FNAOSiPPEA: an effective magnetite almond shell-based nano catalyst for the synthesis of dihydropyrano[3,2-*c*]chromene and tetrahydrobenzo[*b*]pyran

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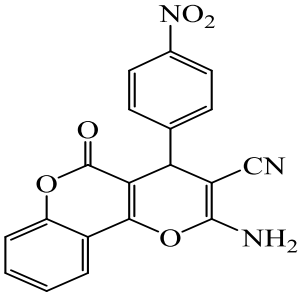
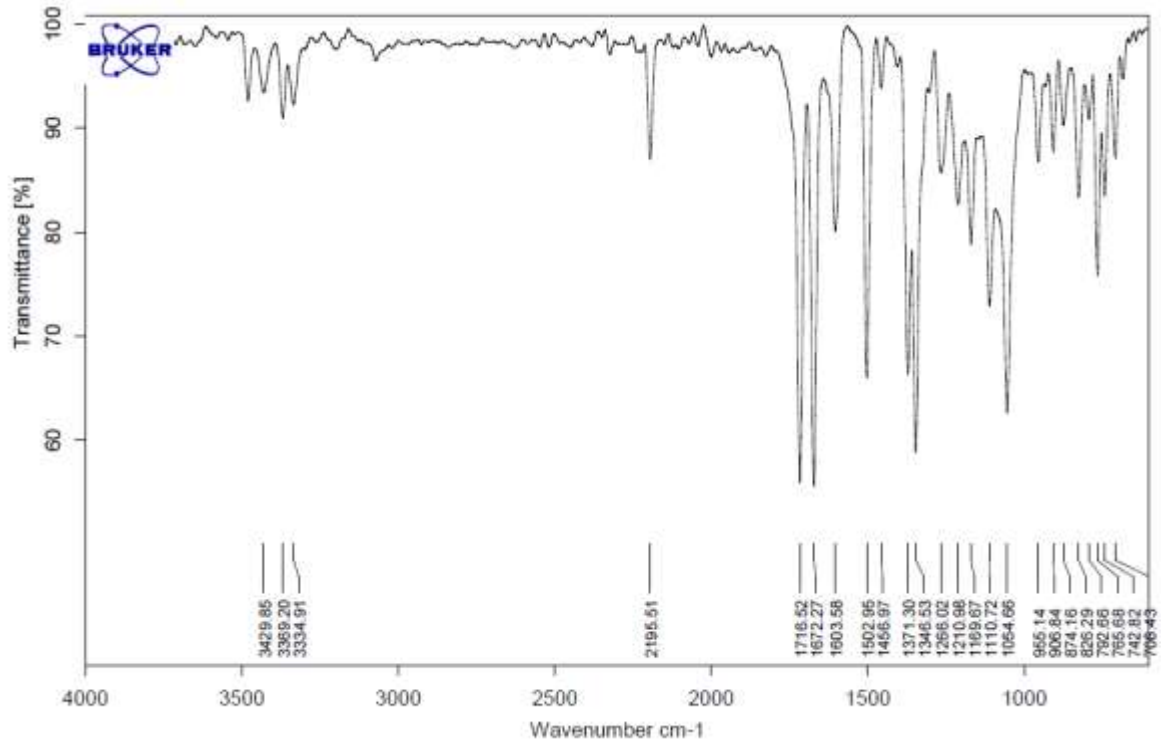
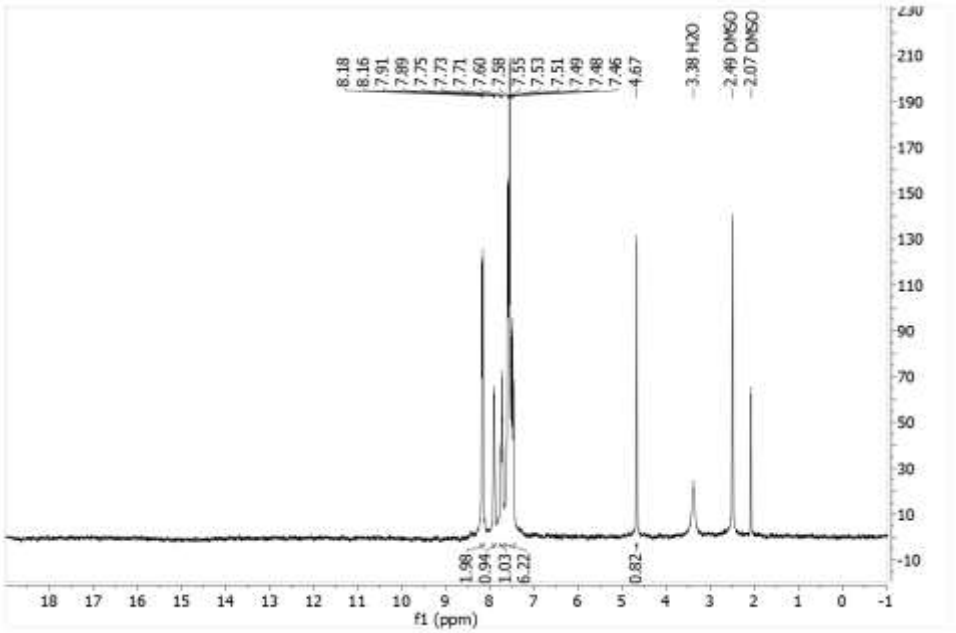
2-Amino-4-(4-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

Pale yellow solid, Melting point: 259-261 ºC, FT-IR (ATR)/υ(cm^{-1}): 3429, 3369, 3334 , 2195, 1716, 1672, 1603. ^{1}HNMR (400MHz, DMSO-d_6) δ(ppm): 4.67 (s, 1H, CH), 8.17 (d, 2H, *J*=8.8 Hz, Ar-H), 7.91 (d, 1H, *J*=7.2 Hz, Ar-H), 7.74 (t, 1H, *J*=7.6 Hz, Ar-H), 7.46-4.60 (m, 6H, Ar-H).

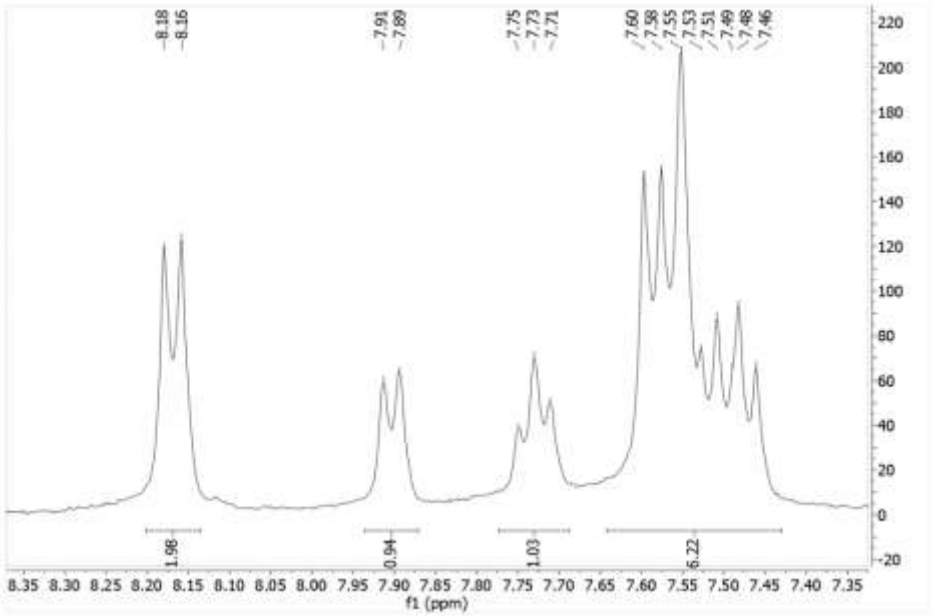




The FT-IR of 2-Amino-4-(4-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(4-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

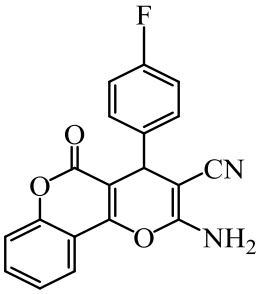


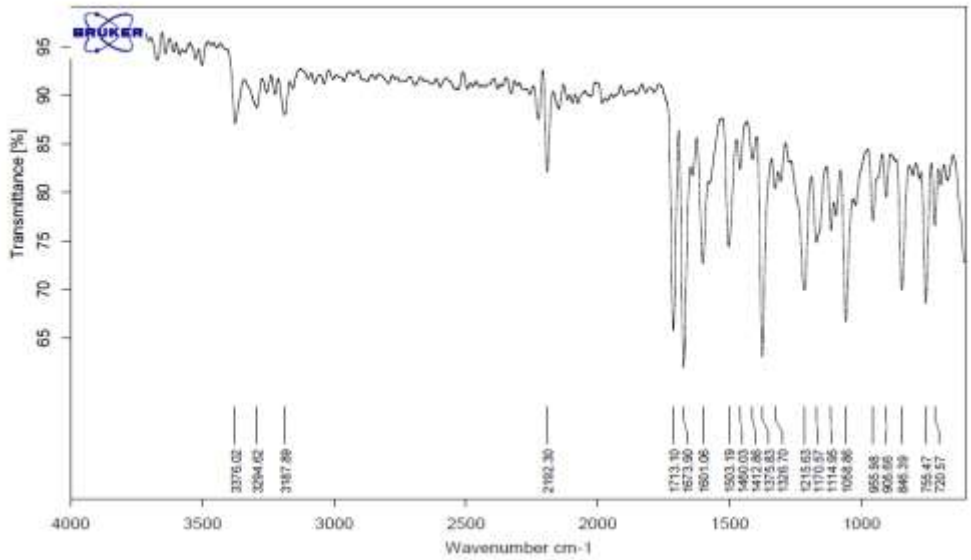
The ^{1}H NMR spectrum of 2-Amino-4-(4-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

2-Amino-4-(4-fluorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

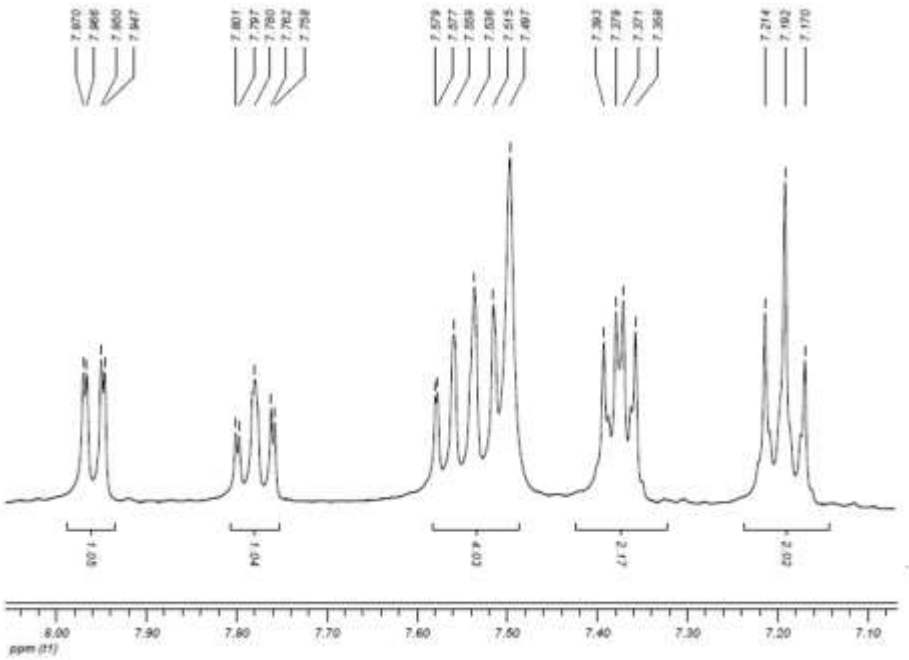
White Solid, Melting point: 261-263 ºC, FT-IR (ATR)/υ(cm^{-1}): 3376, 3295, 3188, 2192, 1713, 1674, 1601; ^{1}H NMR (400 MHz,DMSO-d$_6$) δ (ppm): 4.54(1H, s, CH), 7.17-7.21 (2H, t, *J*= 8.8Hz,

Ar-H), 7.35-7.39 (2H, td, J_1= 3.2Hz, J_2= 6.8Hz, Ar-H), 7.49-7.57 (4H, m), 7.75-7.80 (1H, dt, J_1= 1.6Hz, J_2= 8Hz, Ar-H),7.94-7.97 (1H, dd, J_1= 1.6Hz, J_2= 8Hz, Ar-H).





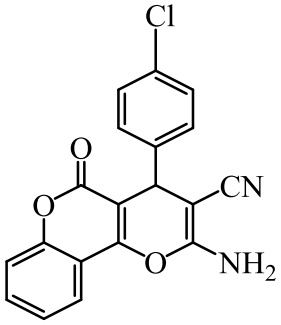
The FT-IR of 2-Amino-4-(4-fluorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

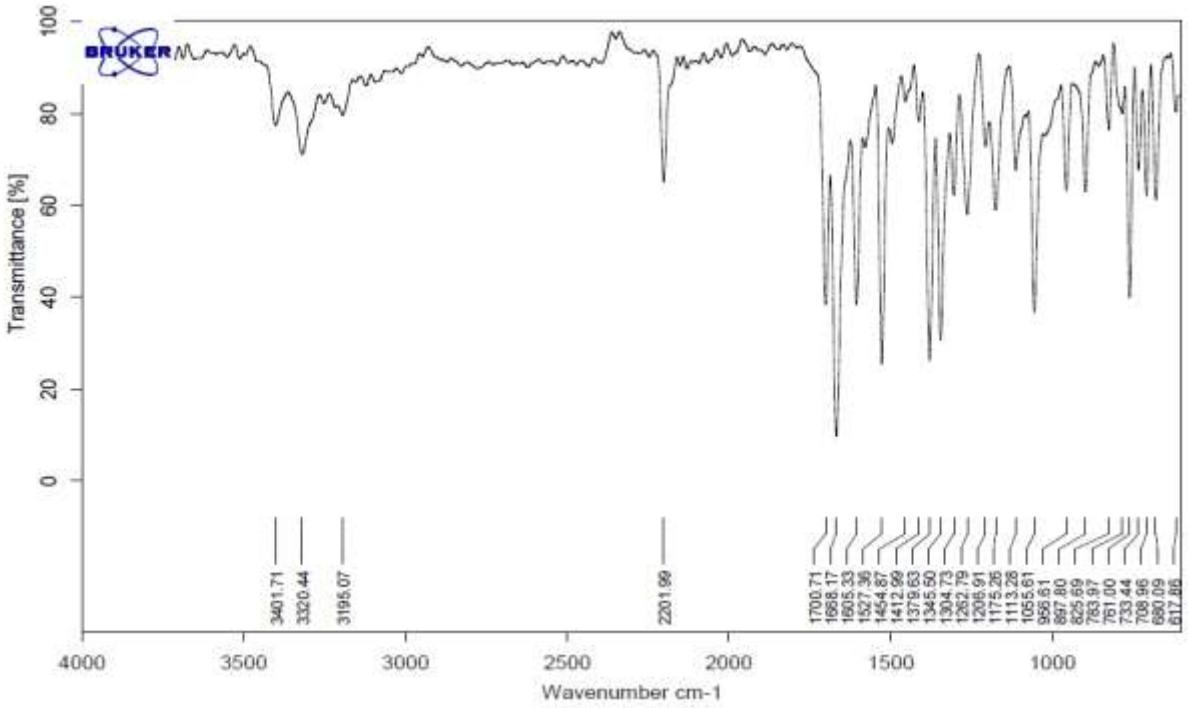


The ^{1}H NMR spectrum of 2-Amino-4-(4-fluorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

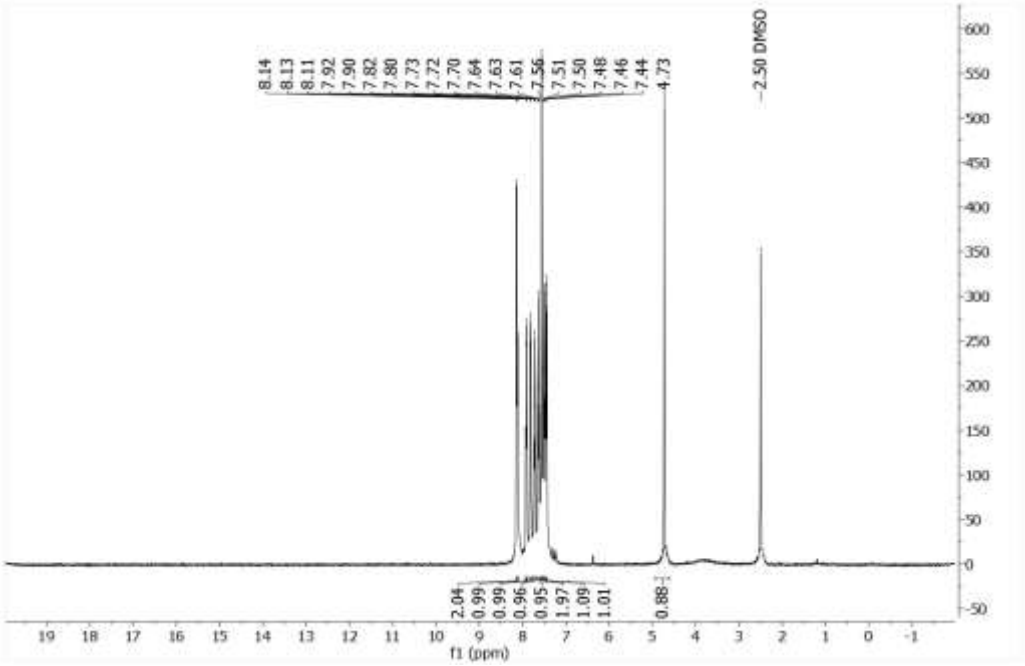
2-Amino-4-(4-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

White Solid, Melting point: 261-263 ºC, FT-IR (ATR)/υ(cm^{-1}): 3401, 3320, 3195, 2201, 1700, 1668, 1605; ^{1}HNMR (500MHz, DMSO-d$_6$) δ(ppm): 4.73 (1H, s, CH), 7.46 (d, 1H, *J* = 8Hz, Ar-H), 7.51 (t, 1H, *J* = 7.5 , Ar-H), 7.56 (s, 1H, NH$_2$), 7.64 (t, 1H, *J*=8Hz, Ar-H), 7.73 (t, 1H, *J* = 8Hz, Ar-H), 7.82 (d, 1H, *J* = 8 Hz, Ar-H), 7.92 (d, 1H, *J* = 7.5 Hz, Ar-H), 8.11-8.14 (m, 2H, Ar-H); ^{13}C NMR (125 MHz, DMSO-d$_6$) δ(ppm): 36.70, 56.97, 102.93, 113.01, 116.55, 119.04 , 122.31, 122.57, 125.02, 130.26, 132.73, 134.70, 145.56,147.65, 147.90, 152.33, 153.94, 158.20, 159.67.

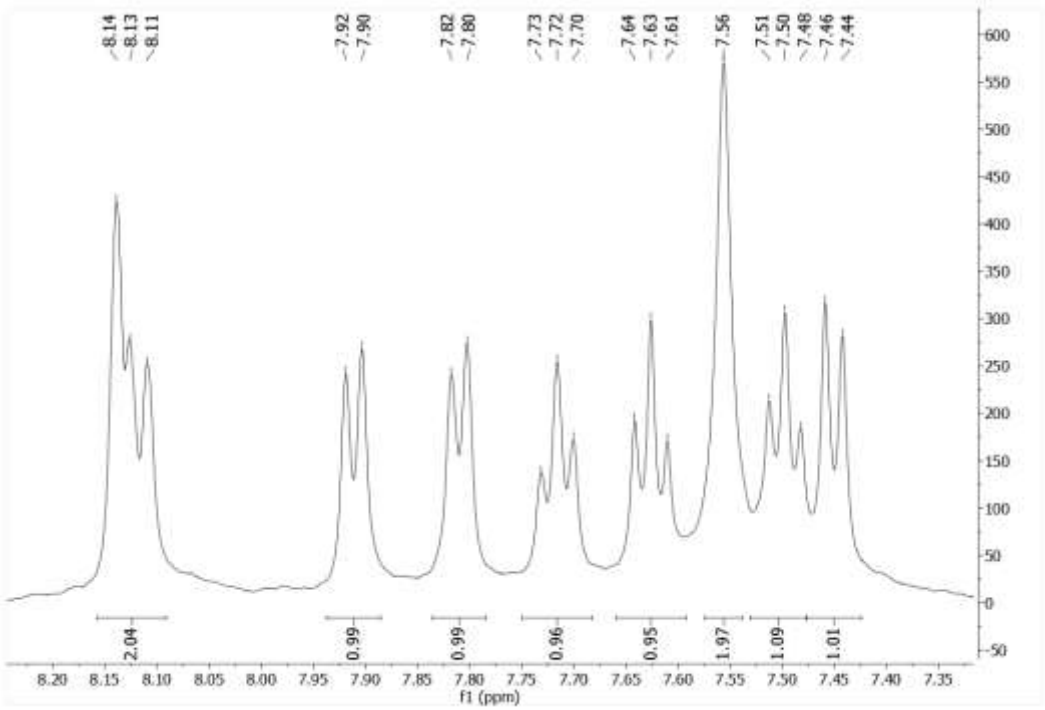




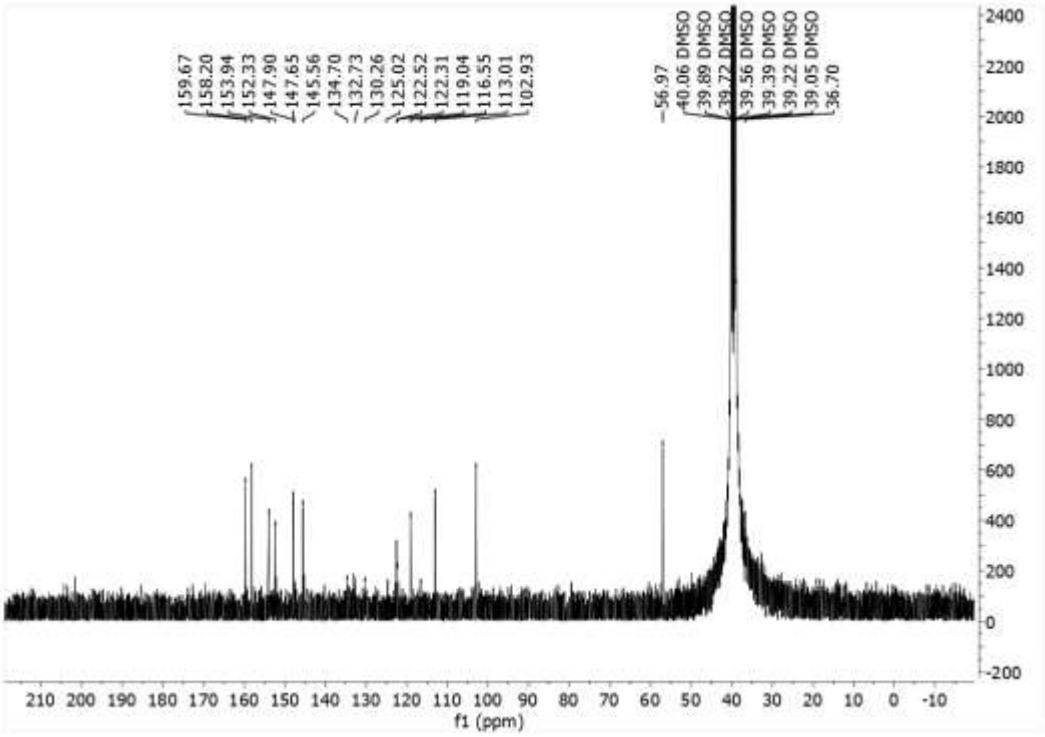
The FT-IR of 2-Amino-4-(4-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(4-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

