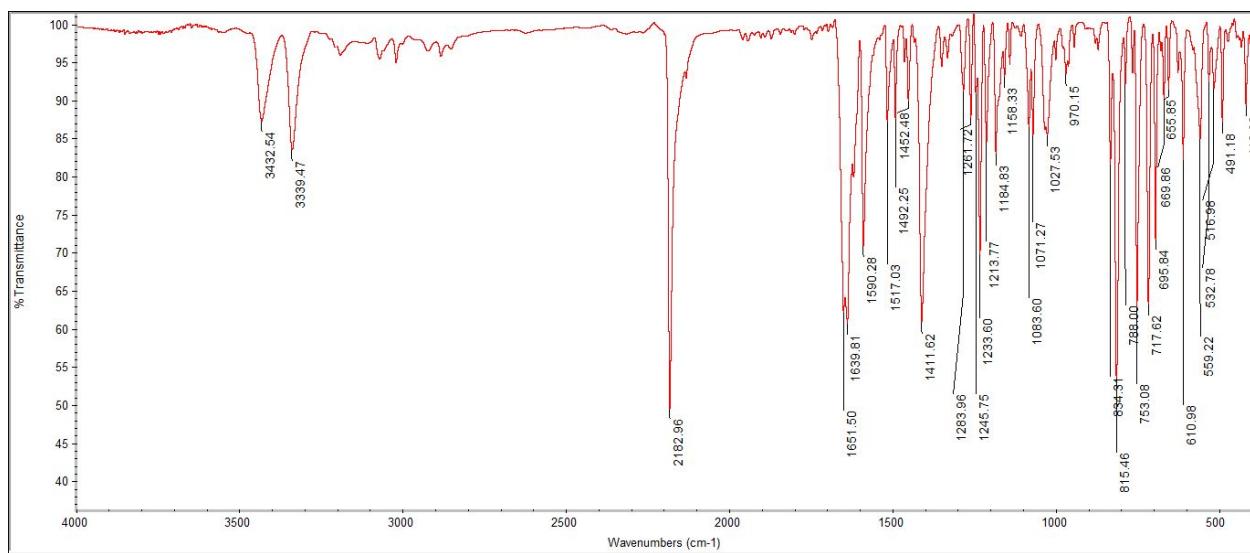


Figure S44. FT-IR spectrum of 3-amino-1-phenyl-1H-benzo[f]chromene-2-carbonitrile

sobhan-rezayati-chrom18-1400-2-20

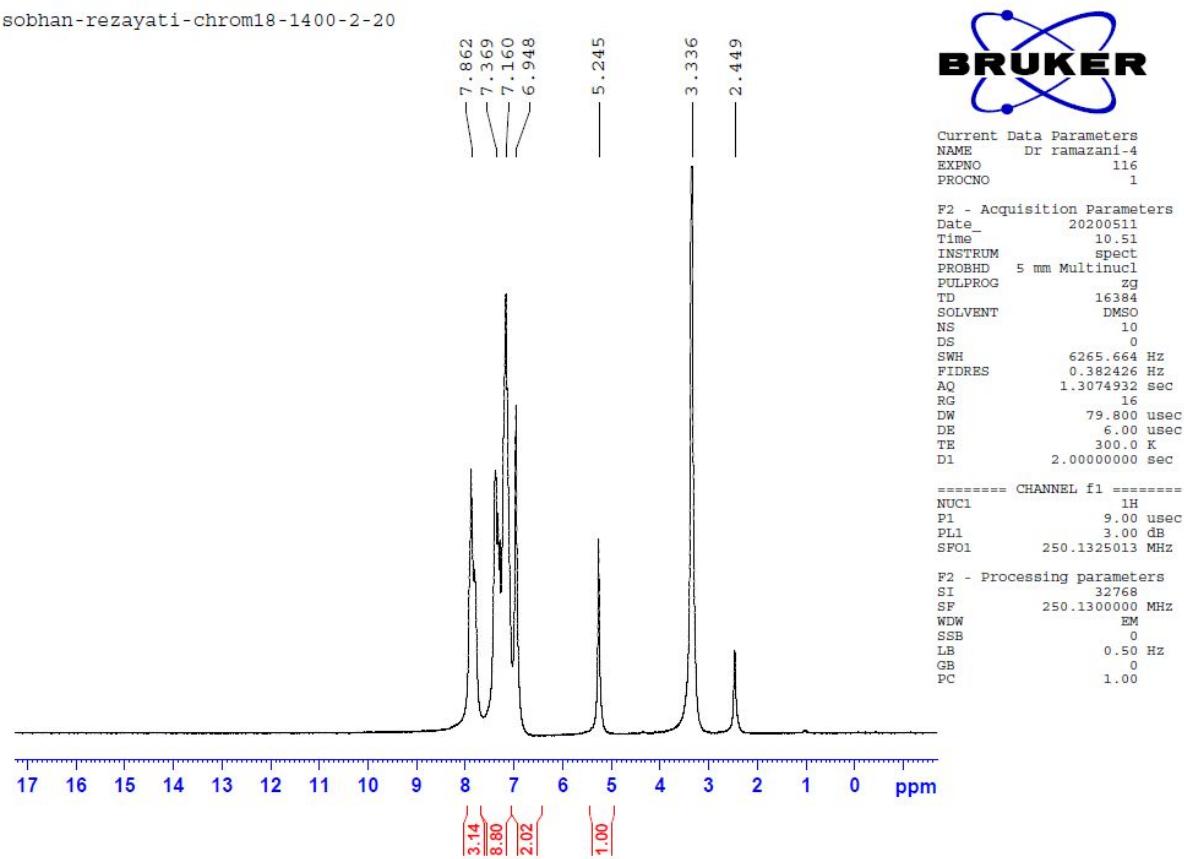


Figure S45. ¹H NMR spectrum of 3-amino-1-phenyl-1H-benzo[f]chromene-2-carbonitrile