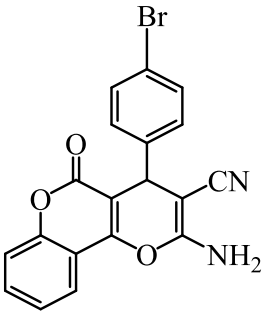


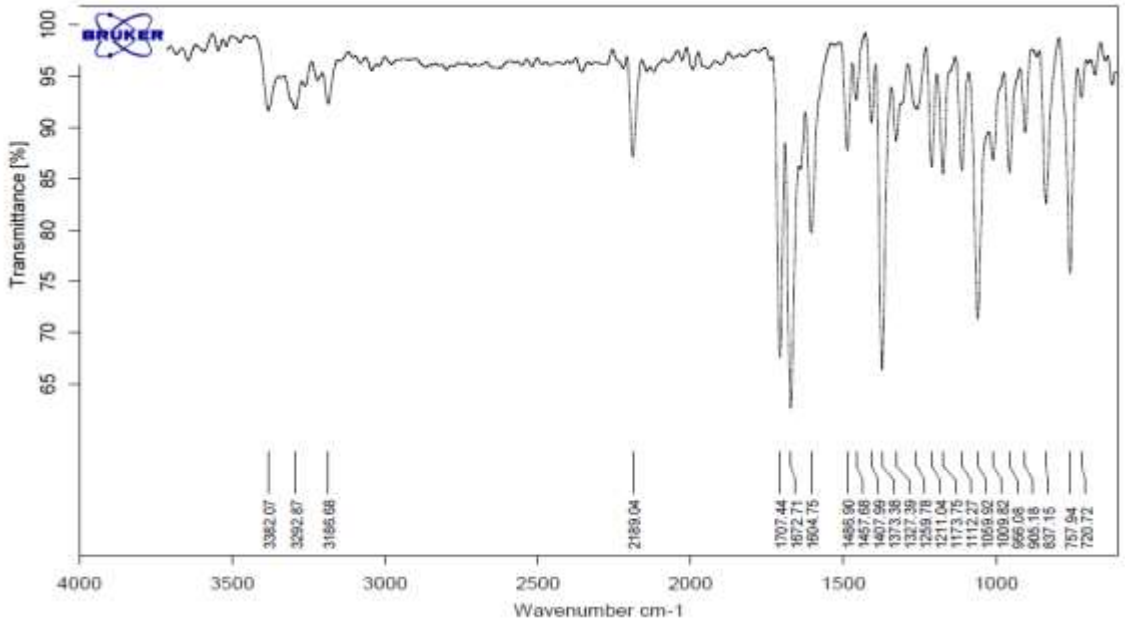
The ^{1}H NMR spectrum of 2-Amino-4-(4-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



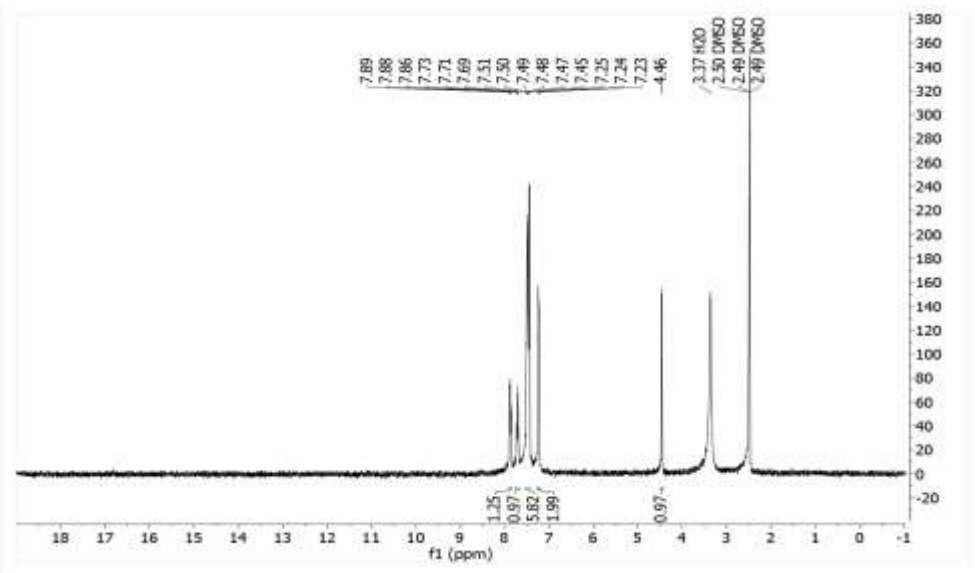
The ^{1}H NMR spectrum of 2-Amino-4-(4-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

2-Amino-4-(4-bromophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile
White Solid, Melting point: 248-250 ºC. FT-IR (ATR)/υ(cm^{-1}): 3382, 3292, 3186, 2189, 1707, 1672, 1604; ^{1}HNMR (400MHz, DMSO-d$_6$) δ(ppm): 4.46 (s, 1H, CH), 7.45-7.51 (m, 6H, Ar-H), 7.73 (t, 1H, *J*=8.4 Hz, Ar-H), 7.87 (d, 2H, *J*=8 Hz, Ar-H).

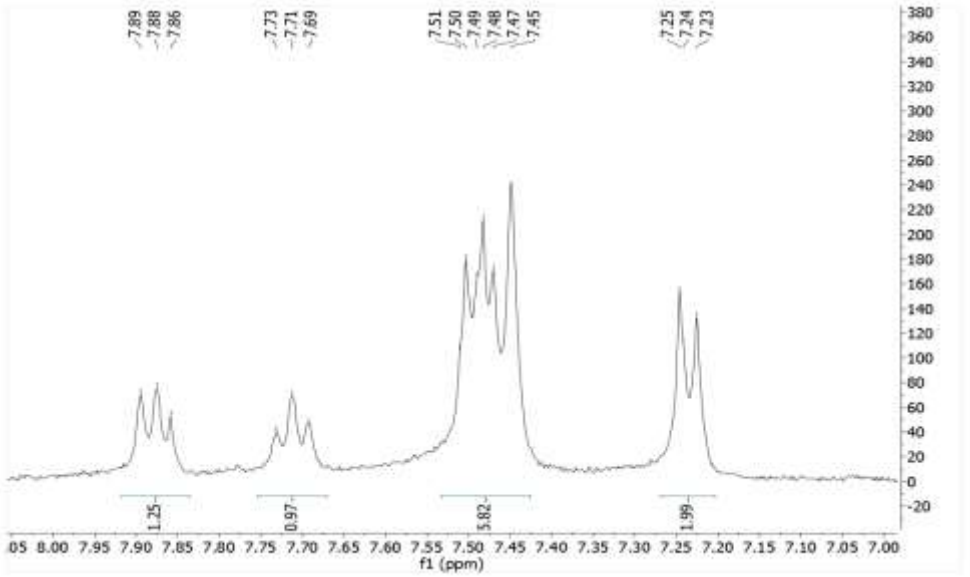




The FT-IR of 2-Amino-4-(4-bromophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(4-bromophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

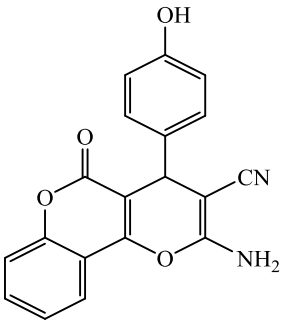


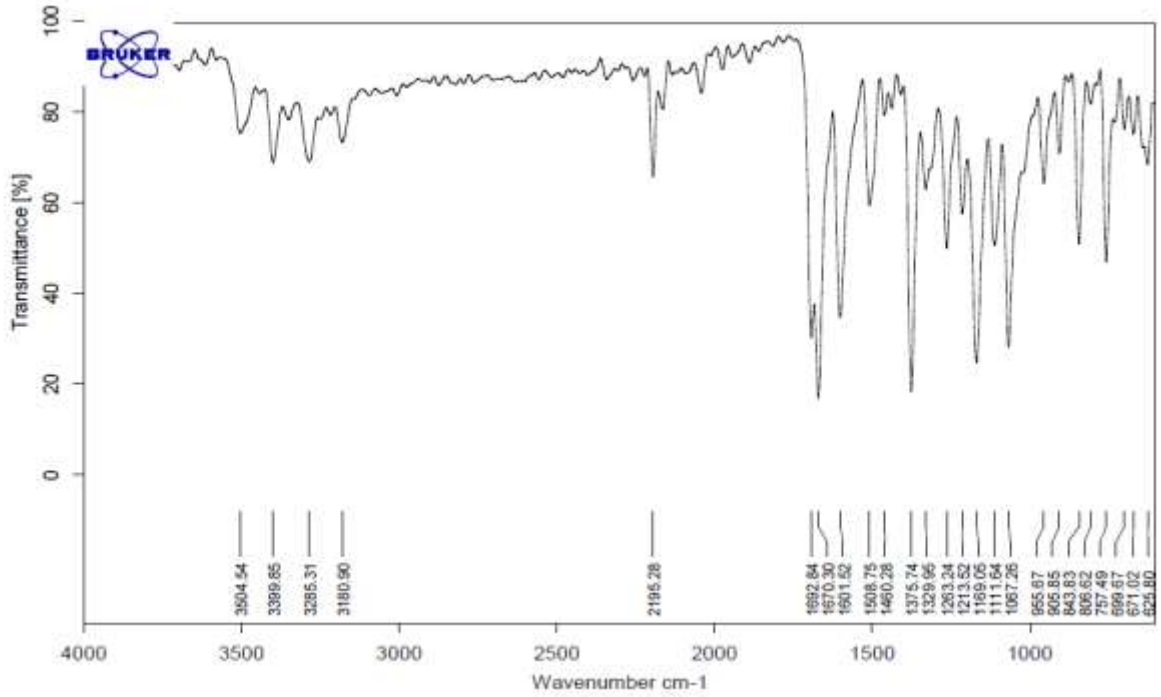
The ^{1}H NMR spectrum of 2-Amino-4-(4-bromophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

2-Amino-4-(4-hydroxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

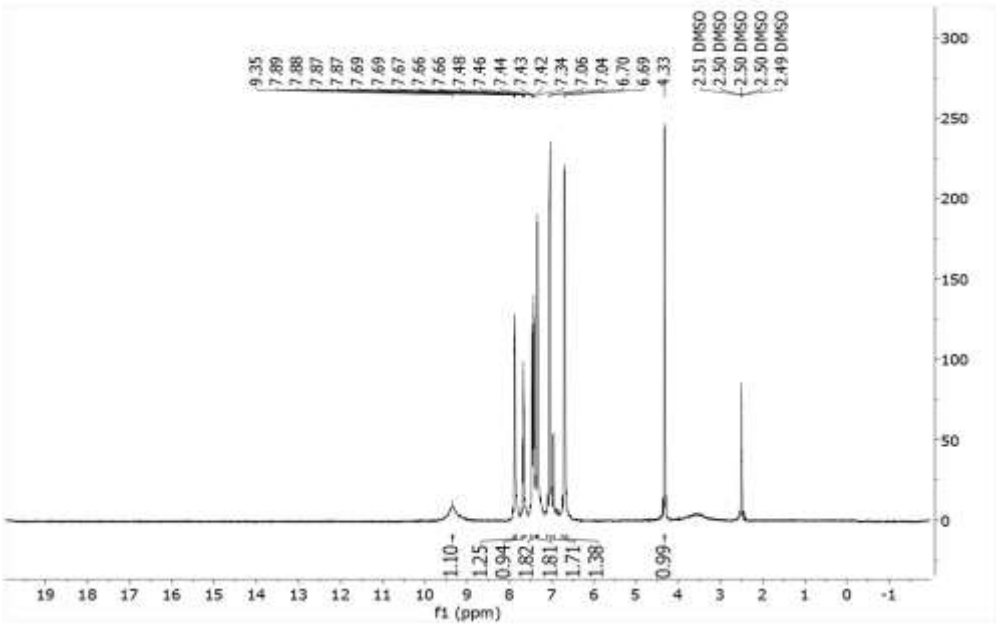
White Solid, Melting point: 260-262 ºC, FT-IR (ATR)/υ(cm^{-1}): 3399, 3285, 3180, 2195, 1692, 1670, 1601; ^{1}HNMR(500MHz,DMSO-d$_6$) δ (ppm): 4.33 (s, 1H), 6.70 (d, 2H, J = 8.5 Hz), 7.06 (d, 2H, J = 8.5 Hz), 7.34 (s, 2H, NH_2), 7.42-7.48 (m, 2H), 7.69 (dt, 1H, J_1 = 7.8 Hz, J_2 = 1.6 Hz), 7.89 (dd, 1H, J_1 = 7.8 Hz, J_2 =1.4 Hz), 9.35 (s, 1H, OH). ^{13}C NMR (125 MHz, DMSO-d$_6$) δ (ppm)

58.40, 75.11, 104.50, 113.03, 114.21, 115.12, 116.63, 119.43, 122.79, 124.68, 128.73, 133.73, 152.05, 152.97, 156.49, 157.90, 159.55, 163.91.

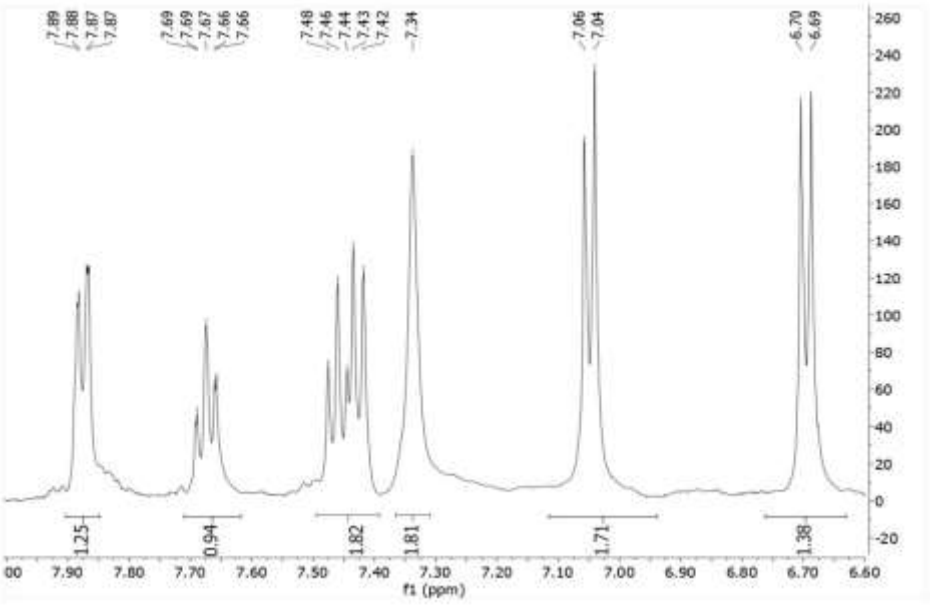




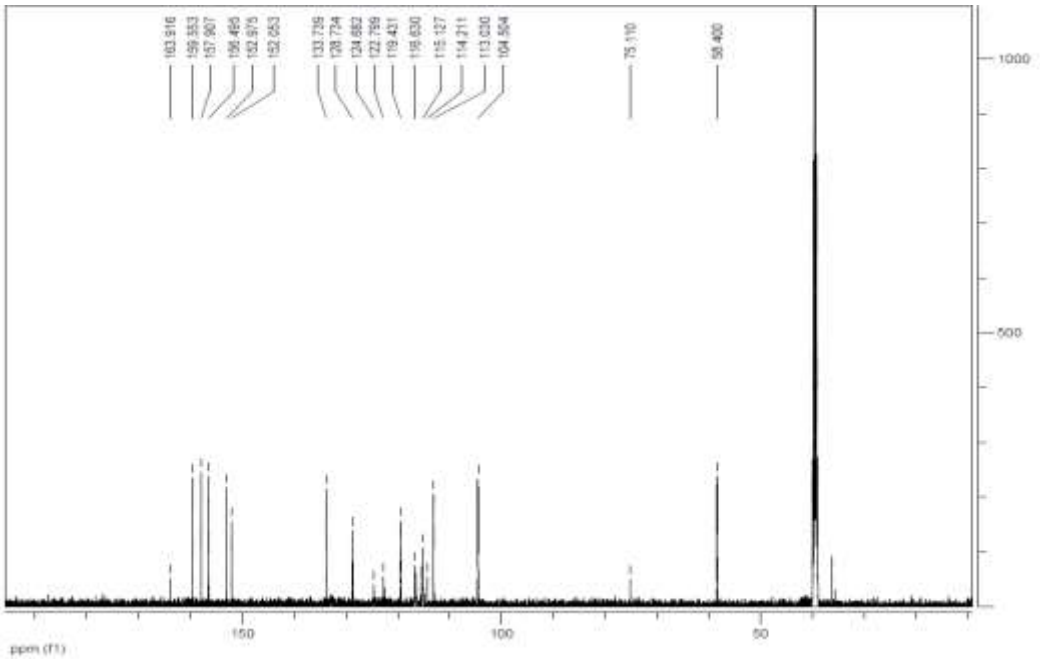
The FT-IR of 2-Amino-4-(4-hydroxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of2-Amino-4-(4-hydroxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



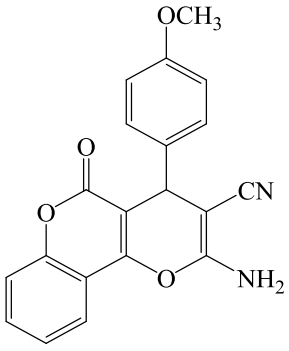
The ^{1}H NMR spectrum of2-Amino-4-(4-hydroxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

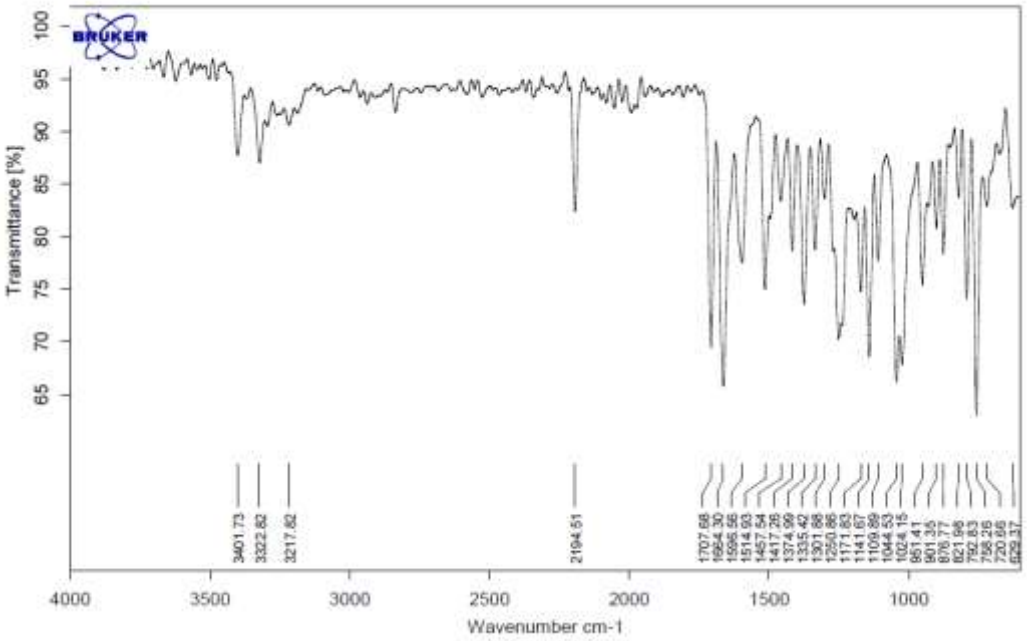


The ^{1}H NMR spectrum of 2-Amino-4-(4-hydroxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

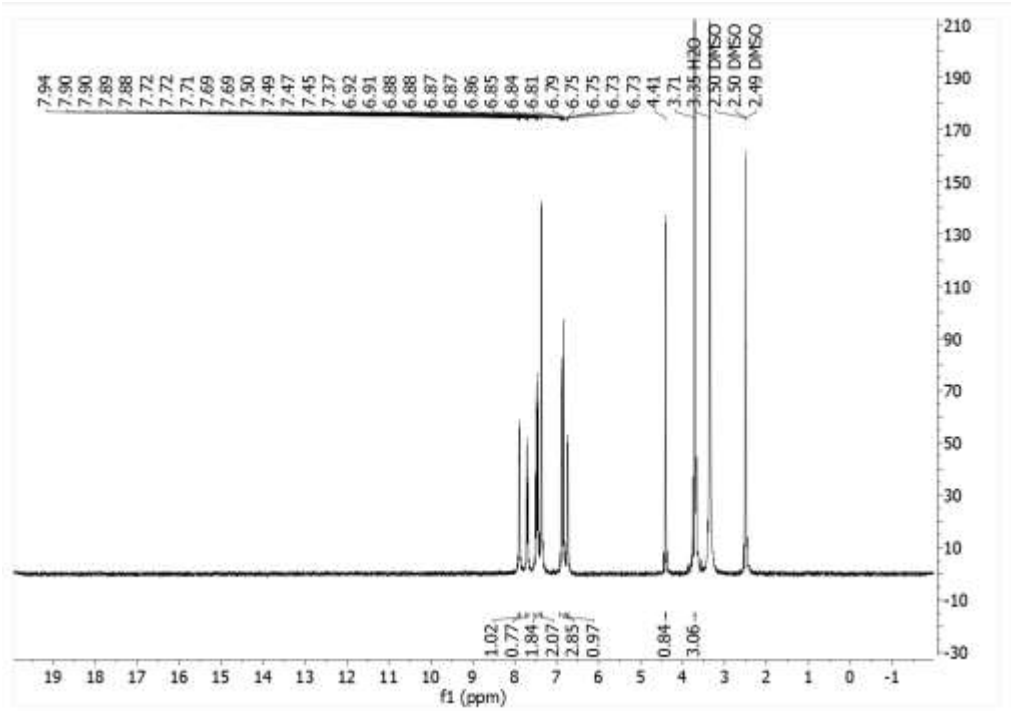
2-Amino-4-(4-methoxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

Pale yellow solid, Melting point: 248-251 ºC, FT-IR (ATR)/υ(cm^{-1}): 3401, 3322, 3217, 2194, 1707, 1664, 1596; ^{1}HNMR(500MHz,DMSO-d$_6$) δ (ppm): 3.71 (s, 3H, OCH_3), 4.41 (s, 1H), 6.75-6.73 (dd, 1H, J_1 = 8.5 Hz, J_2 = 2.5 Hz, Ar-H), 6.84-6.88 (m, 2H, Ar-H), 7.37 (s, 2H, NH_2), 7.45-7.50 (m, 2H, Ar-H), 7.72 (t, 1H, J = 7Hz, Ar-H), 7.88-7.90 (dd, 1H, J_1 = 8 Hz, J_2 =1.5 Hz, Ar-H). ^{13}C NMR (125 MHz, DMSO-d$_6$) δ (ppm) 55.49, 58.11, 66.34, 78.97, 101.95, 104.11, 106.59, 112.22, 113.05, 116.66, 119.34, 119.67, 124.69, 135.84, 147.93, 148.50, 152.11, 153.18, 157.92, 159.60.

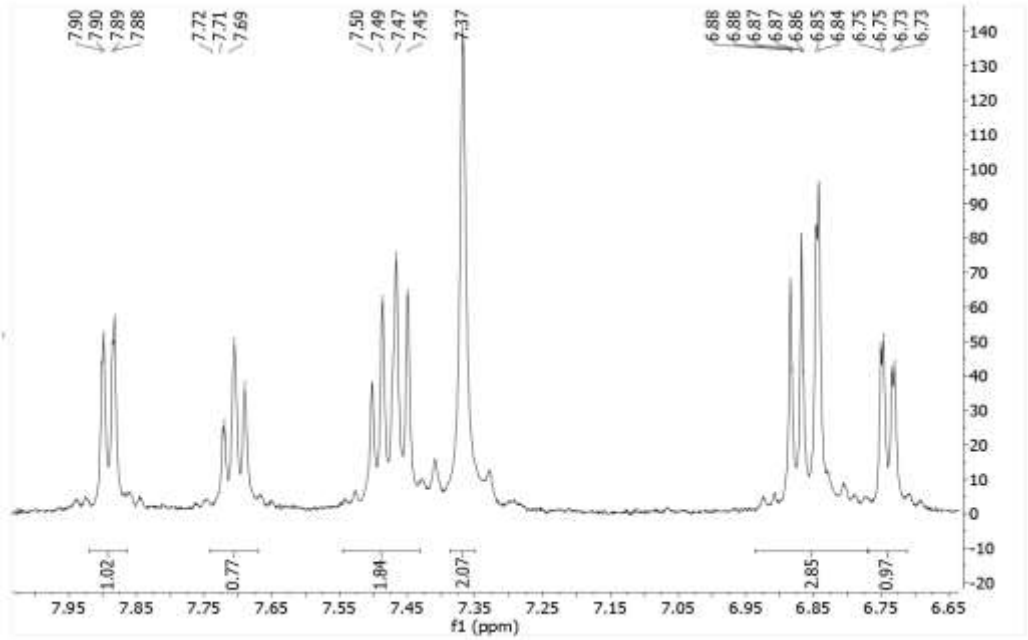




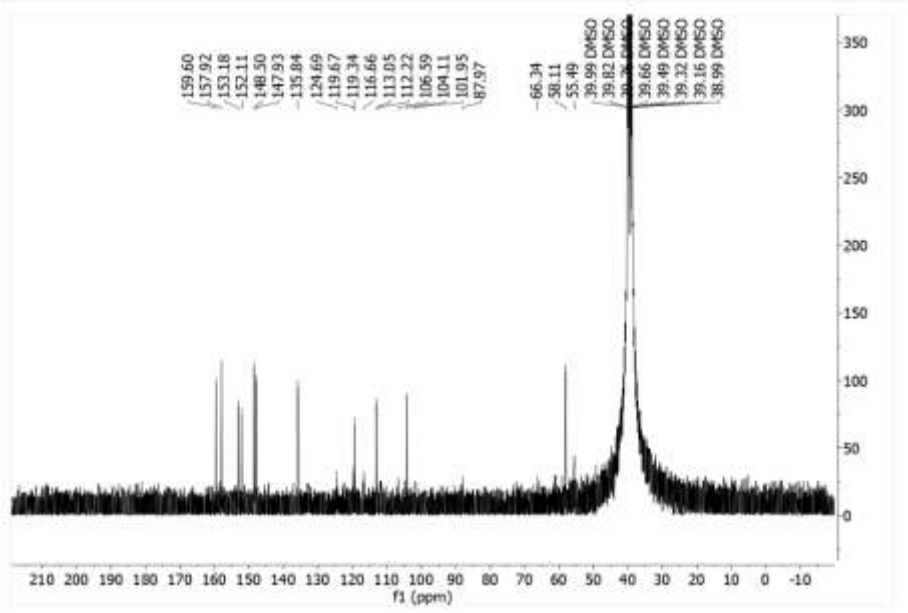
The FT-IR of 2-Amino-4-(4-methoxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(4-methoxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

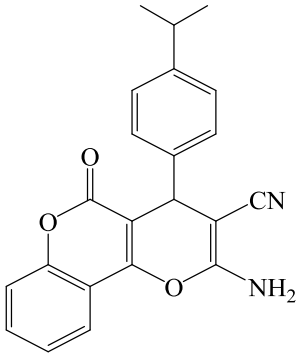


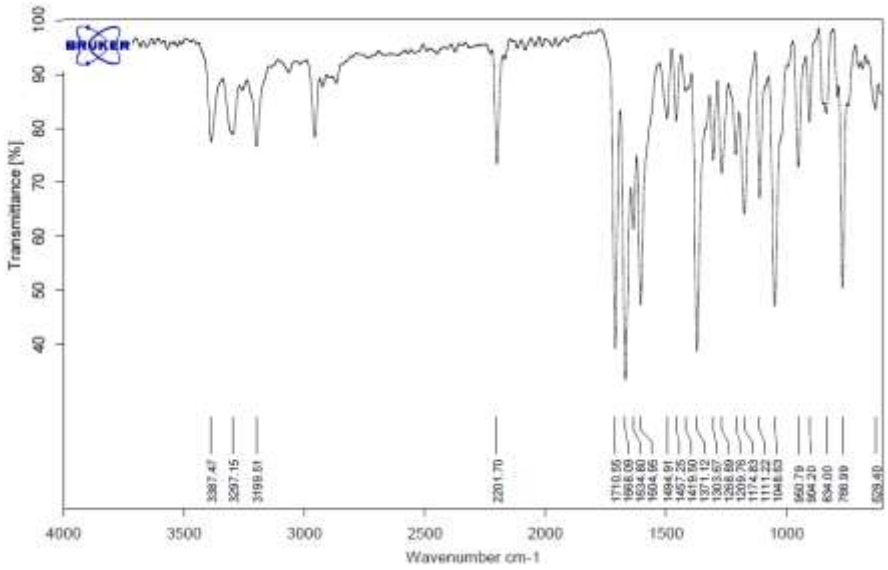
The ^{1}H NMR spectrum of 2-Amino-4-(4-methoxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



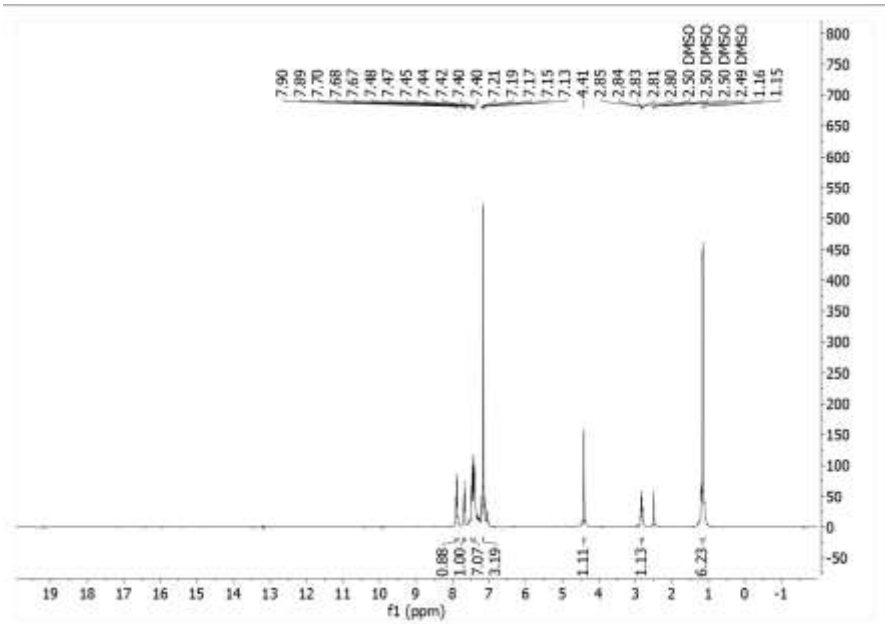
The ^{1}H NMR spectrum of 2-Amino-4-(4-methoxyphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

2-Amino-4-(4-isopropylphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile
Yellow solid, Melting point: 250-252 °C; FT-IR (ATR)/υ(cm^{-1}): 3387, 3297, 3199, 2201, 1710, 1668, 1634, 1604; ^{1}HNMR(500MHz,DMSO-d$_6$) δ (ppm): 1.16 (d, 6H, *J* = 8Hz, 2CH$_3$), 2.80-2.85 (m, 1H, CH), 4.41 (s, 1H, CH), 7.40-7.48 (m, 7H, Ar-H, NH$_2$), 7.67 (t, 1H, *J* = 8Hz, Ar-H), 7.90 (d, 1H, *J* =7.5 Hz, Ar-H). ^{13}C NMR (125 MHz, DMSO-d$_6$) *δ* (ppm) 23.82, 33.06, 36.56, 58.02, 103.91, 104.20, 112.96, 116.56, 119.37, 122.34, 122.53, 124.71, 126.45, 127.50, 132.99, 140.75, 147.14, 152.10, 152.33, 153.30, 158.04, 159.56.

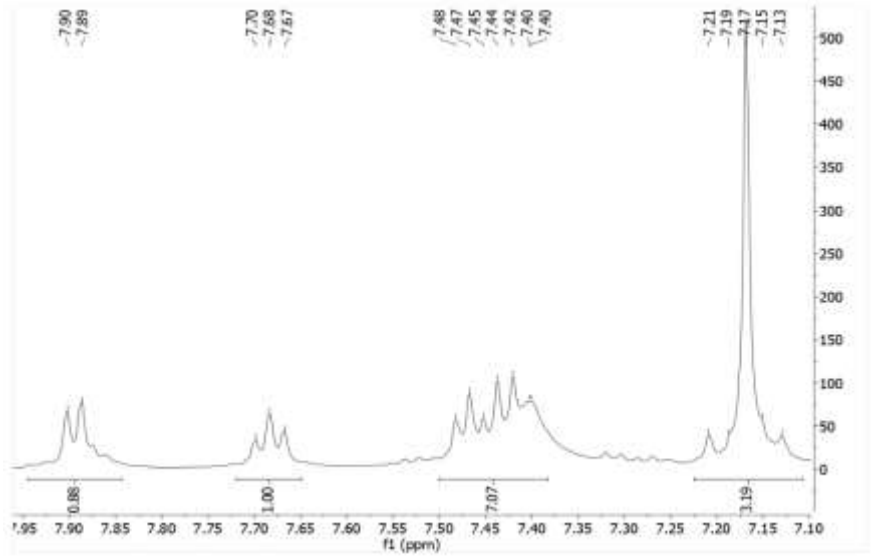




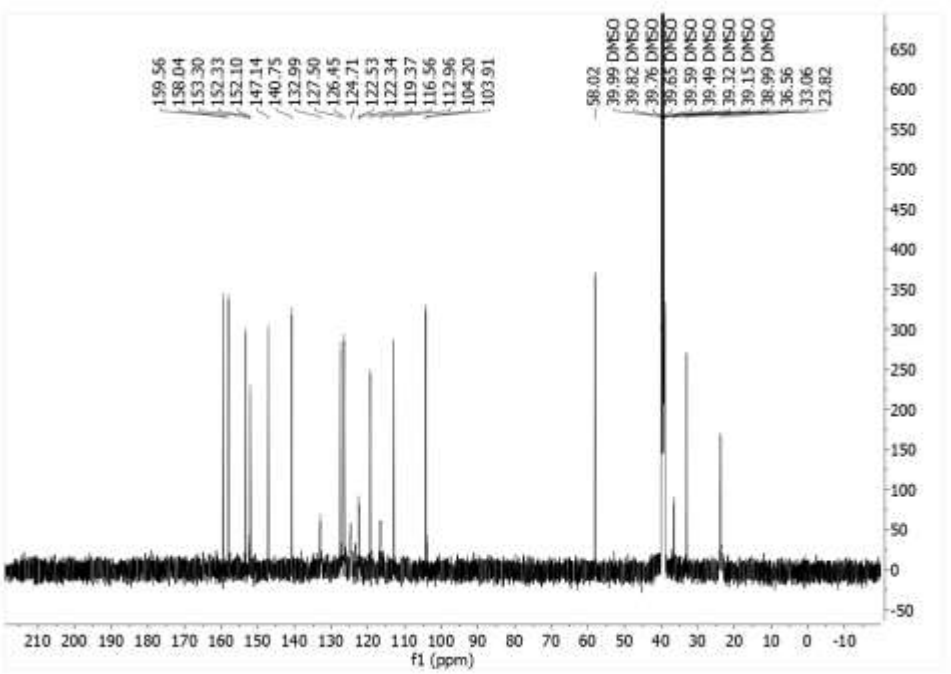
The FT-IR of 2-Amino-4-(4-isopropylphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(4-isopropylphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



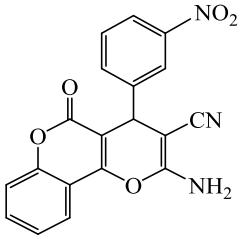
The ^{1}H NMR spectrum of 2-Amino-4-(4-isopropylphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

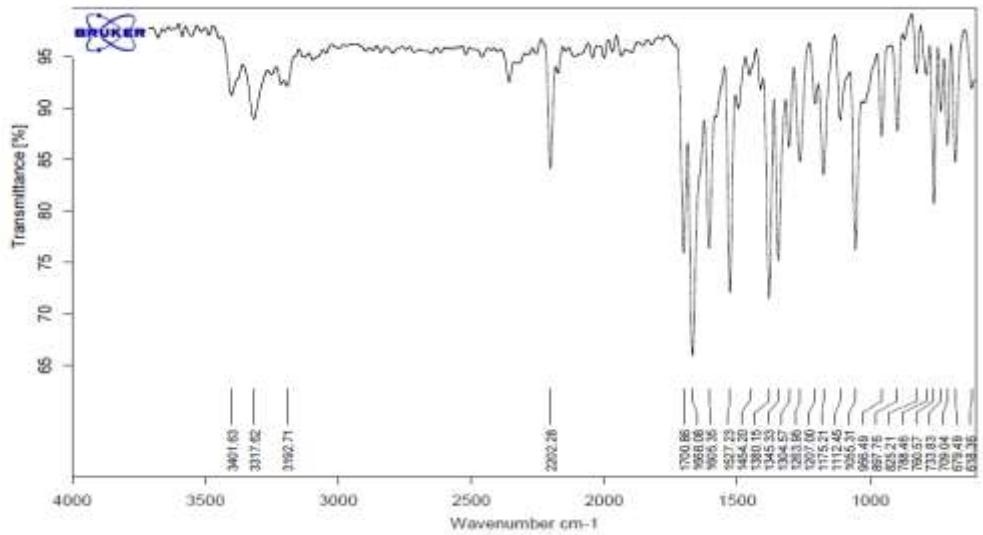


The ^{1}H NMR spectrum of 2-Amino-4-(4-isopropylphenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

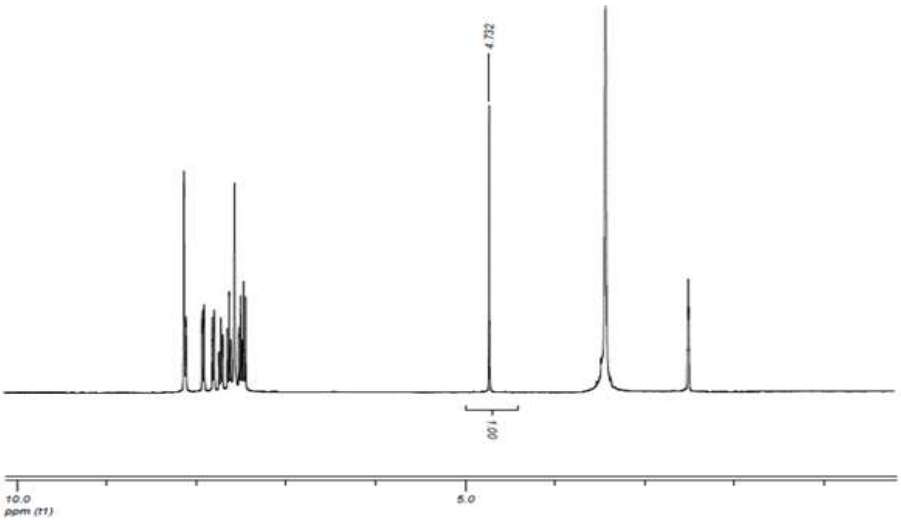
2-Amino-4-(3-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

Yellow solid, Melting point: 261-263 ºC, FT-IR (ATR)/υ(cm^{-1}): 3401, 3317, 3191, 2202, 1700, 1668, 1605, 1527, 1380, 1207, 1112, 1055, 956, 733; ^{1}HNMR (400MHz, DMSO-d$_6$) δ(ppm): 4.73 (1H,s, CH),7.45-7.52 (2H, m, Ar-H), 7.57 (2H, s, NH_2), 7.61-7.65 (1H, m, Ar-H), 7.72 (1H, td, J_1=1.6 Hz, J_2=8Hz, Ar-H), 7.81 (1H, d, J=8Hz, Ar-H), 7.92 (1H, dd, J_1=1.6Hz, J_2=8Hz, Ar-H), 8.11 (2H, d, J=8Hz, Ar-H)

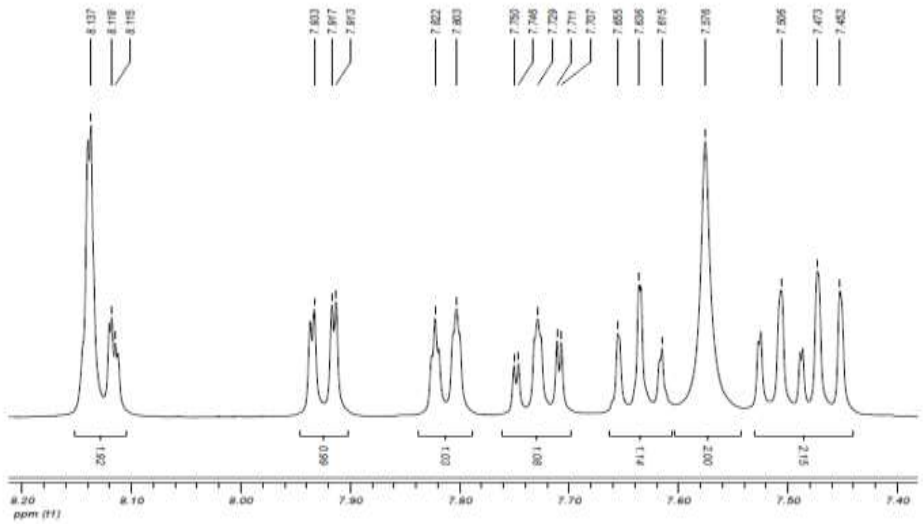




The FT-IR of 2-Amino-4-(3-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



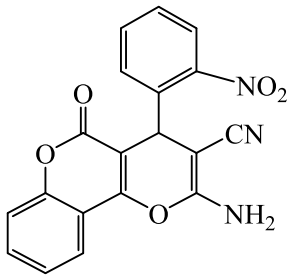
The ^{1}H NMR spectrum of 2-Amino-4-(3-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

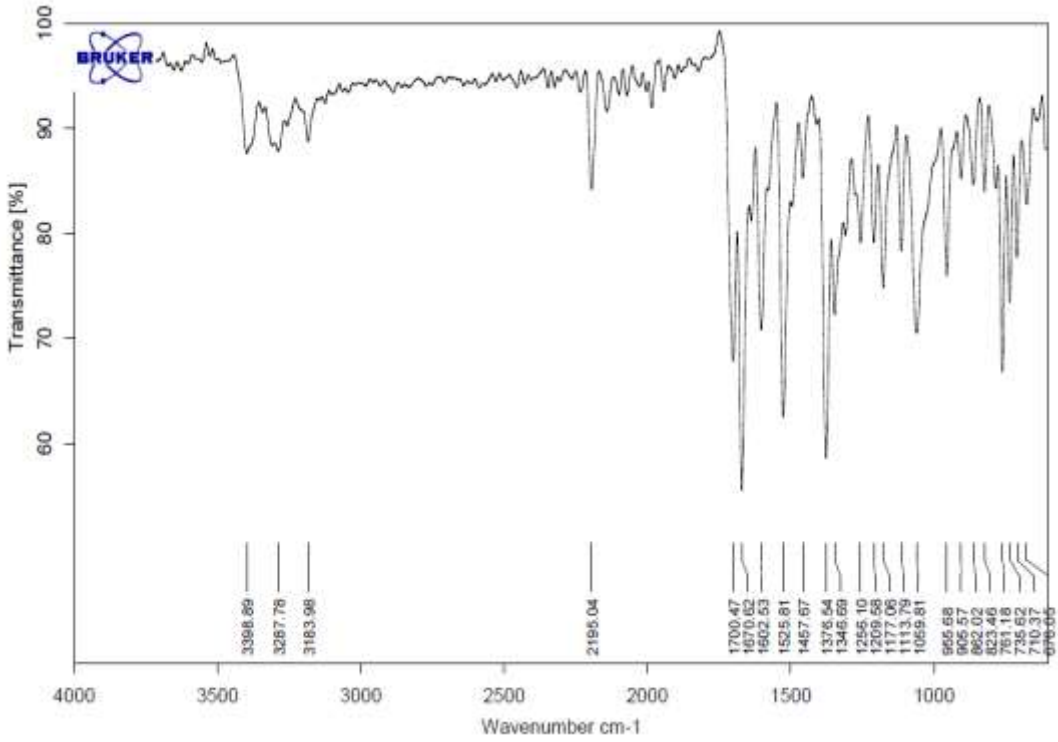


The ^{1}H NMR spectrum of 2-Amino-4-(3-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