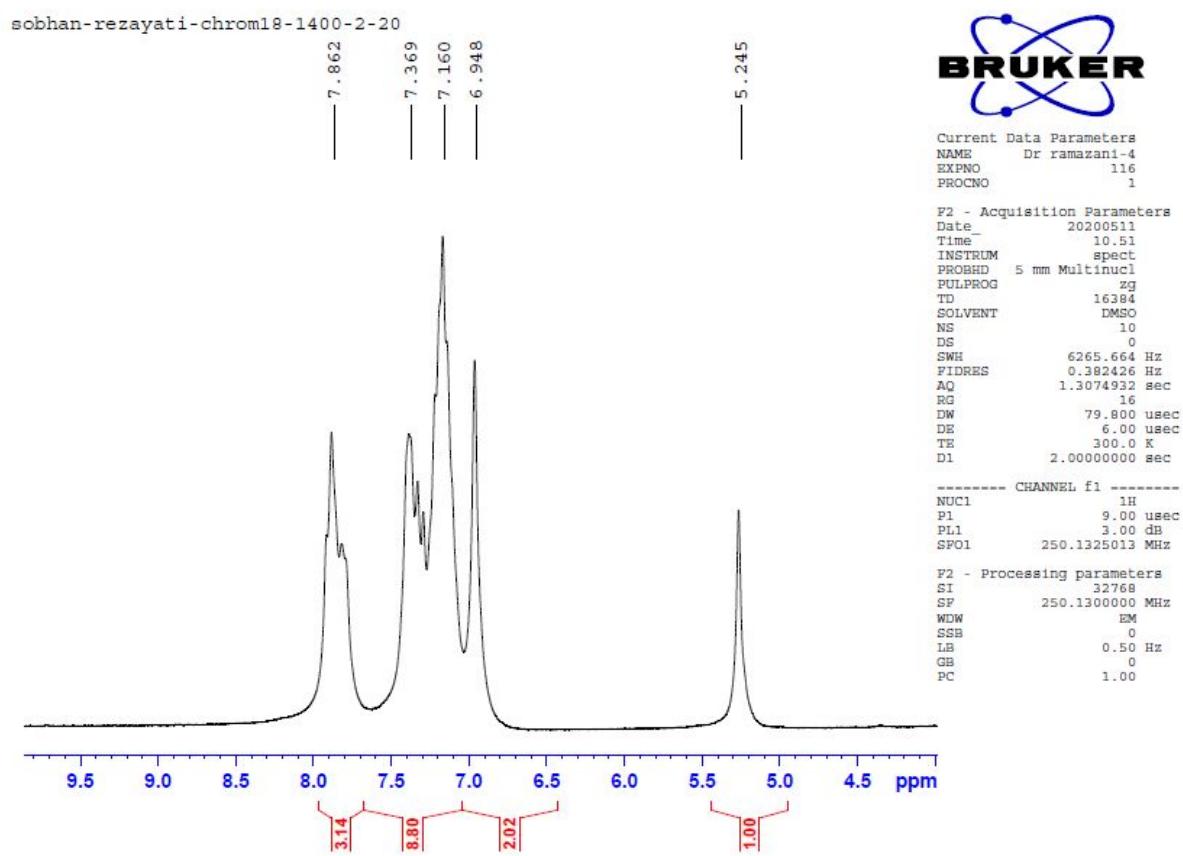


Figure S46. The expanded ^1H NMR spectrum of 3-amino-1-phenyl-1H-benzo[f]chromene-2-carbonitrile