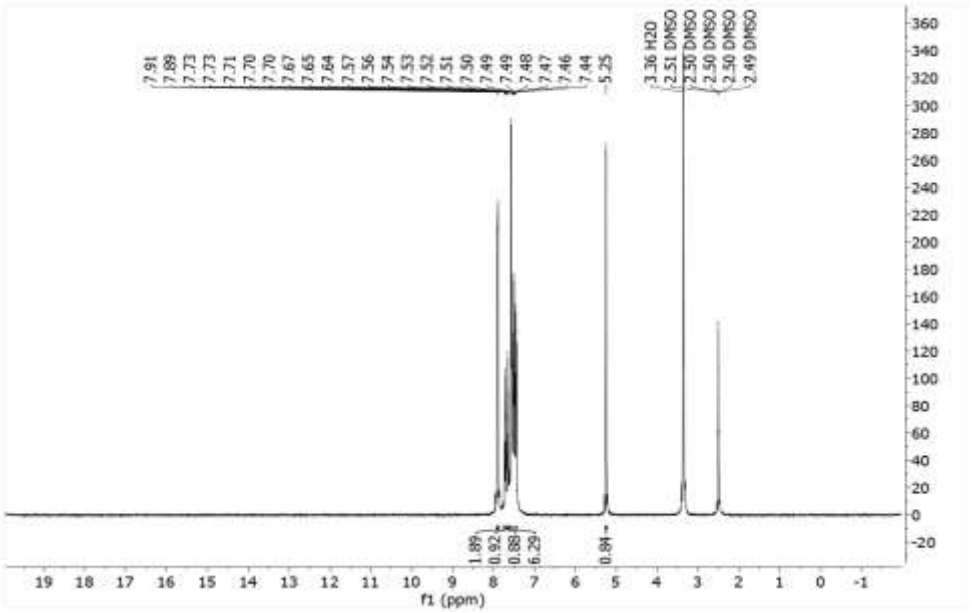
2-Amino-4-(2-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

Pale yellow solid, Melting point: 259-261 ºC, FT-IR (ATR)/υ(cm^{-1}): 3398, 3287, 3183, 2195, 1700, 1670, 1602; ^{1}HNMR(500MHz, DMSO-d$_6$) δ(ppm): 5.24 (s, 1H), 7.44-7.57 (m, 6H), 7.66 (t, 1H, *J* = 7.5 Hz), 7.73 (dt, 1H, *J* = 7.5 Hz), 7.90 (d, 2H, *J* = 8 Hz). ^{13}C NMR (125MHz, DMSO-d6) *δ* (ppm) 31.56, 56.02, 103.32, 112.84, 116.67, 118.72, 122.48, 123.90, 124.08, 124.87, 131.29, 133.48, 137.36, 149.19, 152.18, 153.59, 158.61, 159.74.

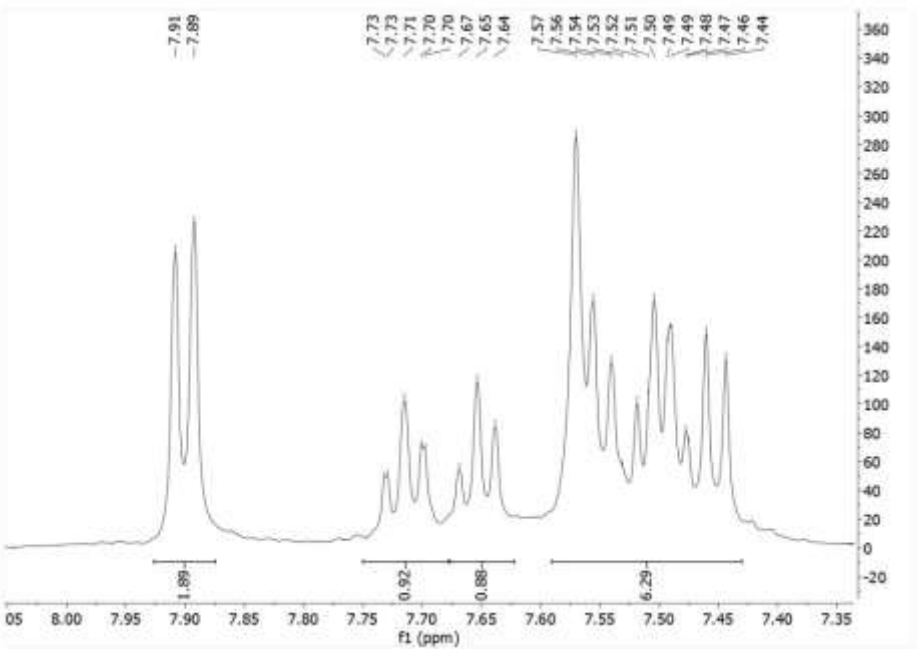




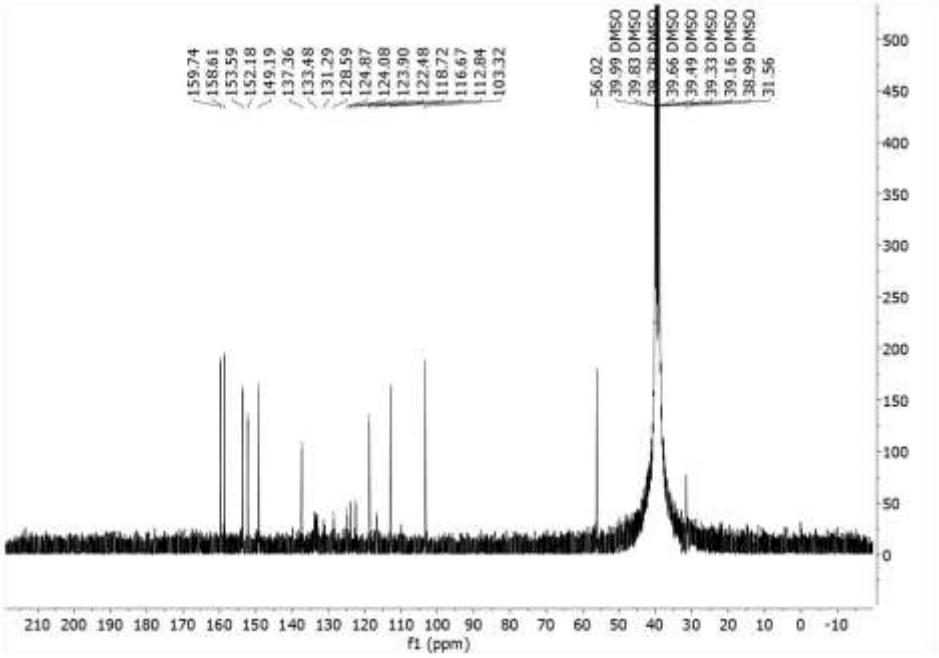
The FT-IR of 2-Amino-4-(2-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(2-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



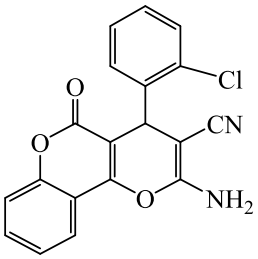
The ^{1}H NMR spectrum of 2-Amino-4-(2-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

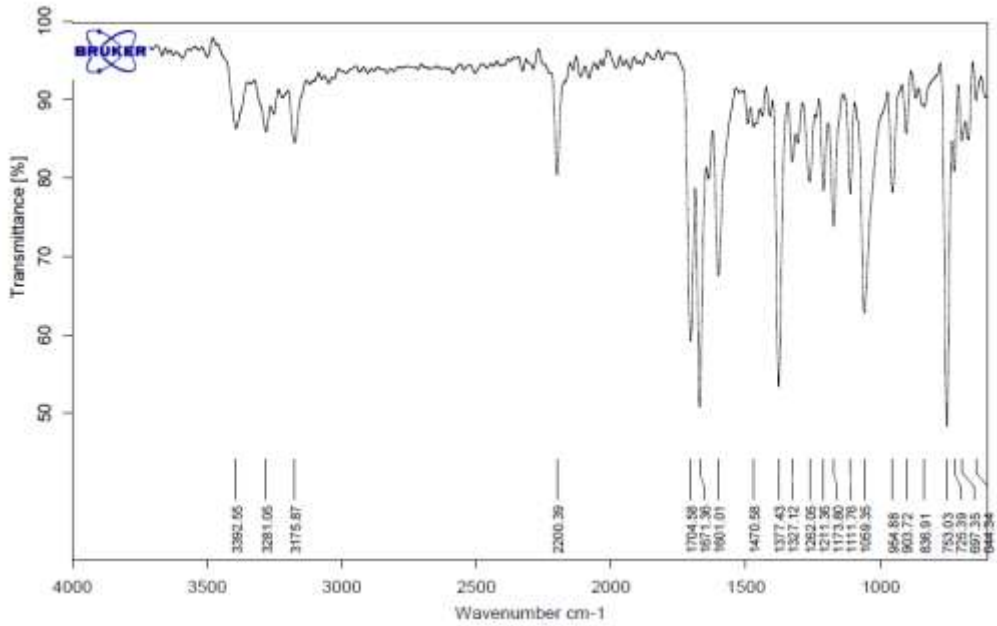


The ^{1}H NMR spectrum of 2-Amino-4-(2-nitrophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

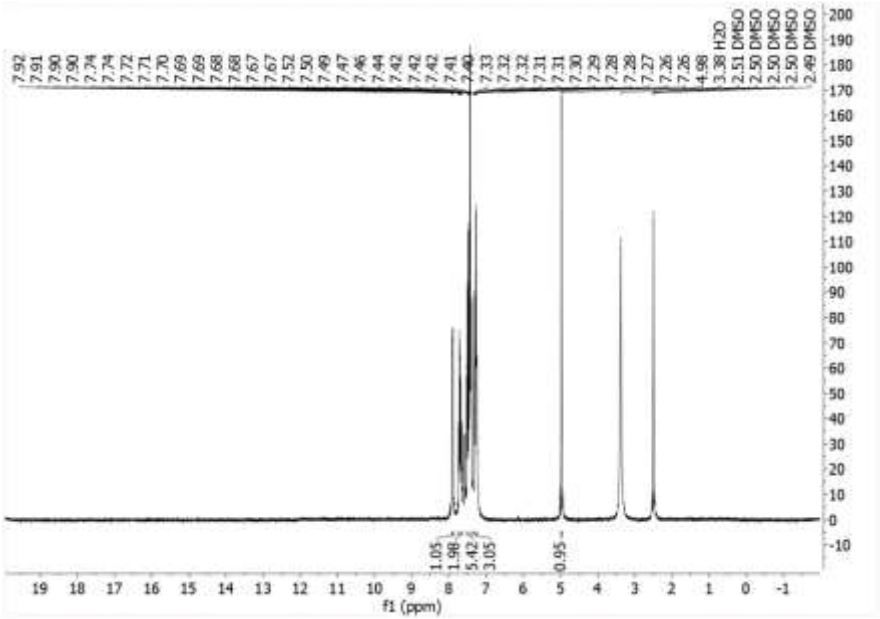
2-Amino-4-(2-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

White Solid, Melting point: 273-275 ºC**,** FT-IR (ATR)/υ(cm^{-1}): 3392, 3281, 3175, 2200, 1704, 1671, 1601; ^{1}HNMR (500MHz, DMSO-d_6) δ(ppm): 4.98 (1H, s, CH), 7.26-7.33 (m, 3H, Ar-H), 7.40-7.52 (m, 5H, Ar-H, NH_2), 7.65-7.74 (m, 2H, Ar-H), 7.90-7.92 (dd, 1H, J_1=1Hz, J_2=7.5Hz, Ar-H);^{13}C NMR (125 MHz, DMSO-d_6) δ(ppm): 56.44, 86.64, 102.92, 112.21, 112.82, 113.47, 118.84, 127.72, 128.82, 129.63, 132.40, 134.28, 140.21, 152.20, 154.04, 158.03, 158.13, 159.42.

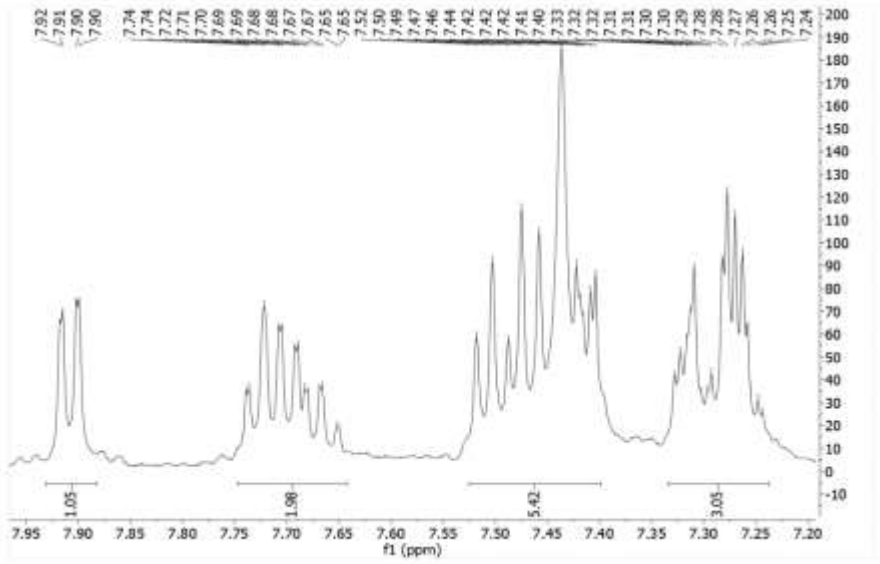




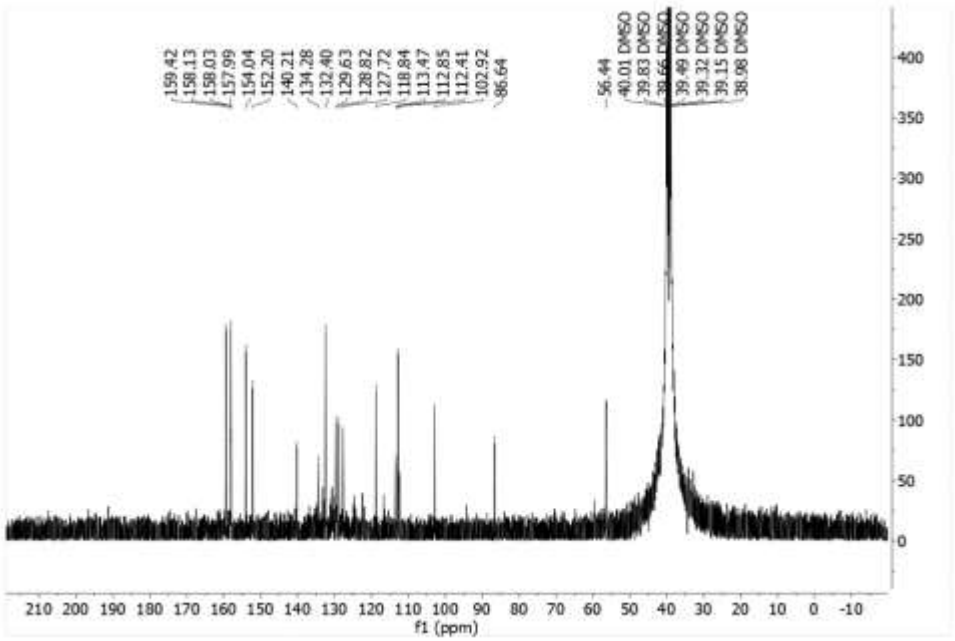
The FT-IR of 2-Amino-4-(2-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-4-(2-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

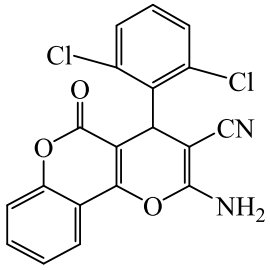


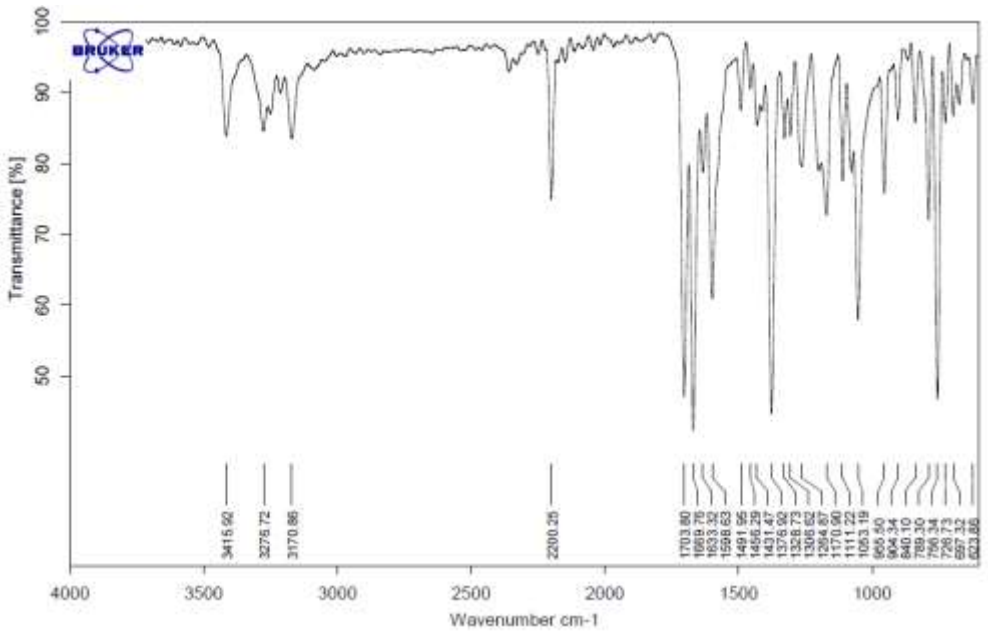
The ^{1}H NMR spectrum of 2-Amino-4-(2-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



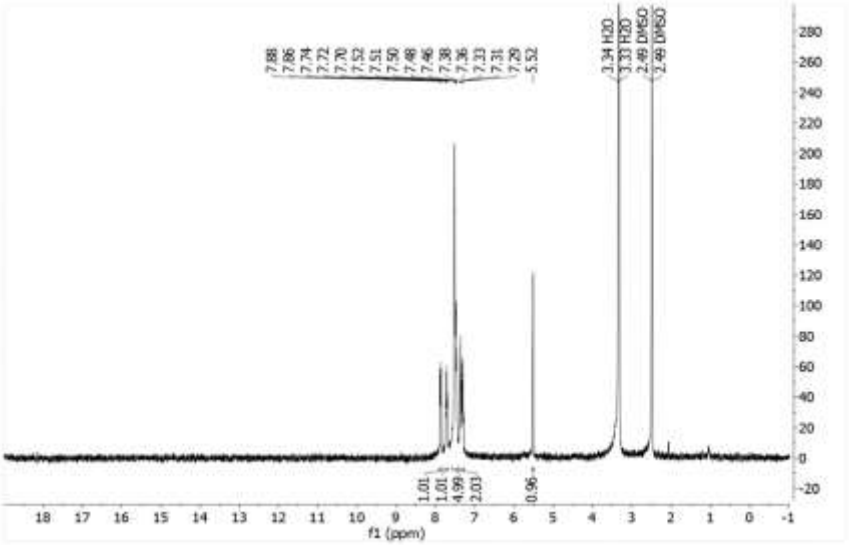
The ^{1}H NMR spectrum of 2-Amino-4-(2-chlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

2-Amino-4-(2,6-dichlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile
White Solid, Melting point: 273-276 ºC**,** FT-IR (ATR)/υ(cm^{-1}): 3415, 3276, 3170, 2200, 1703, 1669, 1633. ^{1}HNMR (400MHz, DMSO-d$_6$) δ(ppm): 5.52 (d, 1H,CH), 7.29-7.38 (m, 2H, Ar-H), 7.46-7.52 (m, 5H, Ar-H, NH$_2$), 7.74 (t, 1H, *J*=8.4 Hz, Ar-H), 7.88 (d, 1H, *J*=7.5, Ar-H).

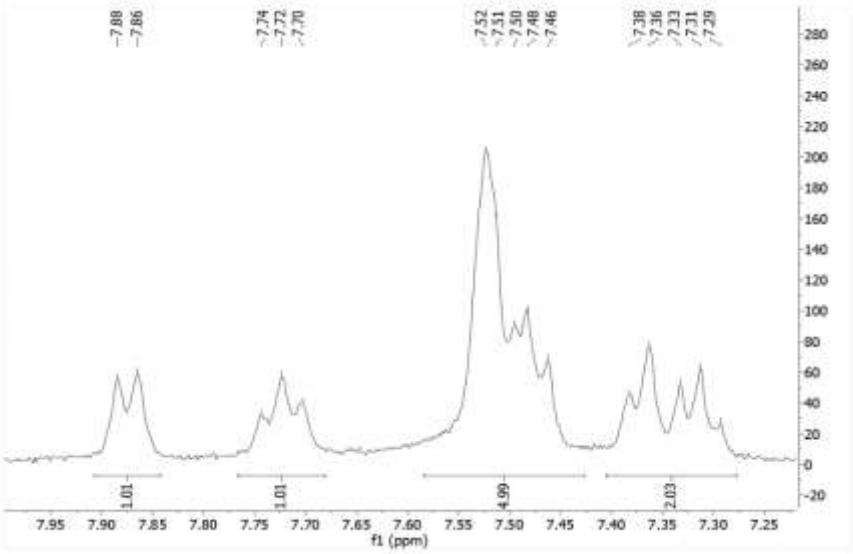




The FT-IR of 2-Amino-4-(2,6-dichlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



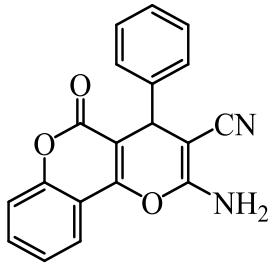
The ^{1}H NMR spectrum of 2-Amino-4-(2,6-dichlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

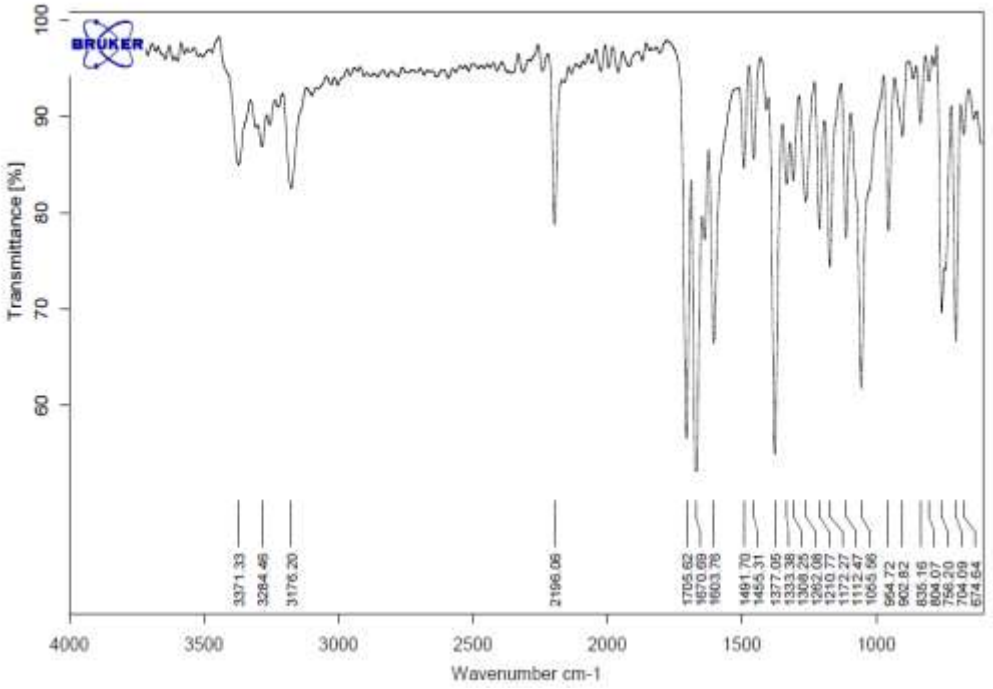


The ^{1}H NMR spectrum of 2-Amino-4-(2,6-dichlorophenyl)-5-oxo-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

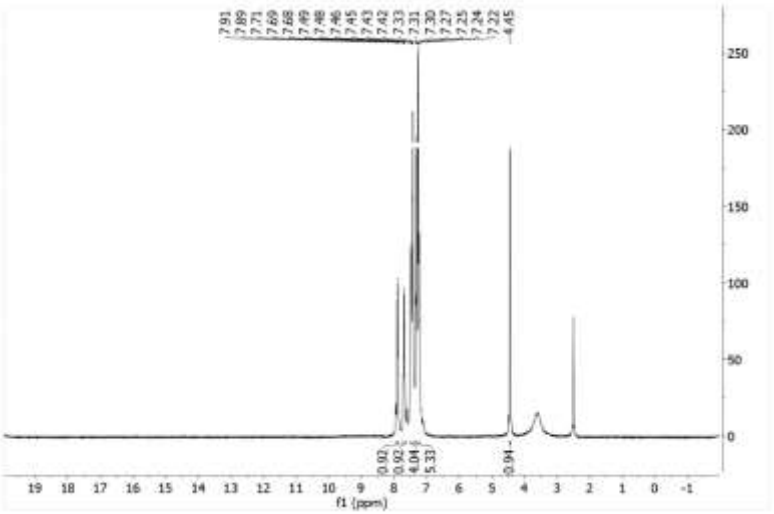
2-Amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

White Solid, Melting point: 255-257º C, FT-IR (ATR)/υ(cm^{-1}): 3371, 3284, 3176, 2196, 1706, 1671, 1604. ^{1}HNMR (500MHz, DMSO-d$_6$) δ(ppm): 4.45 (1H, s, CH), 7.22-7.33 (5H, m, Ar-H), 7.42-7.49 (4H, m, Ar-H,NH$_2$), 7.71 (1H, t, *J*=8Hz, Ar-H), 7.91 (1H, d, *J*=8Hz, Ar-H). ^{13}C NMR (125 MHz, DMSO-d$_6$) δ(ppm): 37.00, 57.94, 103.99, 112.95, 116.61, 119.28, 122.38, 122.56, 124.77, 127.13, 127.65, 128.53, 132.83, 133.04, 143.36, 152.13, 153.42, 157.98, 159.55.

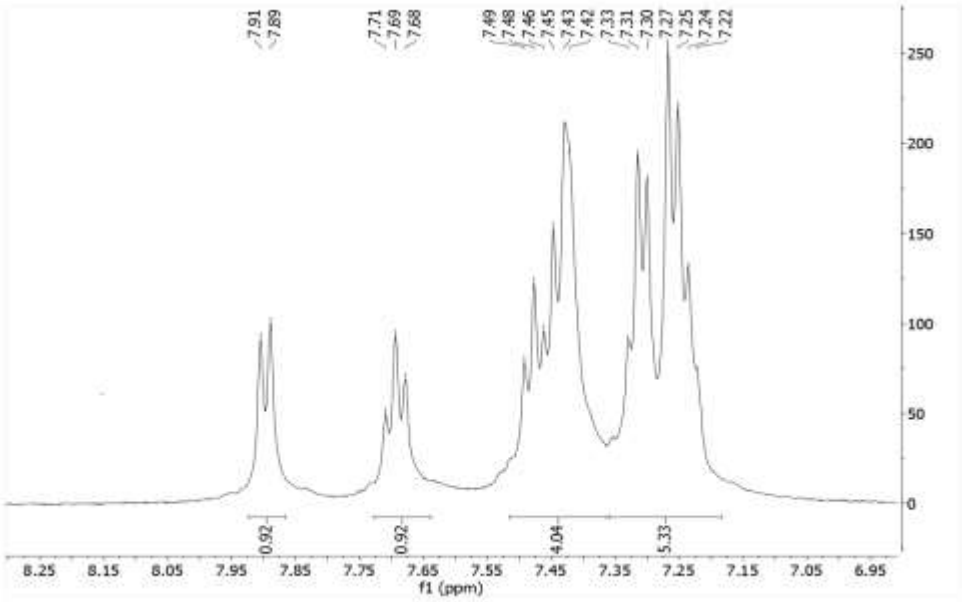




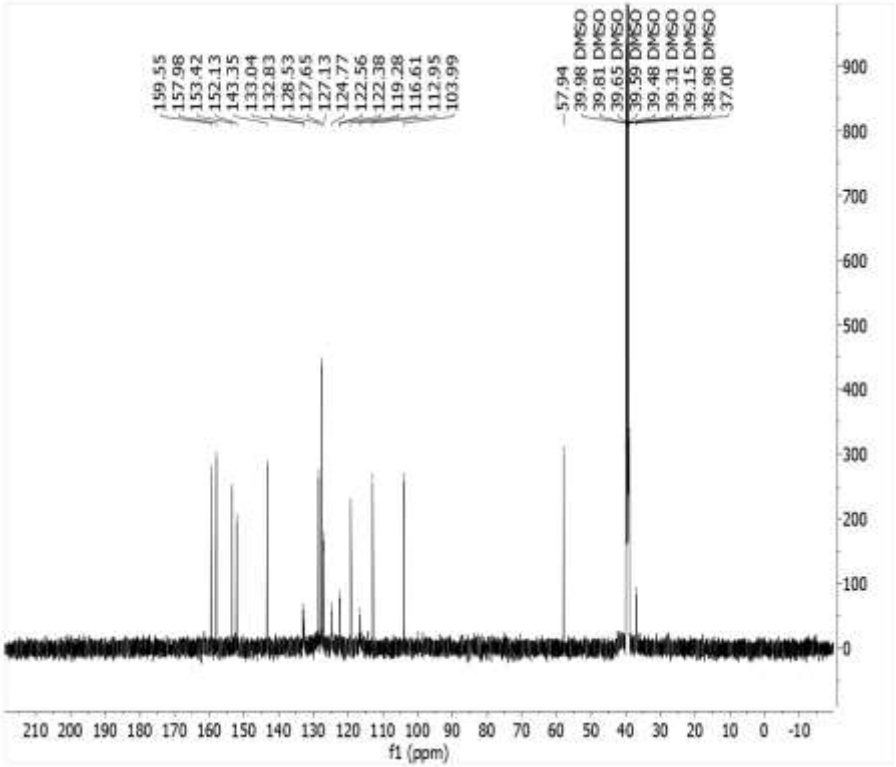
The FT-IR of 2-Amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



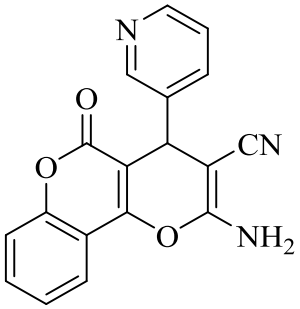
The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

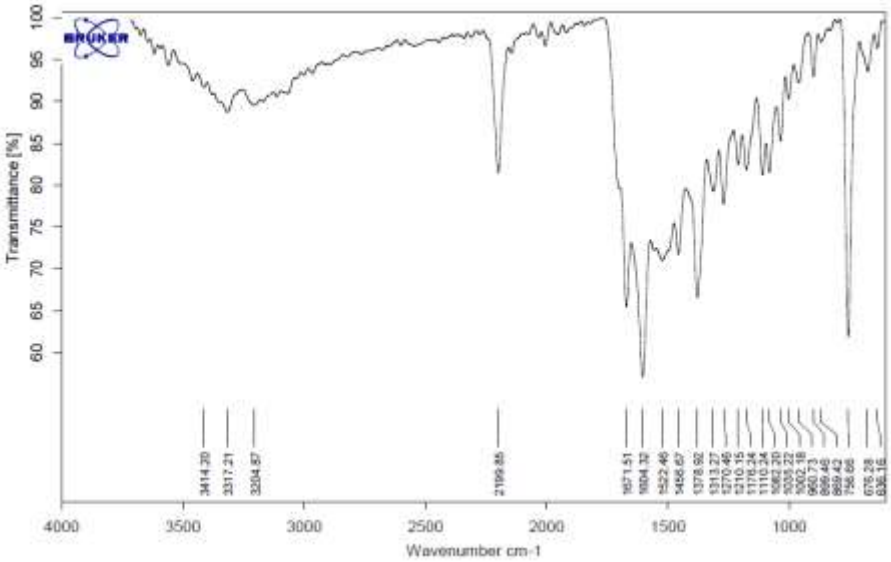


The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

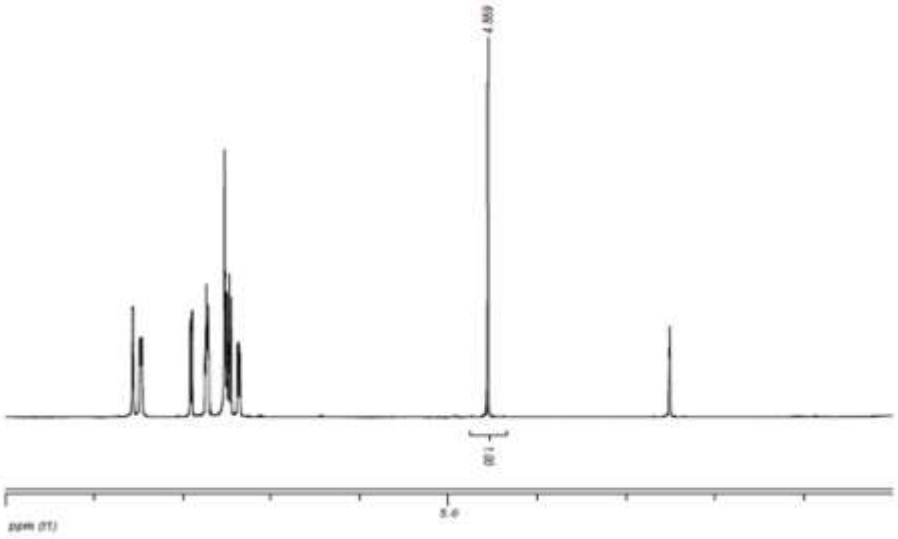
2-Amino-5-oxo-4-(pyridin-3-yl)- 4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

Cream powder**,** Melting point: 250- 252 °C; FT-IR (ATR)/υ(cm^{-1}): 3317, 3204, 2199, 1702, 1671, 1604; ^{1}HNMR(400MHz,DMSO-d_6) δ (ppm): 4.55 (s,1H), 7.35 (dd, 1H J_1=2.8 Hz, J_2=4.8 Hz), 7.45 -7.49 (m, 2H), 7.52 (s, 2H), 7.69-7.77 (m, 2H), 7.90 (dd, 1H, J_1=1.2Hz, J_2=6.8Hz), 8.46 (d, 1H, J=3.6 Hz), 8.55 (d, 1H, J=1.6 Hz); ^{13}C NMR (100 MHz, DMSO-d_6) δ (ppm)): 35.1, 57.4, 103.4, 113.4, 117.0, 119.5, 123.0, 124.2, 125.1, 133.5, 135.8, 139.2, 148.8, 149.5, 152.7, 154.2, 158.5, 160.0.

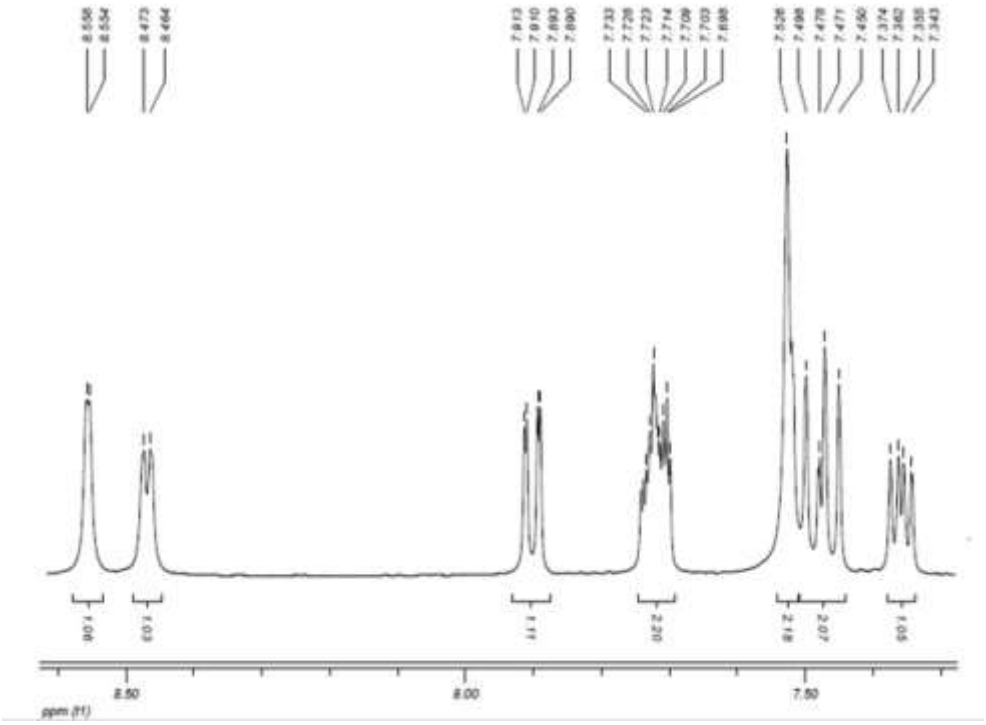




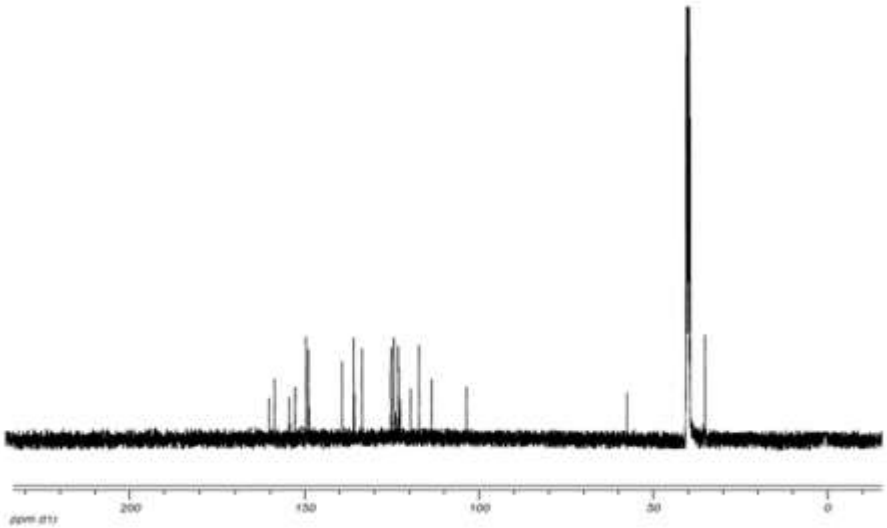
The FT-IR of 2-Amino-5-oxo-4-(pyridin-3-yl)- 4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile



The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-(pyridin-3-yl)- 4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

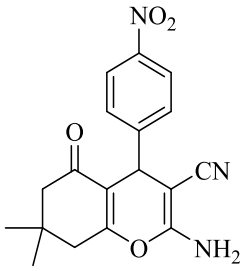


The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-(pyridin-3-yl)- 4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

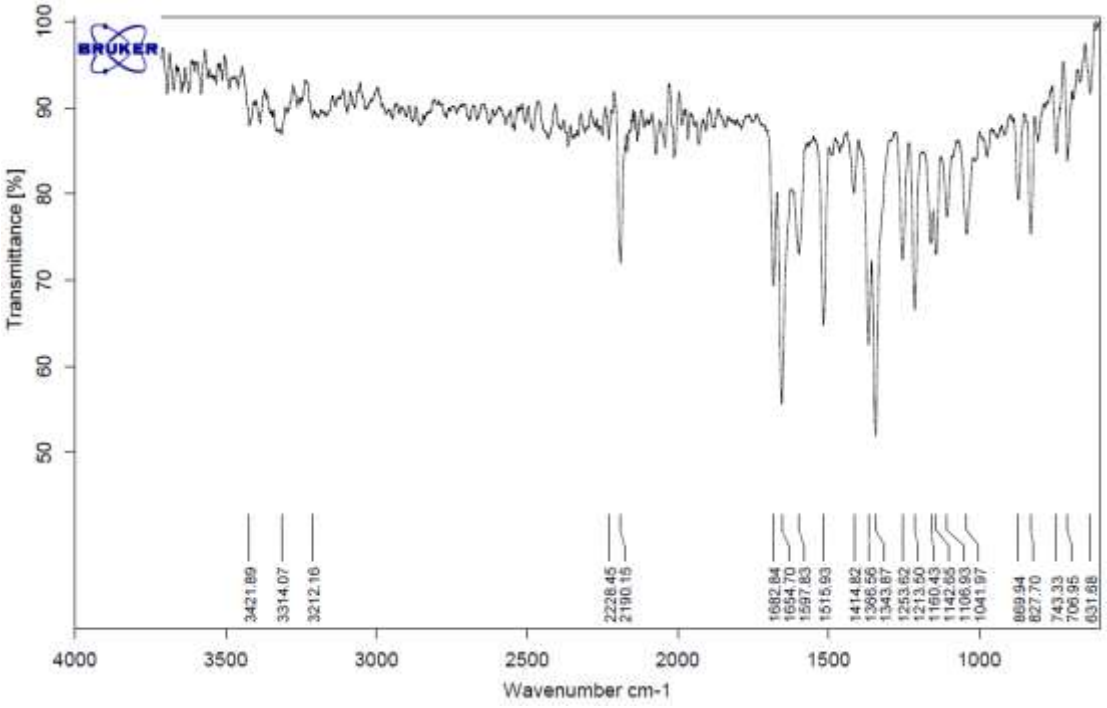


The ^{1}H NMR spectrum of 2-Amino-5-oxo-4-(pyridin-3-yl)- 4,5-dihydropyrano[3,2-*c*]chromene-3-carbonitrile

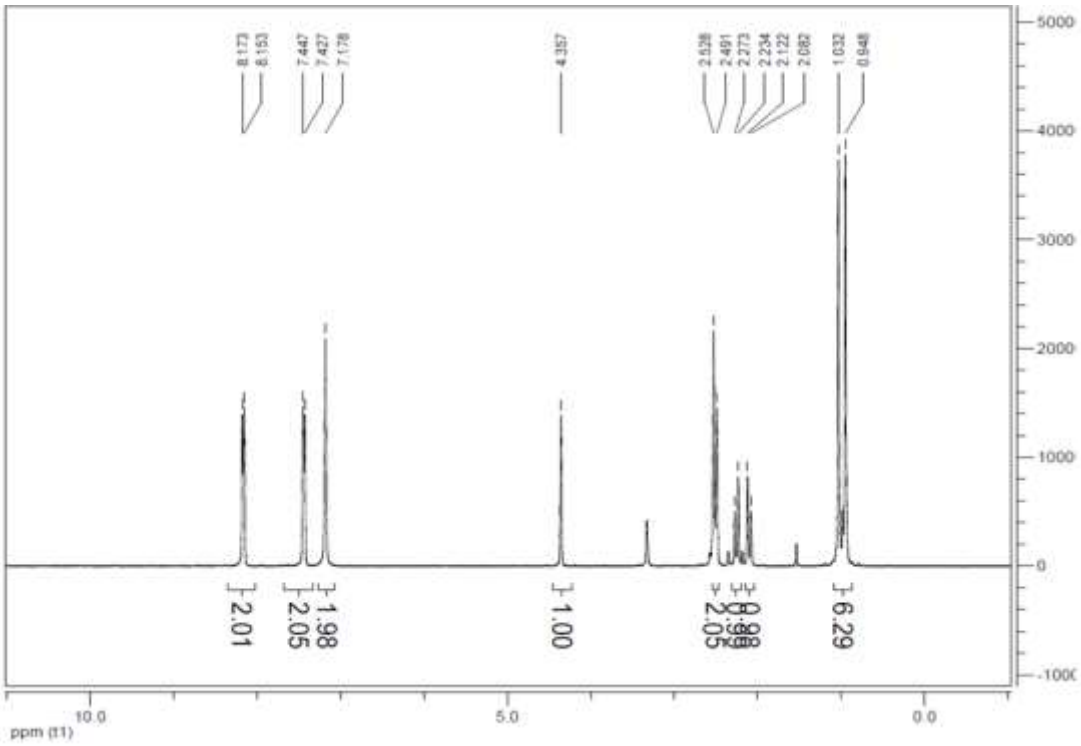
2-Amino-7,7-dimethyl-4-(4-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran