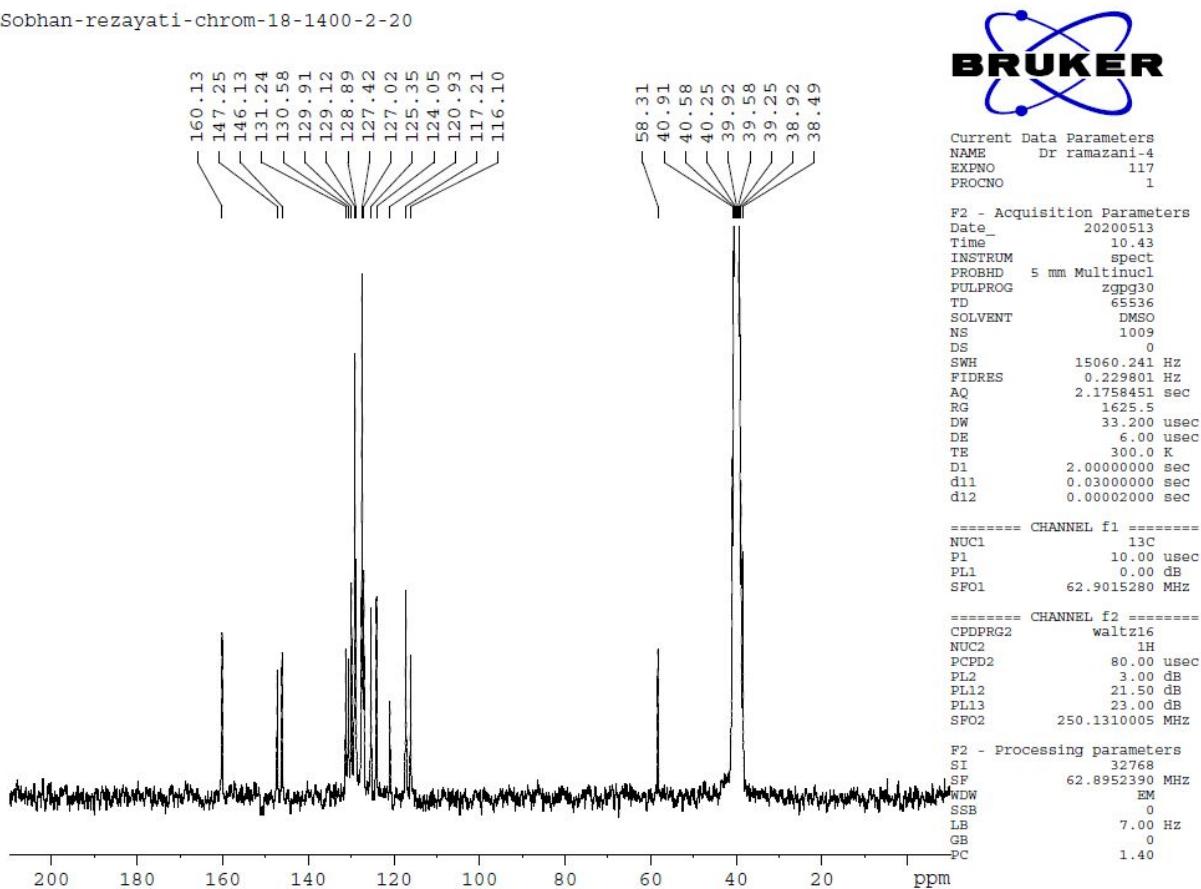


Figure S47. ^{13}C NMR spectrum of 3-amino-1-phenyl-1H-benzo[f]chromene-2-carbonitrile

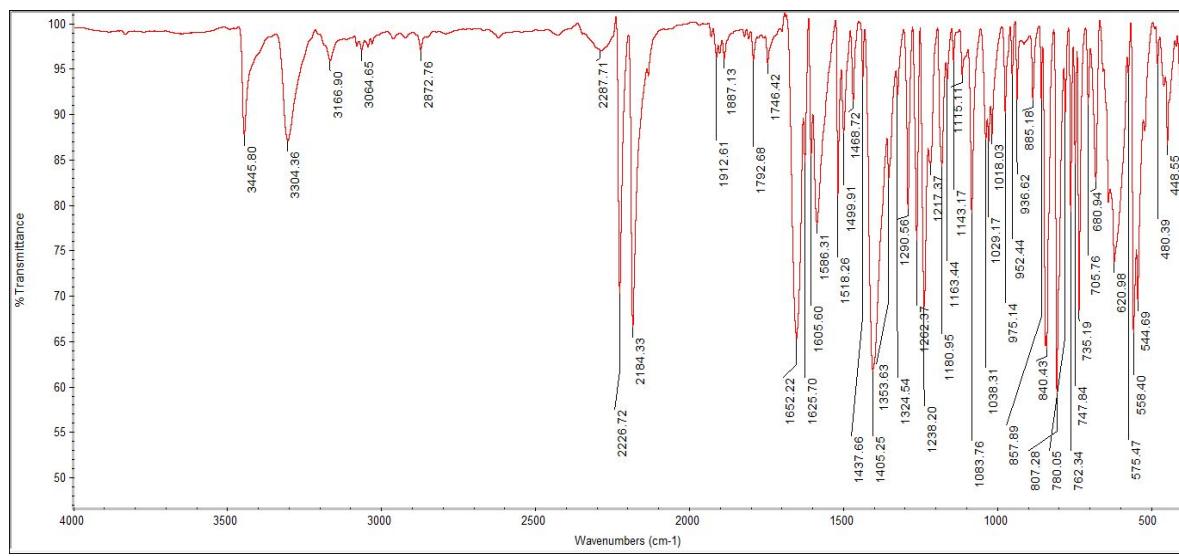


Figure S48. FT-IR spectrum of 3-amino-1-(4-cyanophenyl)-1H-benzo[f]chromene-2-carbonitrile (6c)

Sobhan-Rezayati-chrom-19-1400-2-25

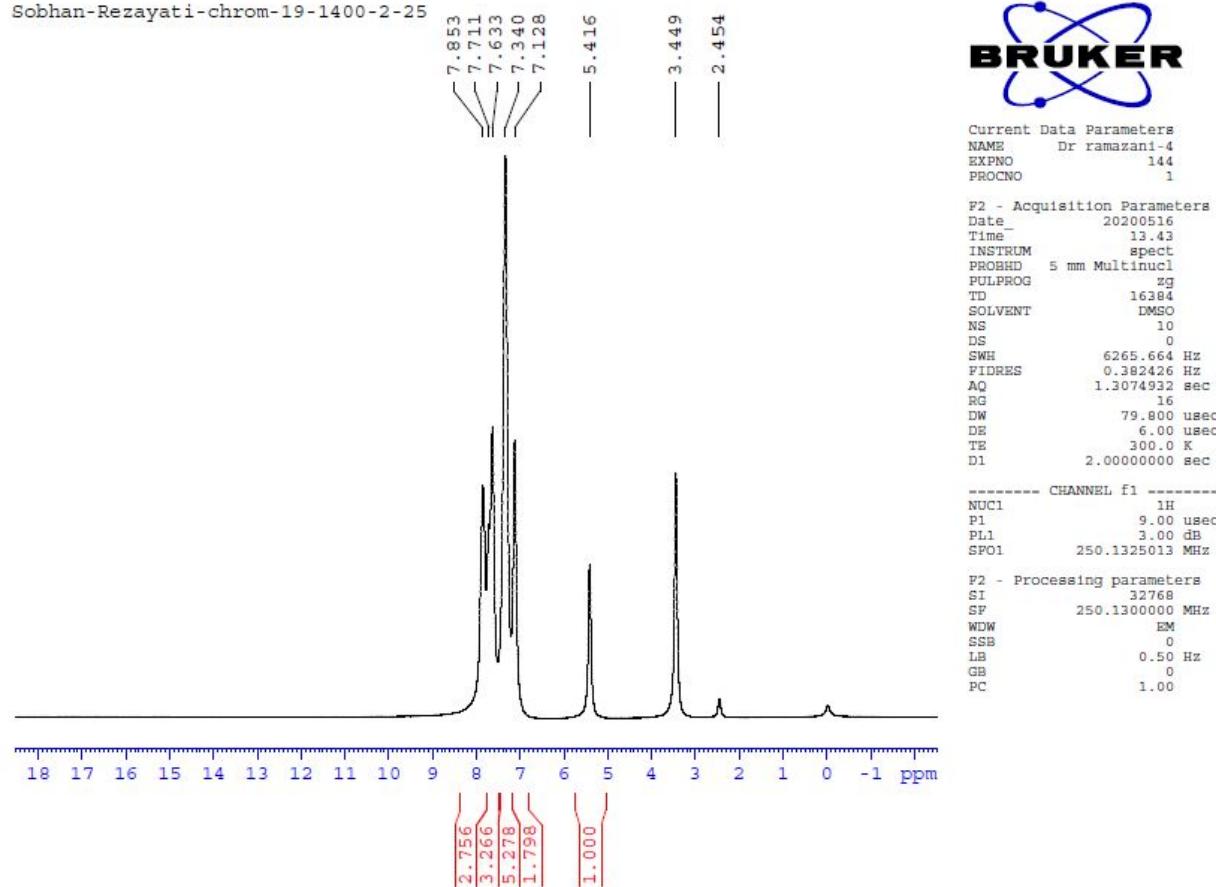


Figure S49. ^1H NMR spectrum of 3-amino-1-(4-cyanophenyl)-1H-benzo[f]chromene-2-carbonitrile

Sobhan-Rezayati-chrom-19-1400-2-25

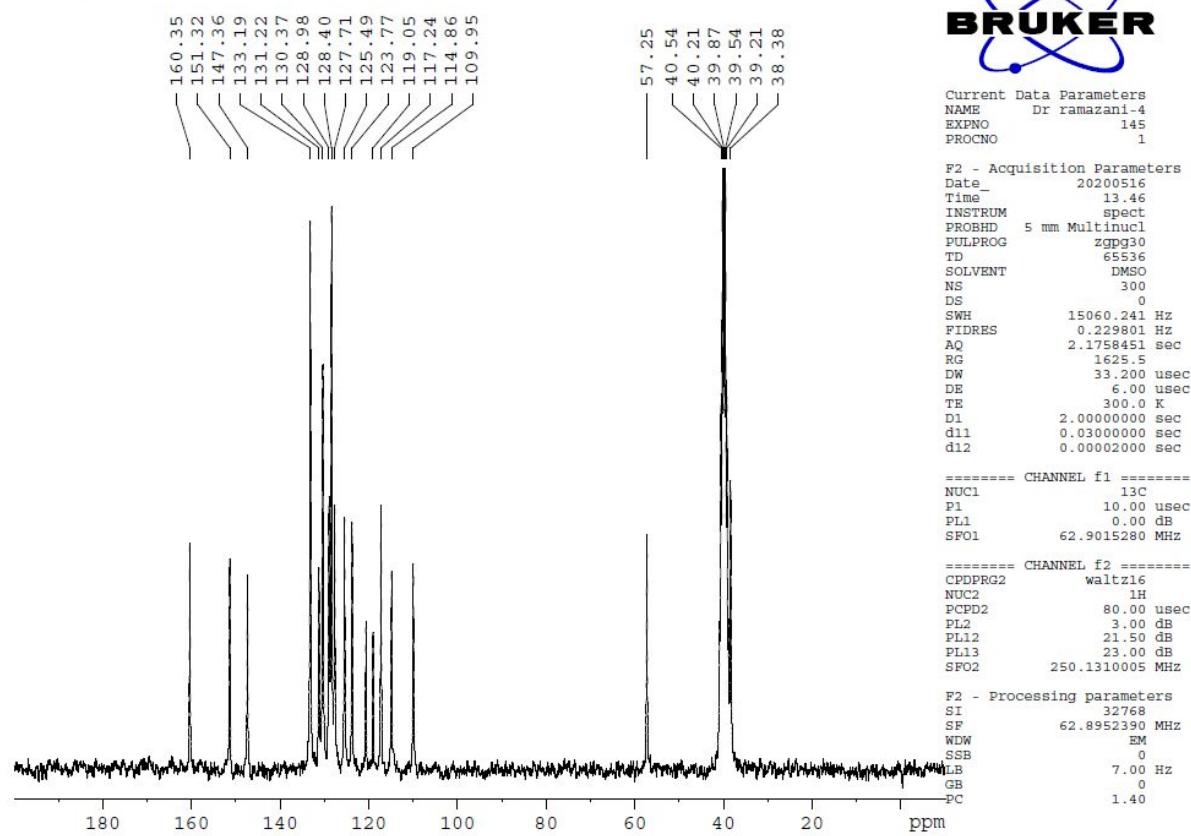


Figure S50. ¹³C NMR spectrum of 3-amino-1-(4-cyanophenyl)-1H-benzo[f]chromene-2-carbonitrile