Yellow solid, m.p. 181-217 ºC FT-IR (ATR) $\bar{\upsilon}$ (cm^{-1}): 3421, 3314, 2190, 1682, 1654, 1515, 1343, 1213. ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.94 (s, 3H), 1.03 (s, 3H), 2.12 (d, J = 16.0 Hz, 1H), 2.27 (d, J = 16.0 Hz, 1H), 2.49-2.52 (m, 2H), 4.35 (s, 1H), 7.17 (s, 2H, NH_2), 7.44 (d, J = 8 Hz, 2H), 8.17 (d, J = 8 Hz, 2H)

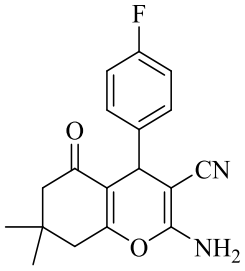


The FT-IR of 2-Amino-7,7-dimethyl-4-(4-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

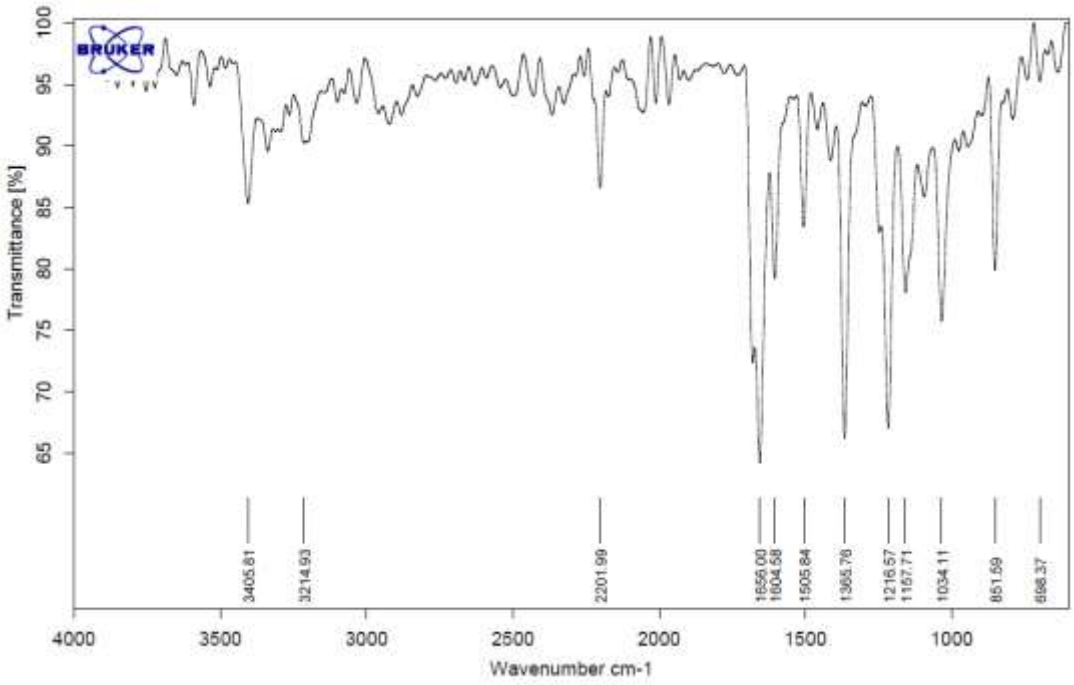


The ^{1}H NMR spectrum of 2-Amino-7,7-dimethyl-4-(4-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

2-Amino-3-cyano-4-(4-fluorophenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran .

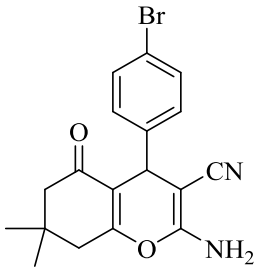


White powder, m.p. 191-194 ºC. FT-IR (ATR) ῡ (cm^{-1}): 3405, 3214, 2201, 1656, 1604, 1216. ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.93 (s, 3 H), 1.02 (s, 3 H), 2.11 (d, *J* = 16.0 Hz, 1 H), 2.25 (d, *J* = 16.0 Hz, 1 H), 2.45–2.54 (m, 2 H), 4.18 (s, 1 H), 7.02 (s, 2 H, NH_2), 7.09-7.16 (m, 4 H) .



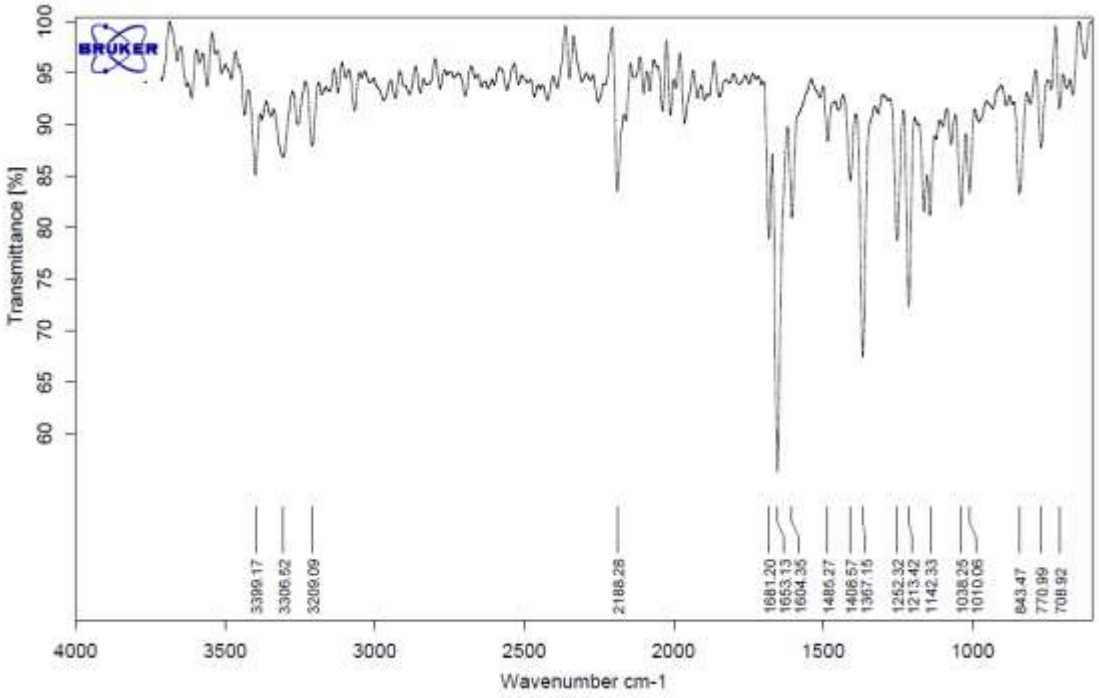
The FT-IR of 2-Amino-3-cyano-4-(4-fluorophenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

2-Amino-3-cyano-4-(4-bromophenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8- tetrahydrobenzo [*b*]pyran



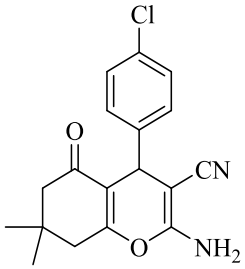
White powder, m.p. 199-200 ºC.

FT-IR (ATR) ῡ (cm^{-1}): 3399, 3306, 3209, 2188, 1681, 1653, 1213.

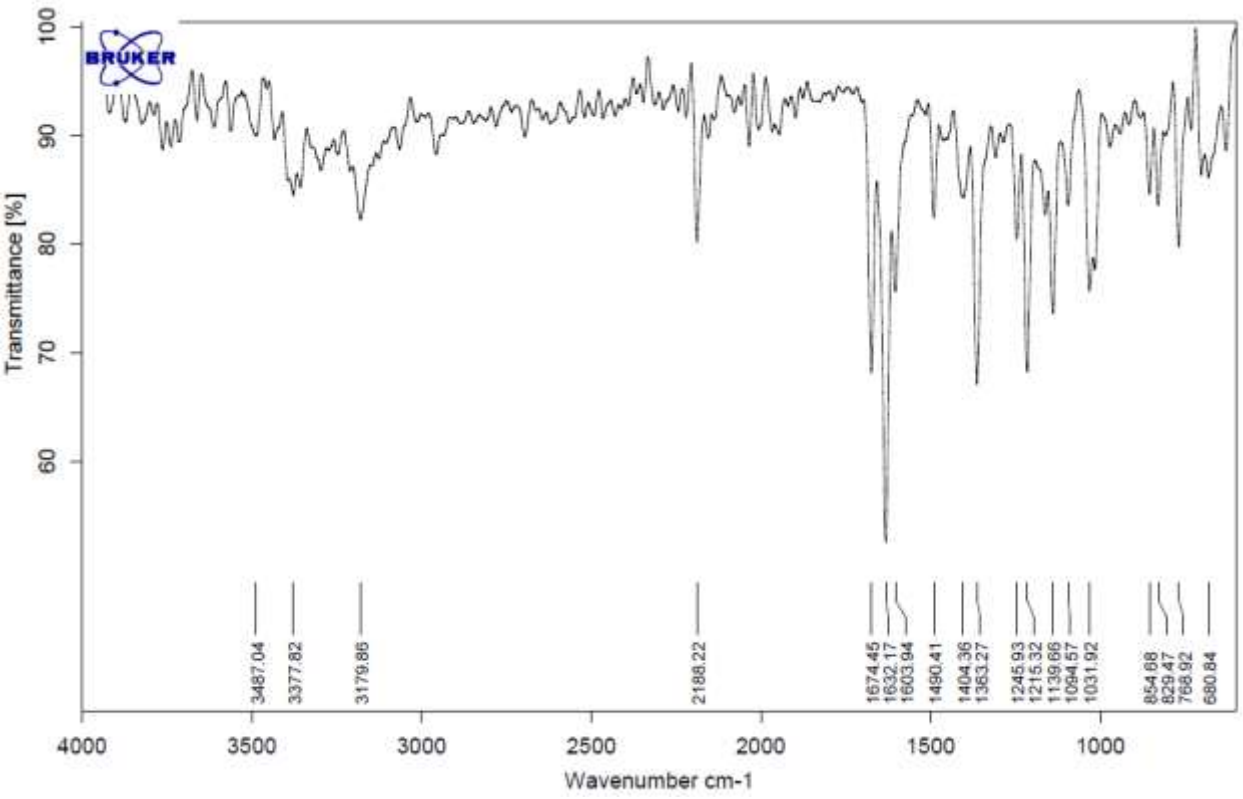


The FT-IR of 2-Amino-3-cyano-4-(4-bromophenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo [*b*]pyran

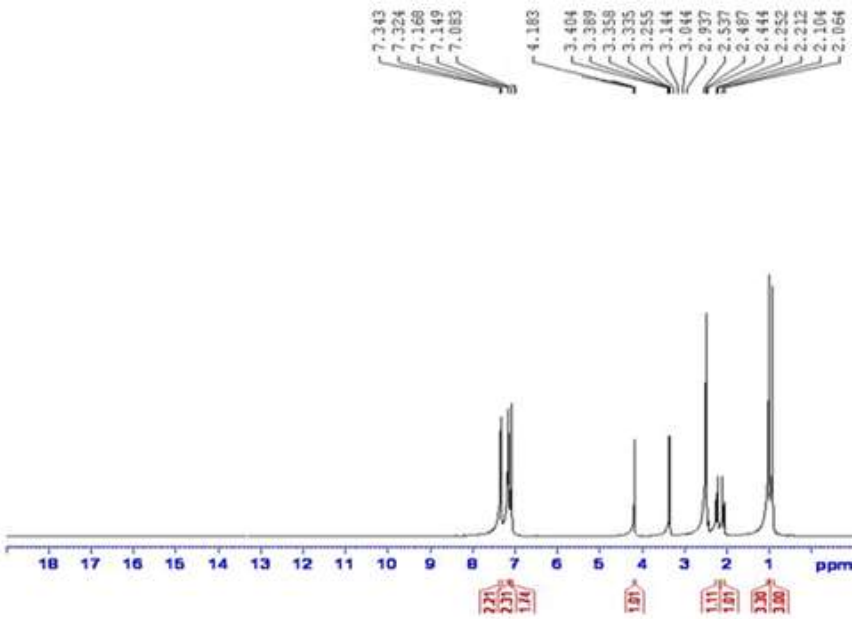
2-Amino-4-(4-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran



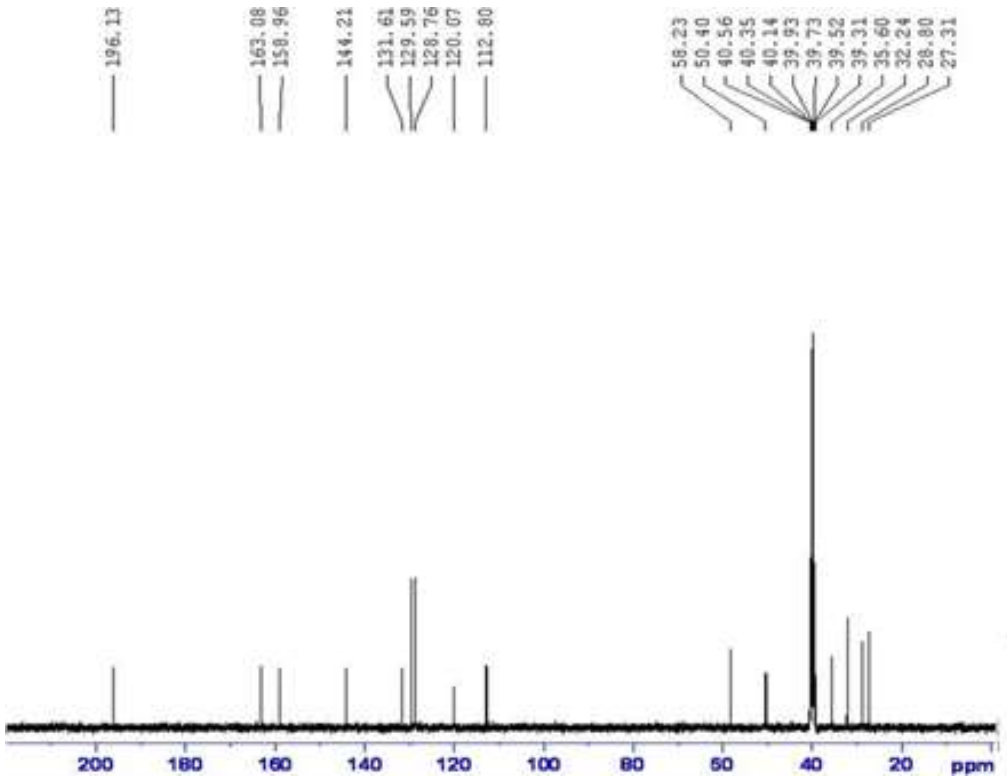
White solid, m.p. 215-216 ºC FT-IR (ATR) ῡ (cm^{-1}): 3487, 3377, 3179, 2188, 1674, 1632, 1215 ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.95 (s, 3H), 1.01 (s, 3H), 2.10 (d, *J* = 16.0 Hz, 1H), 2.25 (d, *J* = 16.0 Hz, 1H), 2.44-2.53 (m, 2H), 4.18 (s, 1H), 7.08 (s, 2H, NH_2), 7.16 (d, *J* = 7.6 Hz, 2H), 7.34 (d, *J* = 7.6 Hz, 2H) ^{13}C NMR (DMSO-d_6, 100 MHz)/ δ ppm: 27.31, 28.80, 32.24, 35.60, 50.40, 58.23, 112.80, 120.07, 128.76, 129.59, 131.61, 144.21, 158.96, 163.08, 196.13



The FT-IR of 2-Amino-4-(4-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

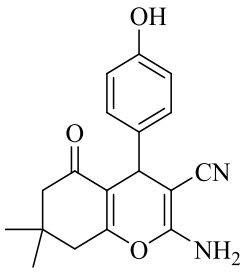


The ^{1}H NMR spectrum of 2-Amino-4-(4-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

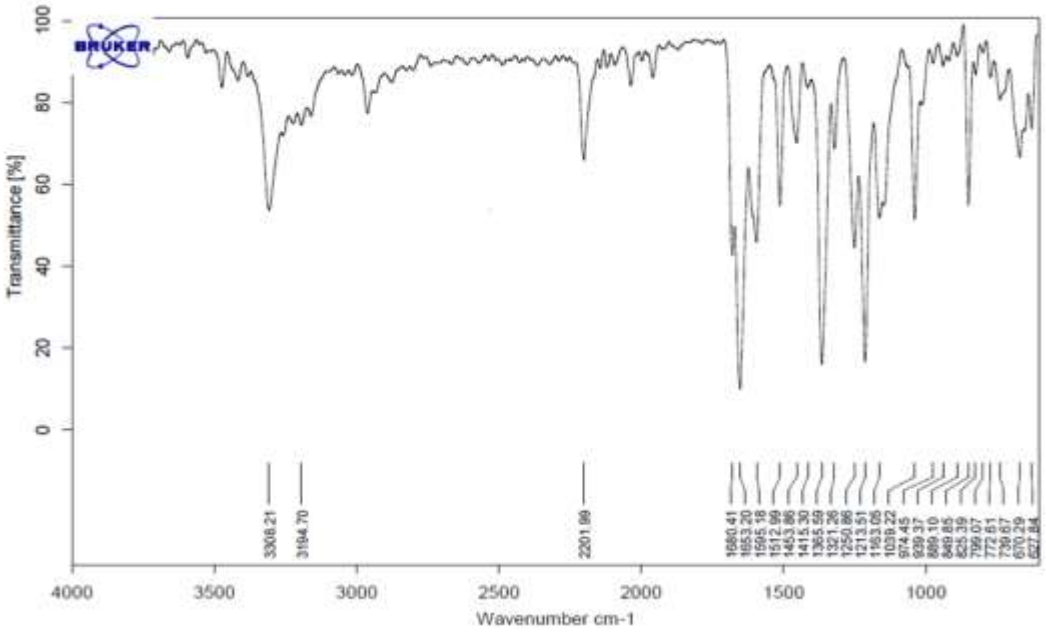


The ^{1}H NMR spectrum of 2-Amino-4-(4-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

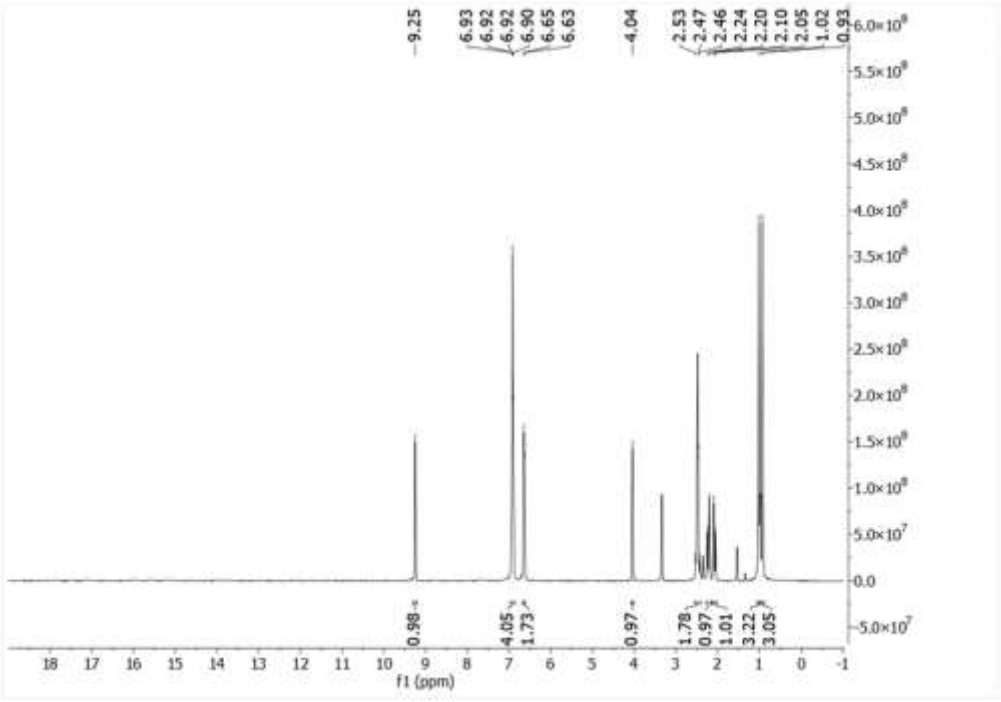
2-Amino-3-cyano-4-(4-hydroxyphenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran



Pale yellow solid, m.p. 213-215 ºC FT-IR (ATR) ῡ (cm^{-1}): 3308, 3194, 2201, 1680, 1653, 1213 ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.93 (s, 3H), 1.02 (s, 3H), 2.10 (d, J = 16.0 Hz, 1H), 2.24 (d, J = 16.0 Hz, 1H), 2.42–2.53 (m, 2H), 4.04 (s, 1H), 6.63-6.65 (d, J = 8.4 Hz, 2H, Ar-H), 6.90-6.92 (m, 4H, NH_2, Ar-H), 9.25 (s, 1H, OH)

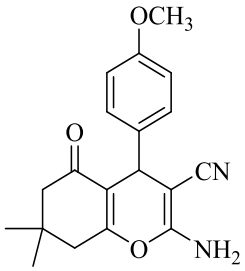


The FT-IR of 2-Amino-3-cyano-4-(4-hydroxyphenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran



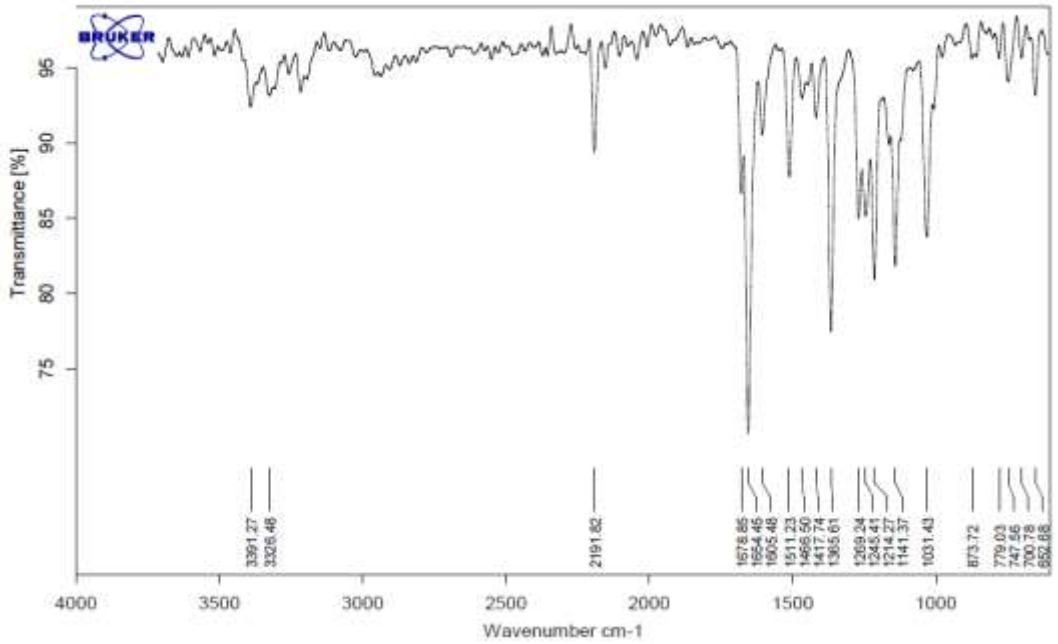
The ^{1}H NMR spectrum of 2-Amino-3-cyano-4-(4-hydroxyphenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

2-Amino-3-cyano-4-(4-methoxyphenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran



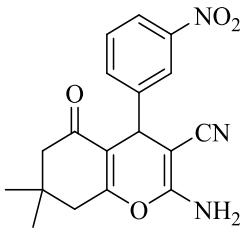
Pale yellow solid, m.p. 208-210 ºC.