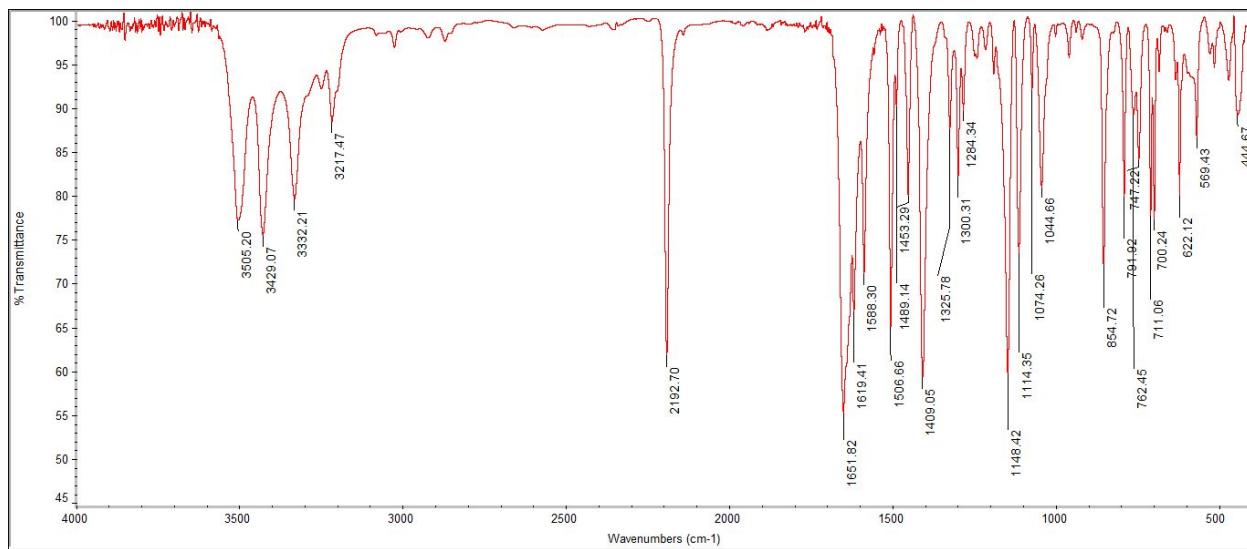


Figure S51. FT-IR spectrum of 2-amino-7-hydroxy-4-phenyl-4Hchromene-3-carbonitrile

Sobhan-rezayati-chrom14-1400-2-20

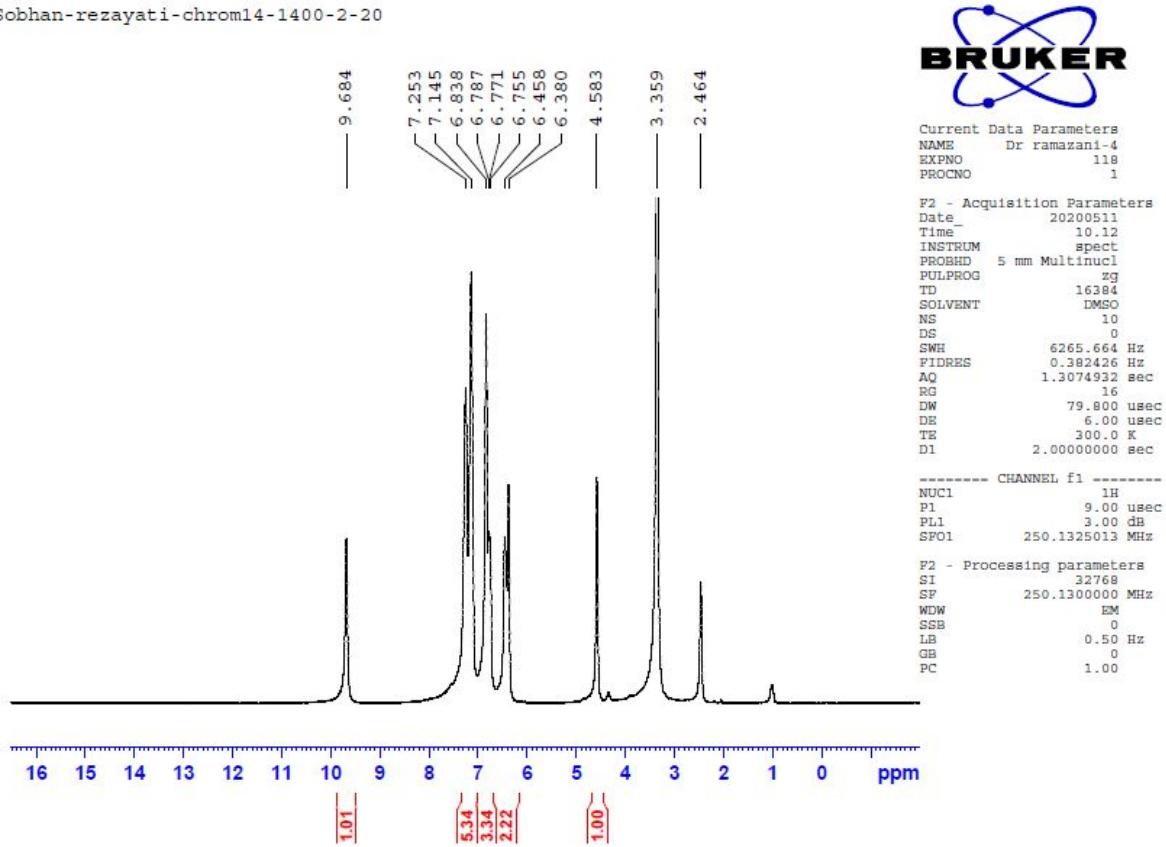


Figure S52. ^1H NMR spectrum of 2-amino-7-hydroxy-4-phenyl-4Hchromene-3-carbonitrile



Current Data Parameters
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 PROCN0 1

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 PULPROG zg
 TD 16384
 SOLVENT DMSO
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 DS 0
 SWH 6265.664 Hz
 FIDRES 0.382426 Hz
 AQ 1.3074932 sec
 RG 16
 DW 79.800 usec
 DE 6.00 usec
 TE 300.0 K
 D1 2.0000000 sec

===== CHANNEL f1 =====
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 P1 9.00 usec
 PL1 3.00 dB
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F2 - Processing parameters
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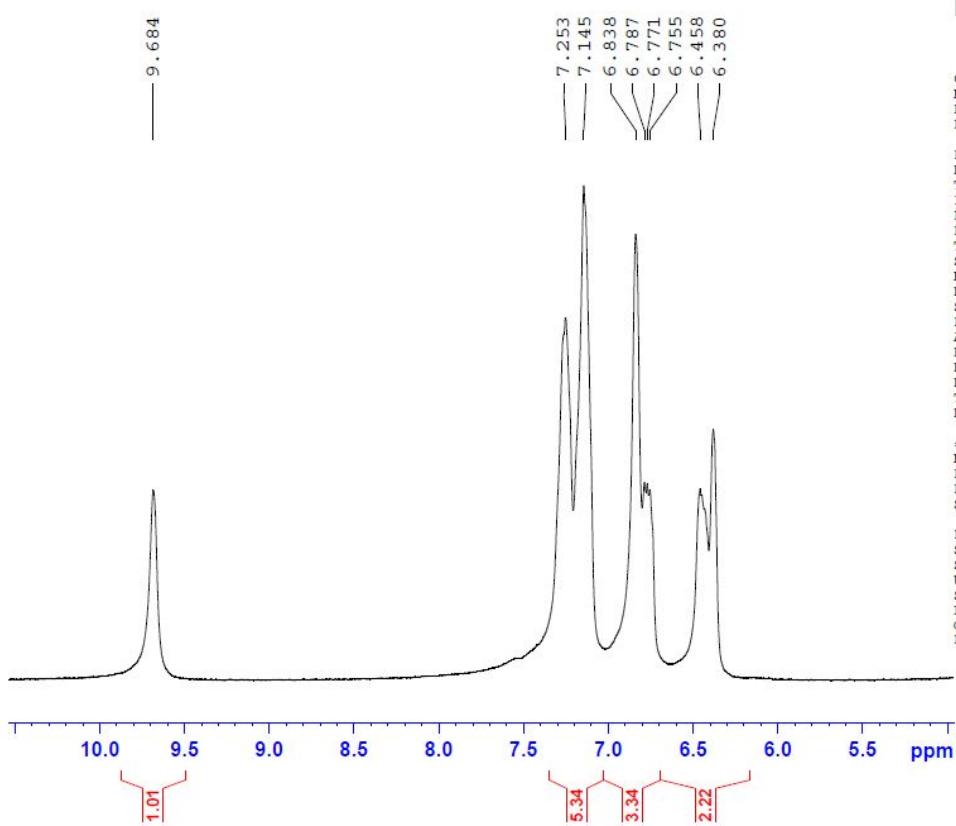


Figure S53. ^1H NMR expand spectrum of 2-Amino-7-hydroxy-4-phenyl-4Hchromene-3-carbonitrile