FT-IR (ATR) ῡ (cm^{-1}): 3391, 3329, 2191, 1678, 1654, 1214

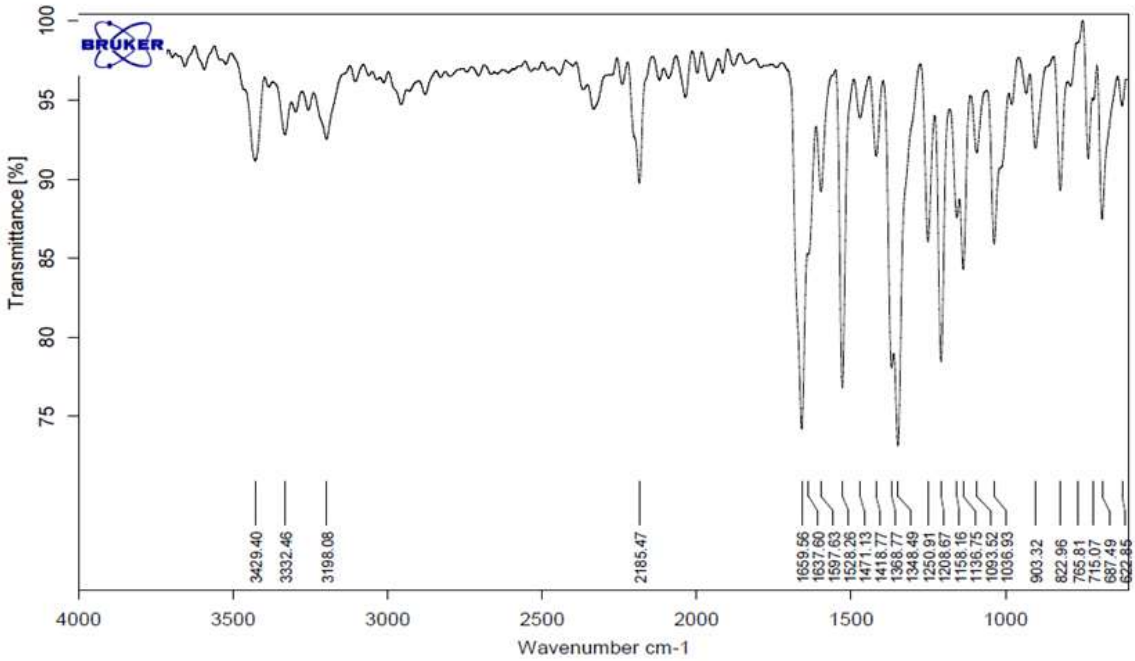


The FT-IR of 2-Amino-3-cyano-4-(4-methoxyphenyl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

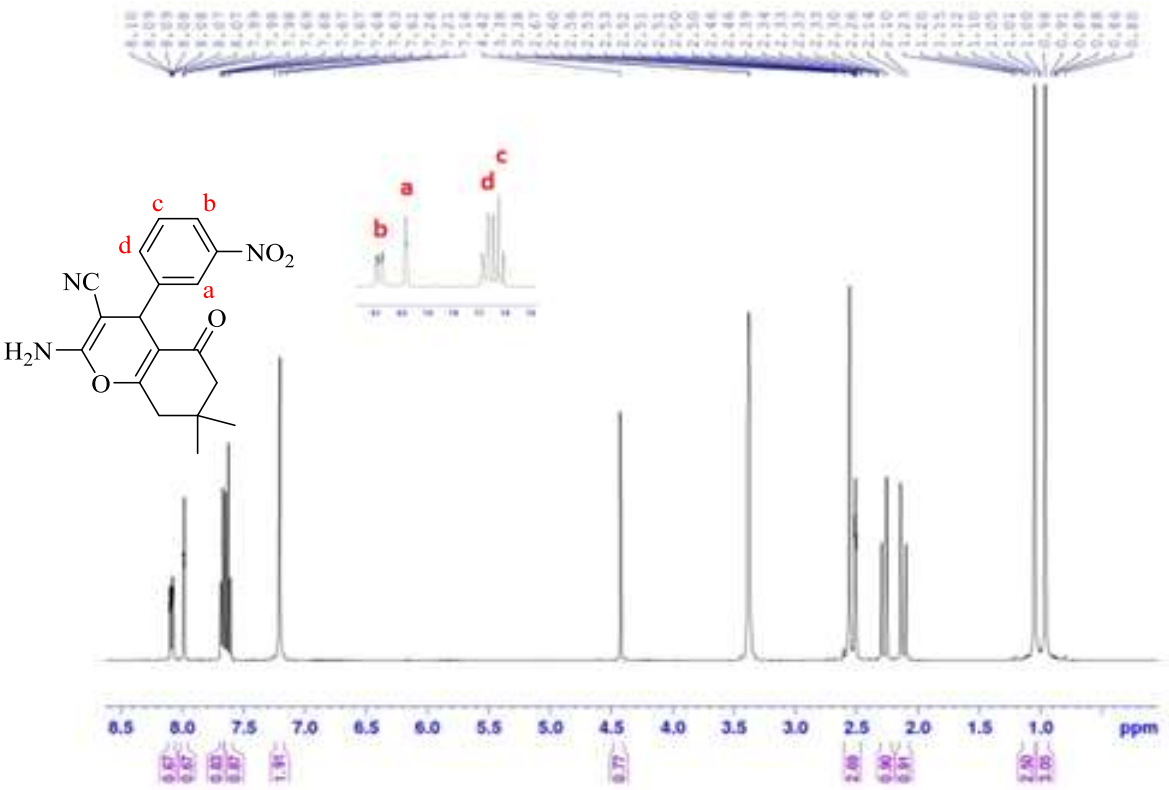
2-Amino-7,7-dimethyl-4-(3-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran



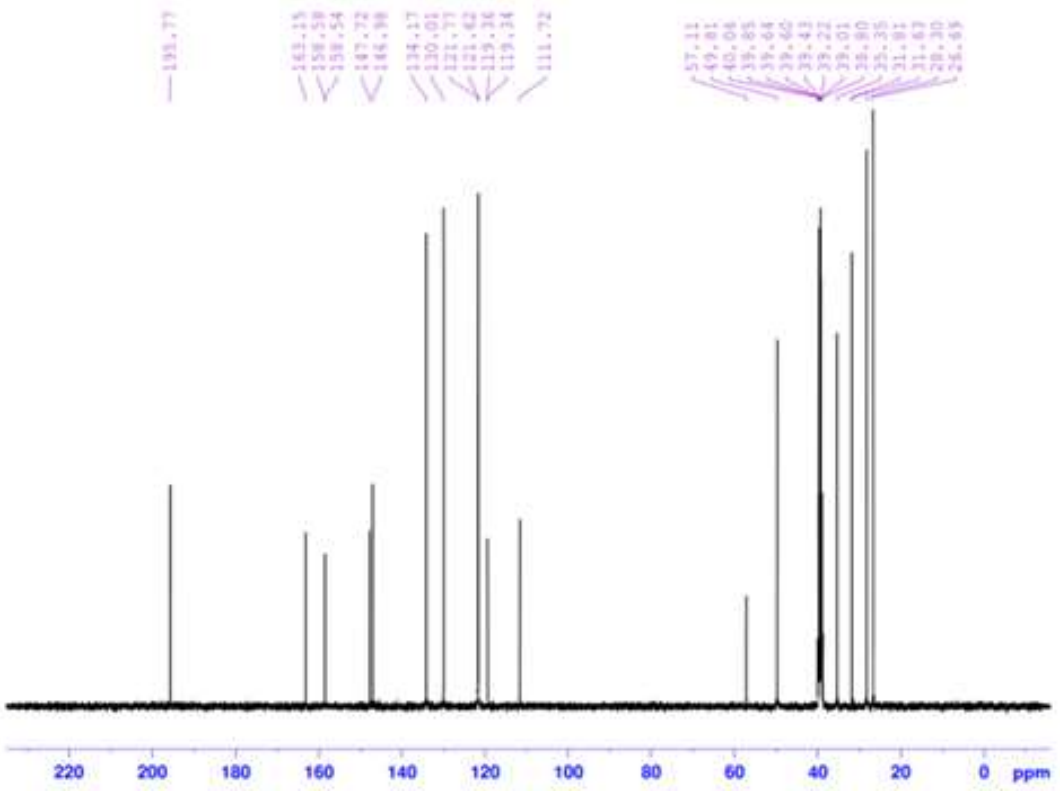
Yellow solid, m.p. 216-218 ºC. FT-IR (ATR) ῡ (cm^{-1}): 3429, 3332, 2185, 1659, 1637, 1528, 1348, 1208. ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.96 (s, 3H), 1.04 (s, 3H), 2.14 (d, *J* = 16.0 Hz, 1H), 2.30 (d, *J* = 16.0 Hz, 1H), 2.50-2.60 (m, 2H), 4.42 (s, 1H), 7.21 (s, NH_2, 2H), 7.63 (t, *J* = 8.0 Hz, 1H), 7.68 (d, *J* = 8.0 Hz, 1H), 7.98(s, 1H), 8.08 (d, *J* = 8.0 Hz, 1H). ^{13}C NMR(100 MHz, DMSO-d_6)/ δ ppm: 26.69, 28.30, 31.63, 35.35, 49.81, 57.11, 111.72, 119.34, 121.62, 121.77, 130.01, 134.17, 146.98, 147.72, 158.58, 163.15, 195.77



The FT-IR of 2-Amino-7,7-dimethyl-4-(3-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

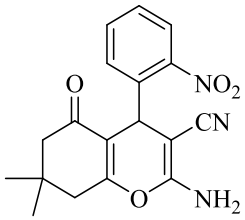


The ^{1}H NMR spectrum of 2-Amino-7,7-dimethyl-4-(3-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran



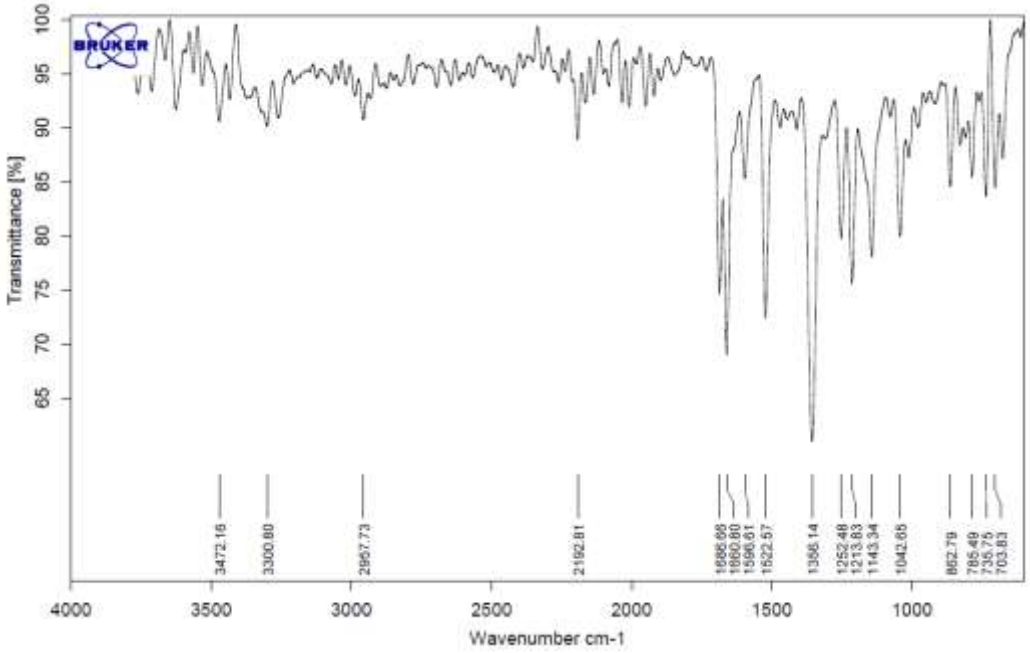
The ^{1}H NMR spectrum of 2-Amino-7,7-dimethyl-4-(3-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

2-Amino-7,7-dimethyl-4-(2-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

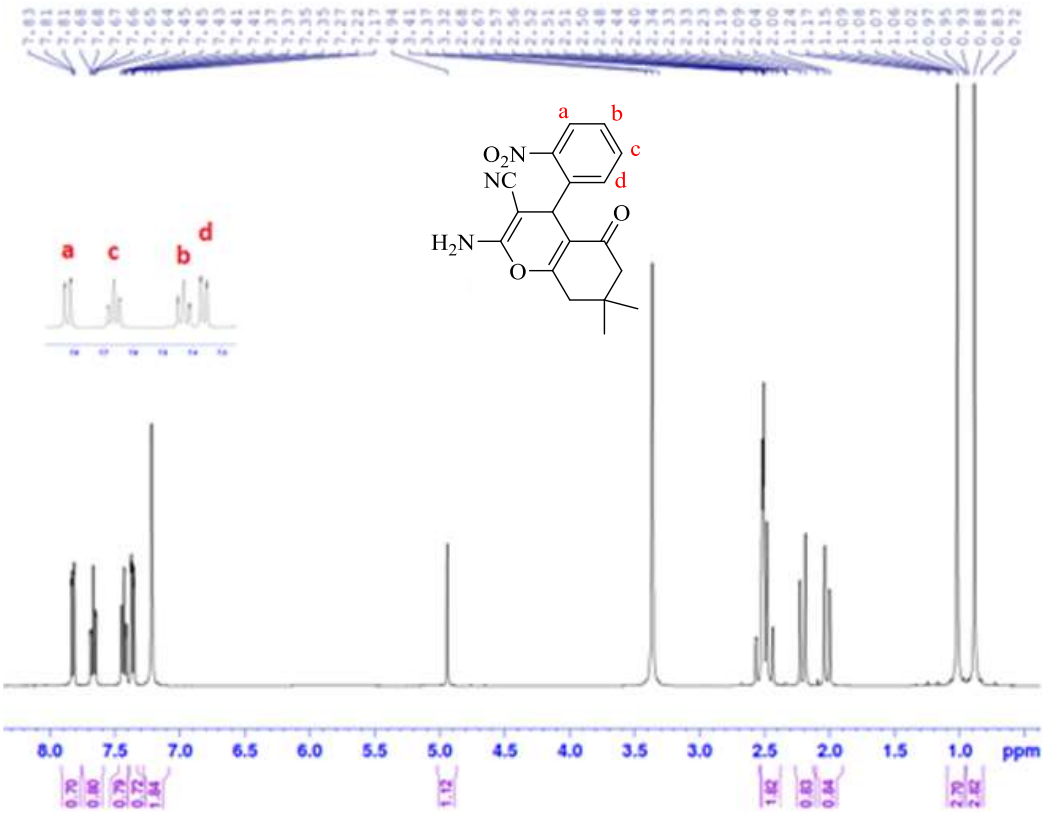


Yellow solid, m.p. 234-236 ºC. FT-IR (ATR) ῡ (cm^{-1}): 3472, 3300, 2957, 2192, 1686, 1660, 1522, 1356, 1213. ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.88 (s, 3H), 1.02 (s, 3H), 2.02 (d, *J* = 16.0 Hz, 1H), 2.21 (d, *J* = 16.0 Hz, 1H), 2.44-2.57 (m, 2H), 4.94 (s, 1H), 7.22 (s, NH_2 , 2H), 7.36 (d, *J* = 8.0 Hz , 1H), 7.43 (t, *J* = 8.0 Hz, 1H), 7.66 (t, *J* = 8.0 Hz, 1H), 7.82 (d, *J* = 8.0 Hz, 1H) . ^{13}C

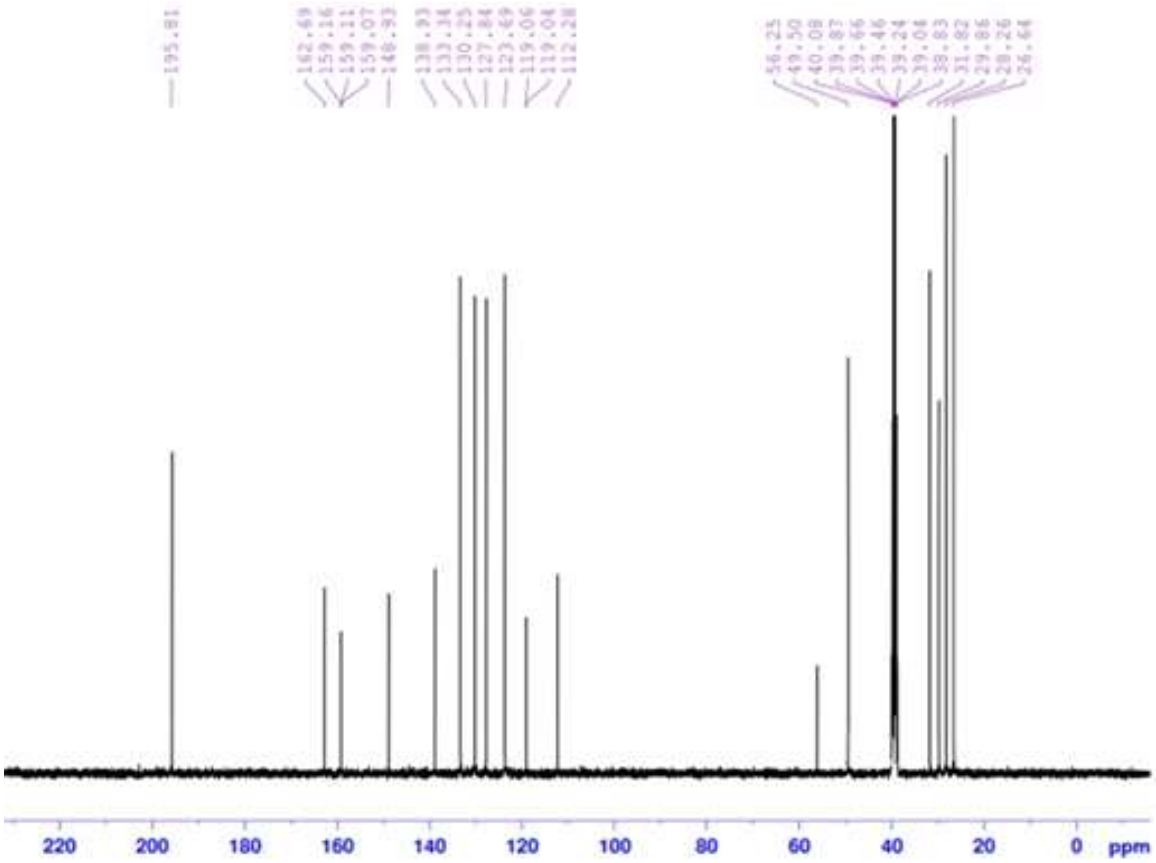
NMR (100 MHz, DMSO-d_6)/ δ ppm: 26.64, 28.26, 29.86, 31.82, 49.50, 56.25, 112.28, 119.06, 123.69, 127.84, 130.25, 133.34, 138.93, 148.93, 159.16, 162.69, 195.81.