Sobhan-rezayati-chrom14-1400-2-20

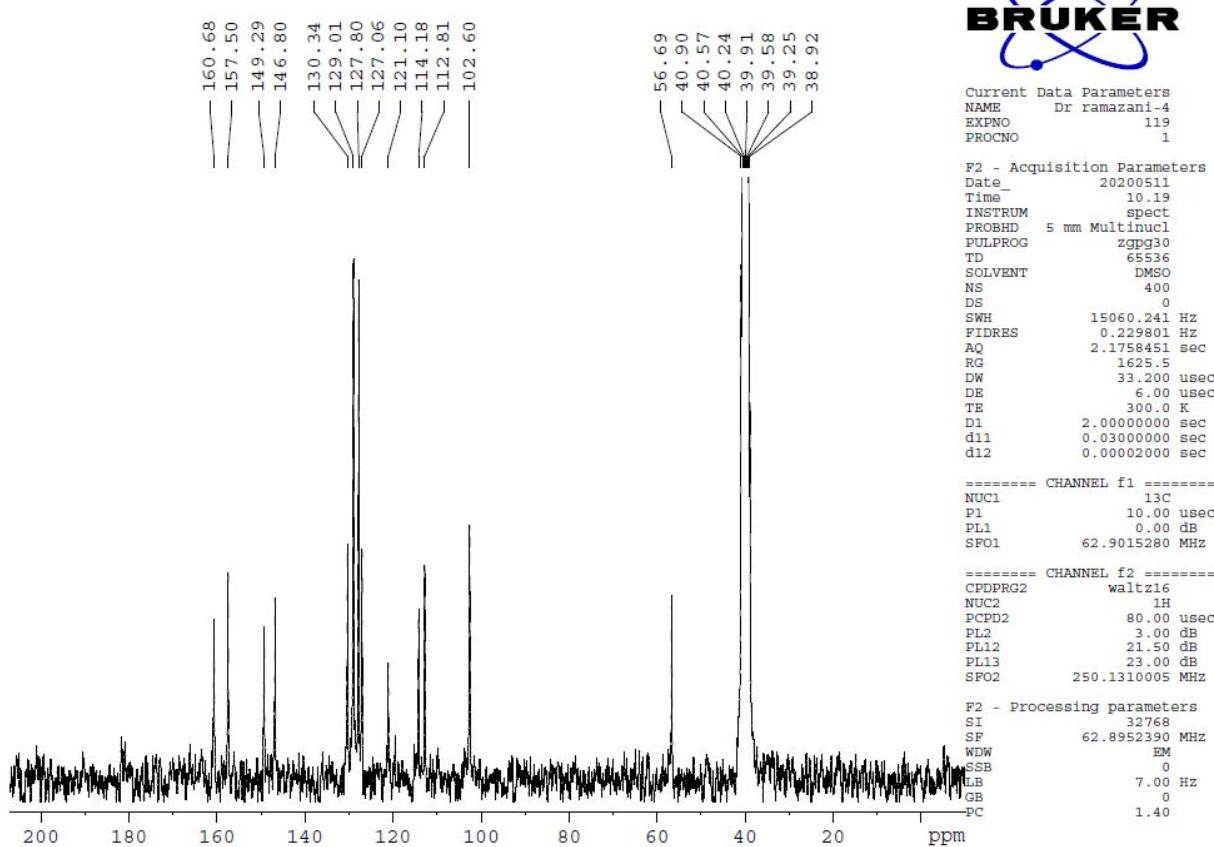


Figure S54. ^{13}C NMR spectrum of 2-amino-7-hydroxy-4Hchromene-3-carbonitrile

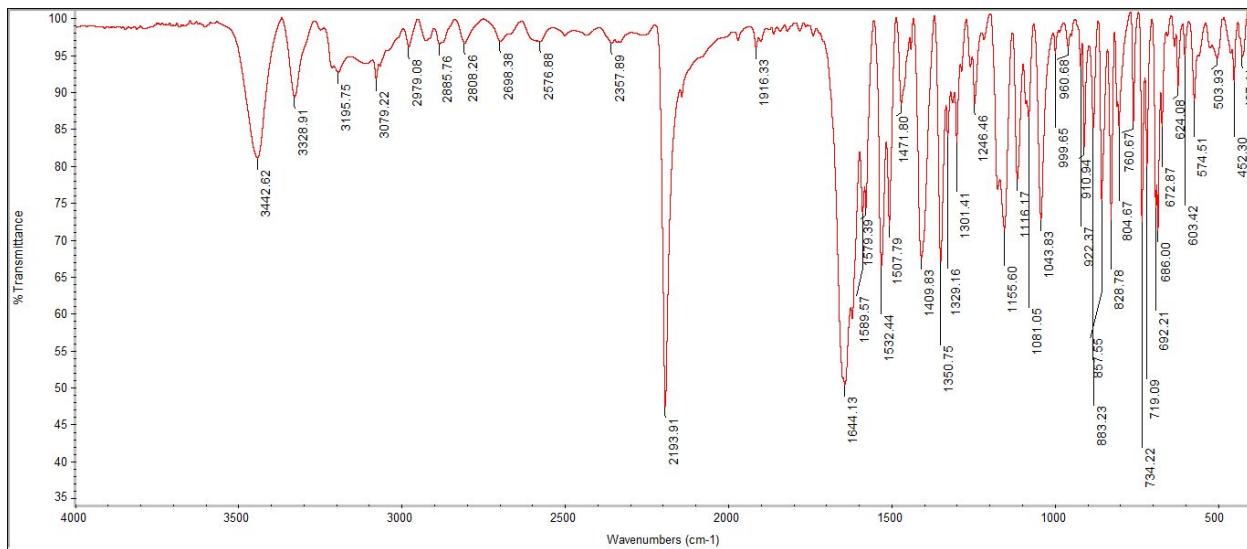


Figure S55. FT-IR spectrum of 2-amino-7-hydroxy-4-(3-nitrophenyl)-4H-chromene-3-carbonitrile

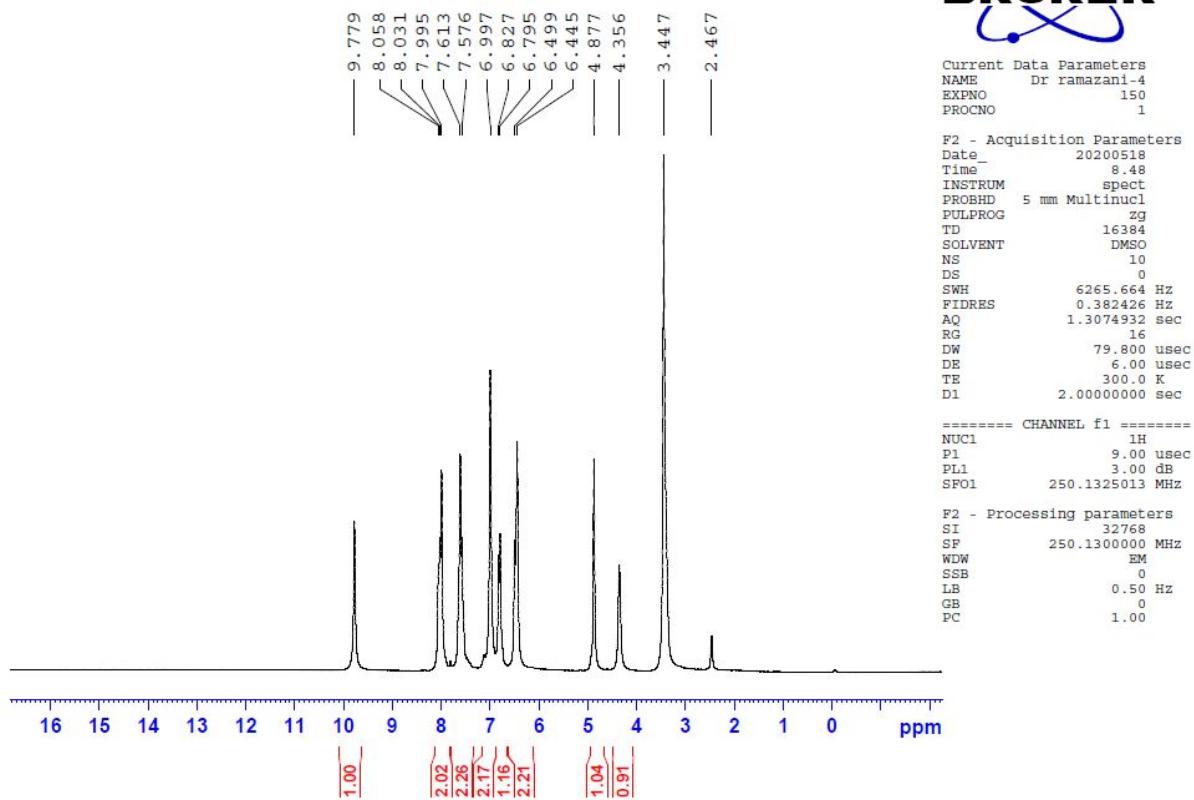


Figure S56. ^1H NMR spectrum of 2-amino-7-hydroxy-4-(3-nitrophenyl)-4*H*-chromene-3-carbonitrile



Current Data Parameters
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 PROCNO 1

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 RG 16
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 DE 6.00 usec
 TE 300.0 K
 D1 2.0000000 sec

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F2 - Processing parameters
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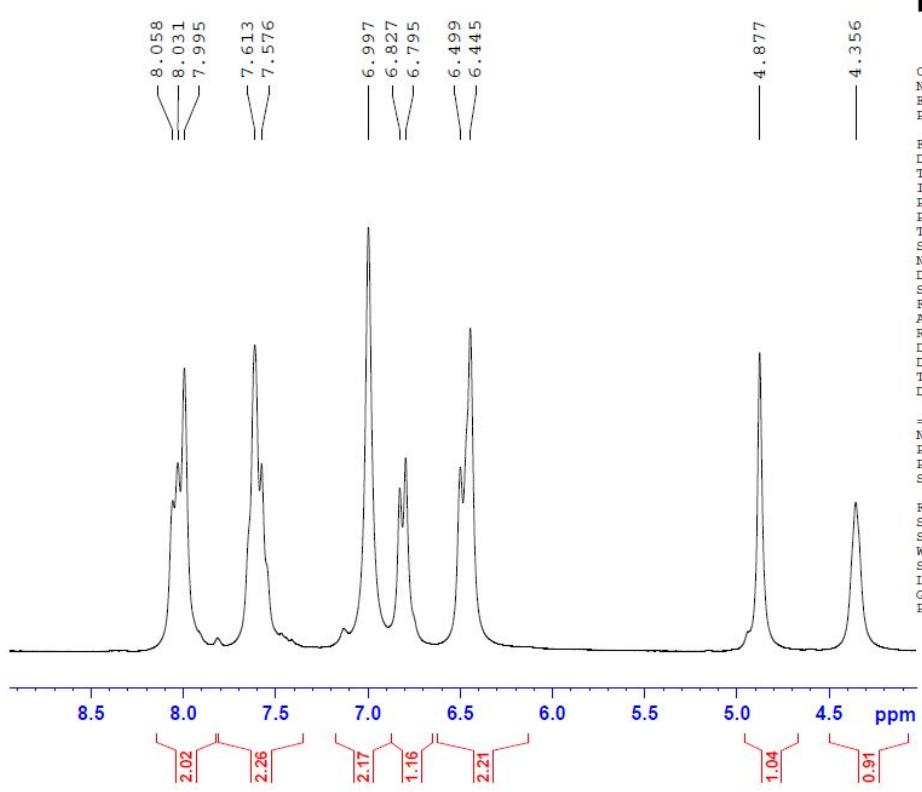


Figure S57. The expanded ^1H NMR spectrum of 2-amino-7-hydroxy-4-(3-nitrophenyl)-4*H*-chromene-3-carbonitrile

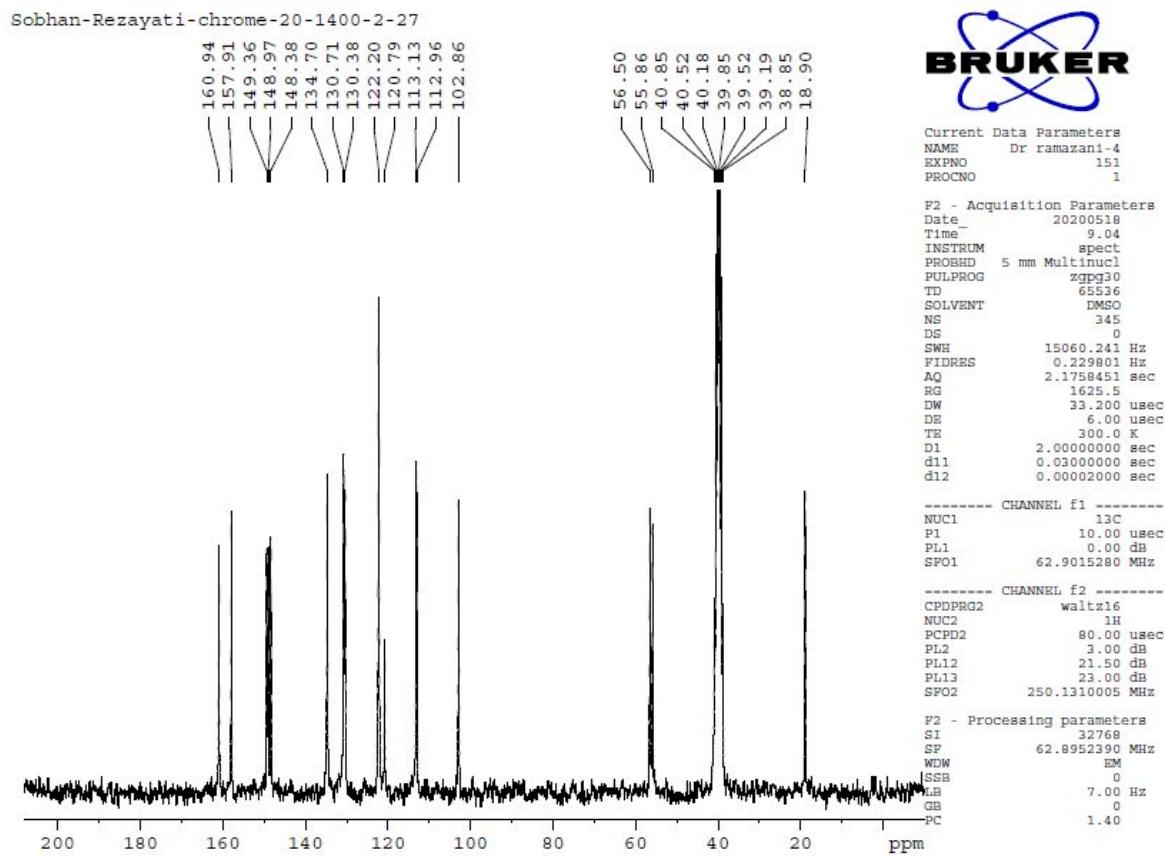


Figure S58. ¹³C NMR spectrum of 2-amino-7-hydroxy-4-(3-nitrophenyl)-4H-chromene-3-carbonitrile