The FT-IR of 2-Amino-7,7-dimethyl-4-(2-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

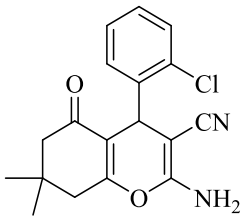


The ^{1}H NMR spectrum of 2-Amino-7,7-dimethyl-4-(2-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran



The ^{1}H NMR spectrum of 2-Amino-7,7-dimethyl-4-(2-nitrophenyl)-5-oxo-5,6,7,8-tetrahydrobenzo[*b*]pyran

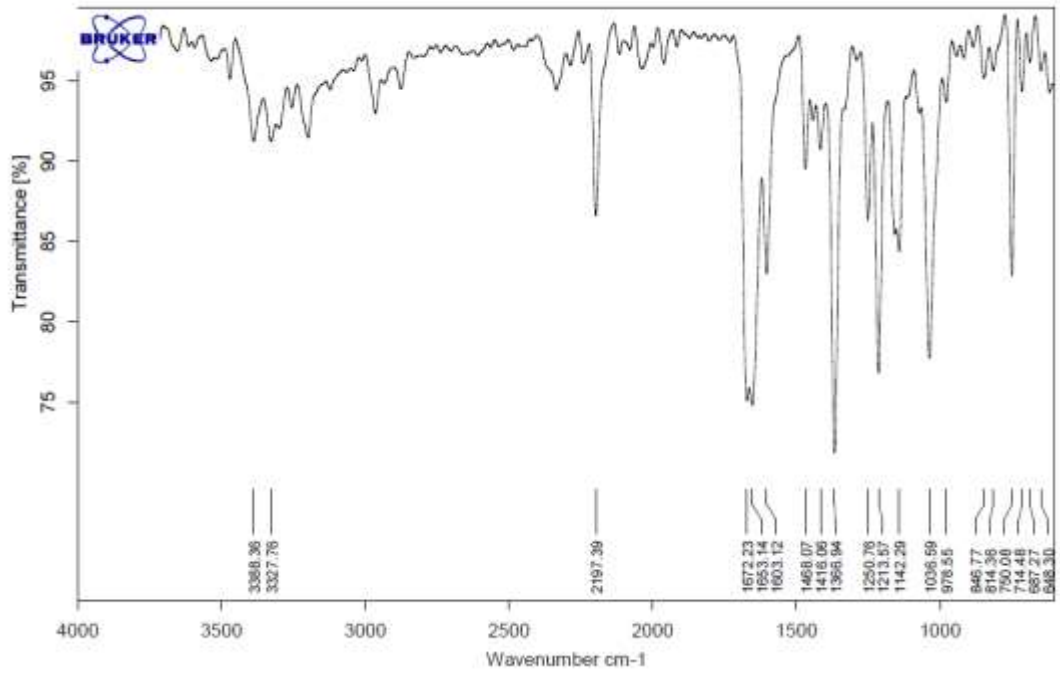
2-Amino-4-(2-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran



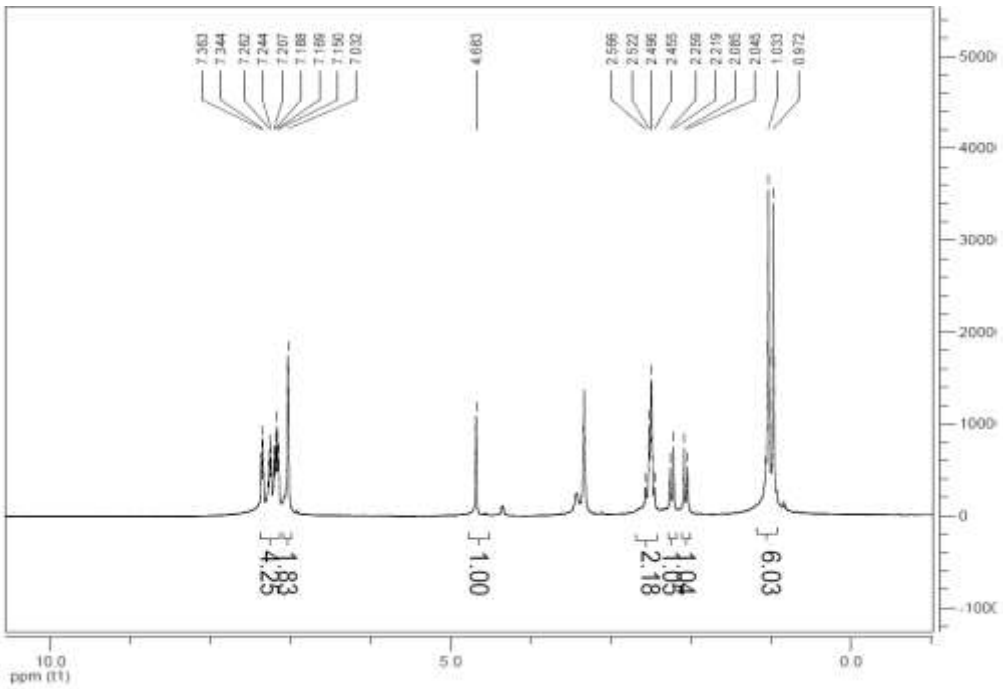
Pale yellow solid, m.p. 216-218 ºC

FT-IR (ATR) $\bar{\upsilon}$ (cm^{-1}): 3388, 3327, 2197, 1653, 1654, 1214

^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.97 (s, 3H), 1.03 (s, 3H), 2.08 (d, J = 16.0 Hz, 1H), 2.25 (d, J = 16.0 Hz, 1H), 2.45-2.56 (m, 2H), 4.68 (s, 1H), 7.03 (s, 2 H, NH_2), 7.15-7.36 (m, 4H)

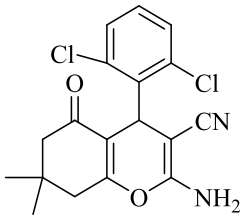


The FT-IR of 2-Amino-4-(2-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran

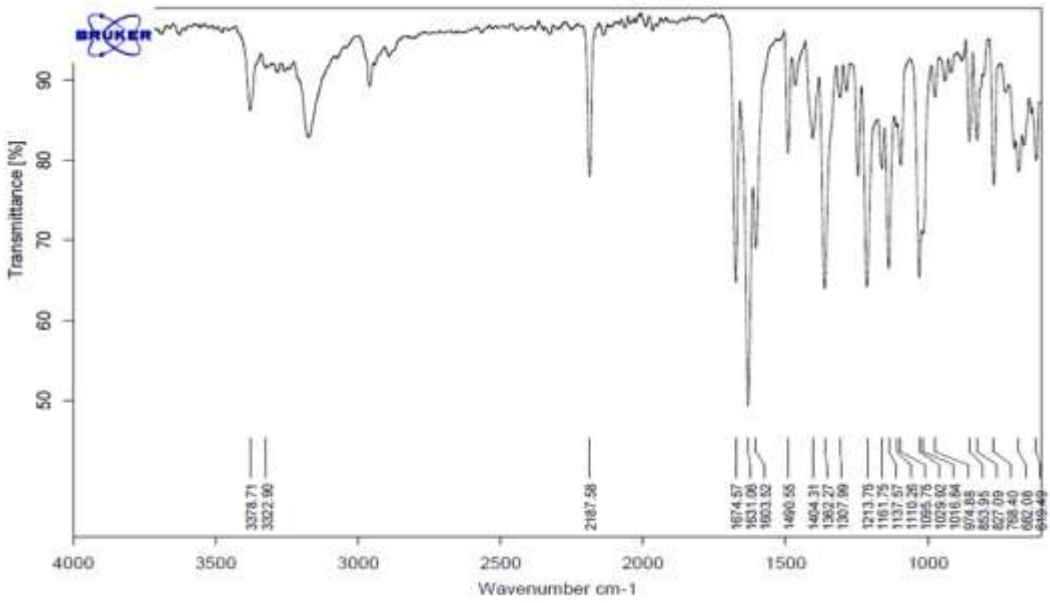


The ^{1}H NMR spectrum of 2-Amino-4-(2-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran

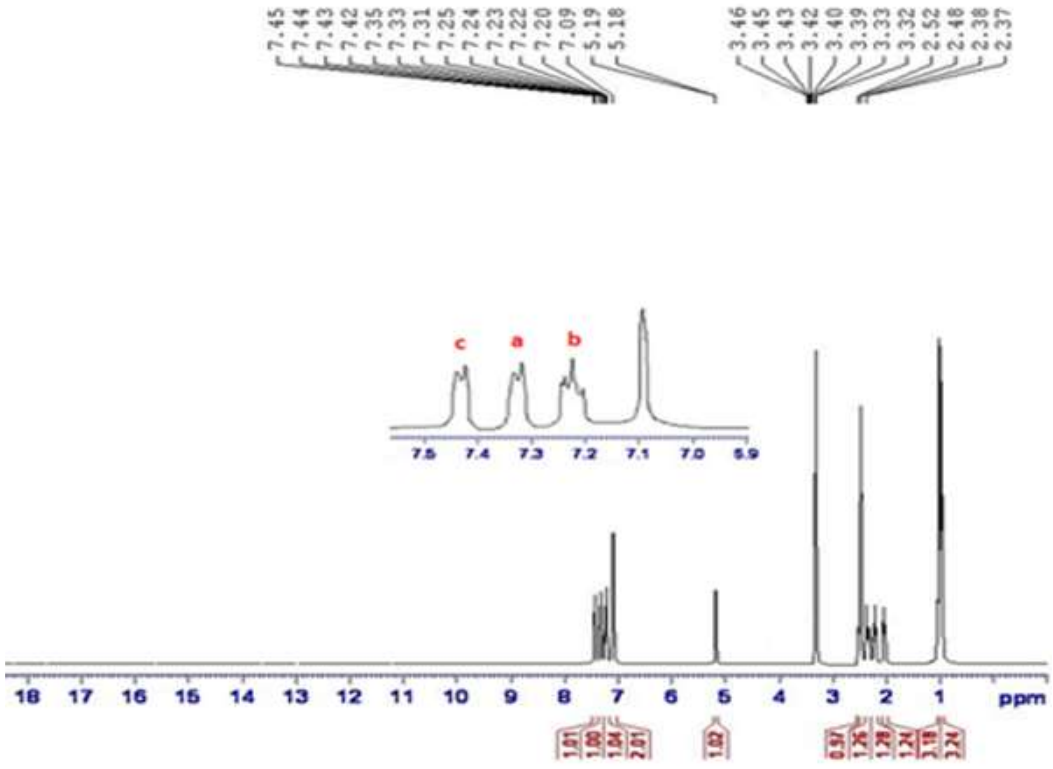
2-Amino-4-(2,6-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8tetrahydrobenzo[*b*]pyran



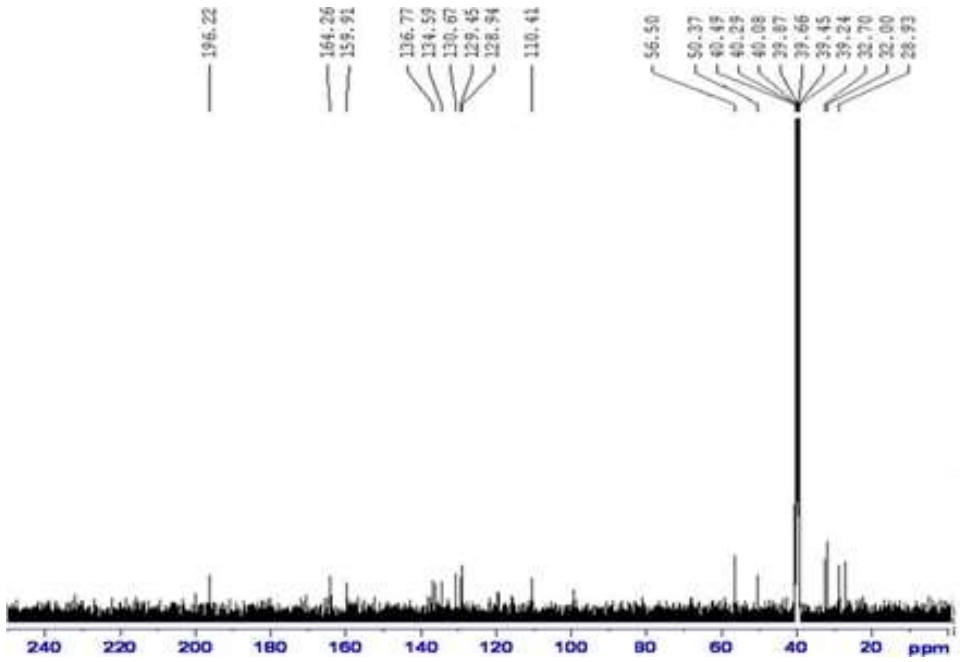
White solid, m.p. 249-251 ºC FT-IR (ATR) ῡ (cm^{-1}): 3378, 3322, 2187, 1674, 1631, 1214 .^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.98 (s, 3H), 1.04 (s, 3H), 2.05 (d, *J* = 16.0 Hz, 1H), 2.23 (d ,*J* = 16.0 Hz, 1H), 2.38 (d, *J* = 16.0 Hz, 1H), 2.52 (d, *J* =16.0 Hz, 1H), 5.19 (s, 1H), 7.09 (s, NH_2, 2H), 7.23 (t, *J* = 8.0 Hz, 1H), 7.33 (d, *J* = 7.2 Hz, 1H), 7.43 (d, *J* = 6.8 Hz, 1H) ^{13}C NMR (100 MHz, DMSO-d_6)/ δ ppm: 28.93, 32.00, 32.70, 50.37, 56.50, 110.41, 128.94, 129.45, 130.67, 134.59, 136.77, 159.91, 164.26, 196.22



The FT-IR of 2-Amino-4-(2,6-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8tetrahydrobenzo[*b*]pyran

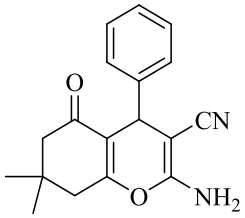


The ^{1}H NMR spectrum of 2-Amino-4-(2,6-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8tetrahydrobenzo[*b*]pyran



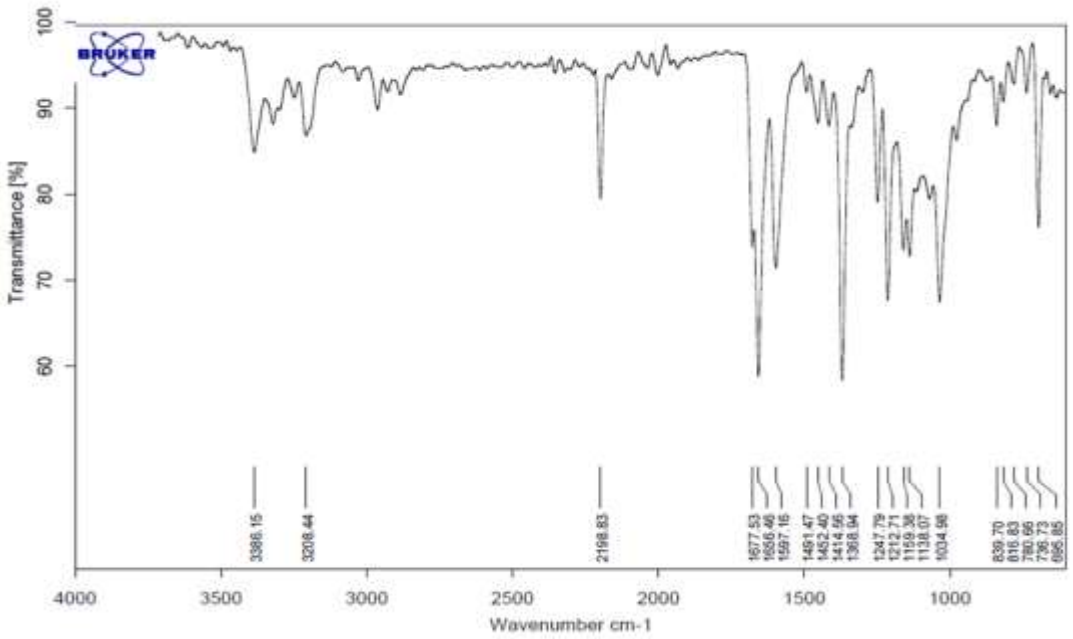
The ^{1}H NMR spectrum of 2-Amino-4-(2,6-chlorophenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8tetrahydrobenzo[*b*]pyran

2-Amino-3-cyano-7,7-dimethyl-5-oxo-4-phenyl-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran

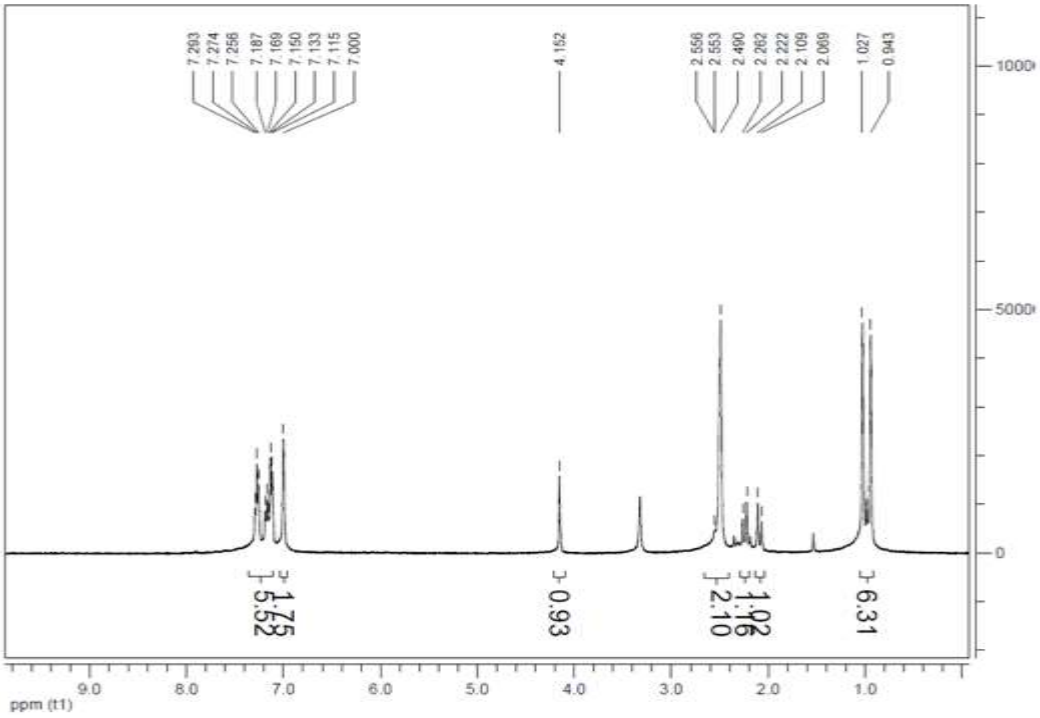


Wite solid, m.p. 231-234 ºC FT-IR (ATR) ῡ (cm^{-1}): 3386, 3208, 2198, 1677, 1656, 1212

^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.94 (s, 3H), 1.02 (s, 3H), 2.10 (d, J = 16.0 Hz, 1H), 2.26 (d, J = 16.0 Hz, 1H), 2.49-2.55 (m, 2H), 4.15 (s, 1H), 7.00 (s, 2H, NH_2), 7.11-7.29 (m, 5H)

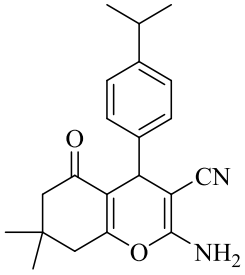


The FT-IR of 2-Amino-3-cyano-7,7-dimethyl-5-oxo-4-phenyl-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran



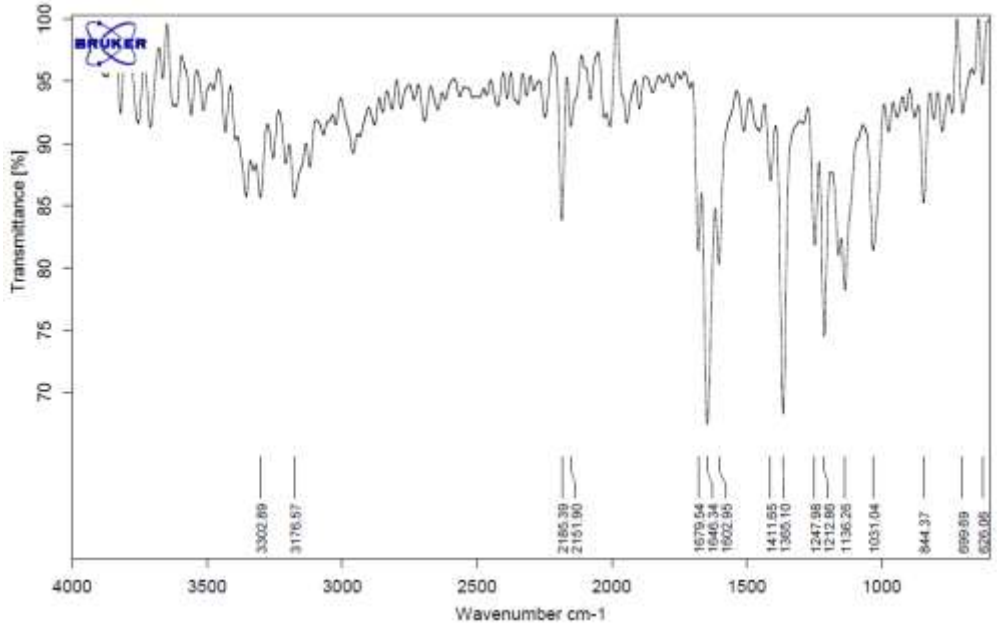
The ^{1}H NMR spectrum of 2-Amino-3-cyano-7,7-dimethyl-5-oxo-4-phenyl-4*H*-5,6,7,8 tetrahydrobenzo[*b*]pyran

2-Amino-4-(4-isopropylphenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

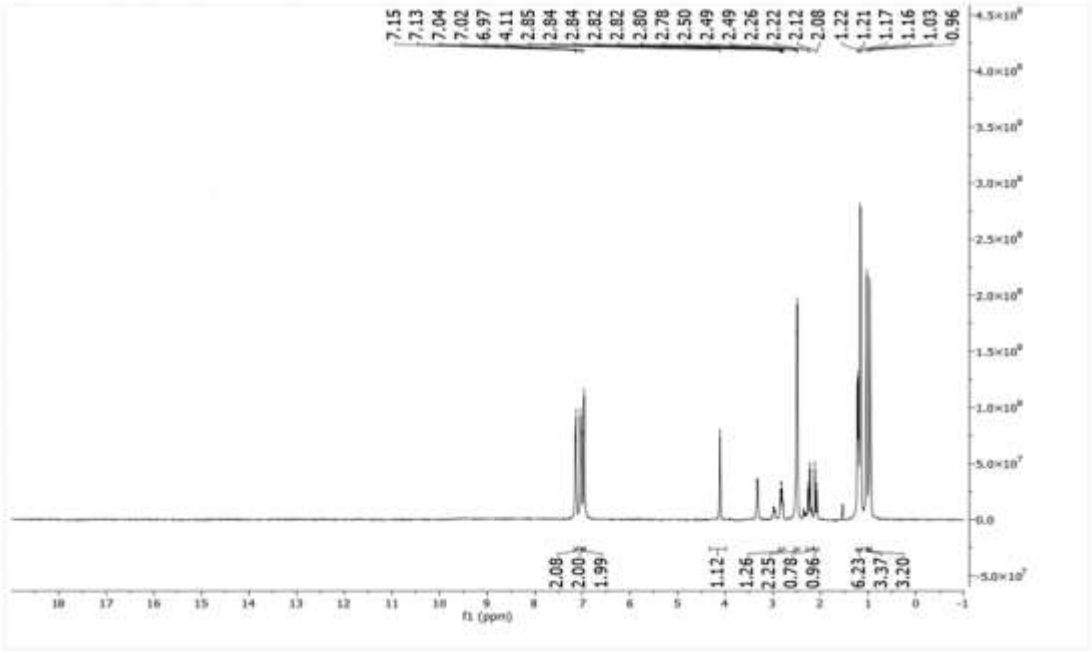


Yellow solid, m.p. 197-199 ºC .

FT-IR (ATR) ῡ (cm^{-1}): 3364, 3305, 2185, 1679, 1645, 1213 .^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.96 (s, 3H), 1.03 (s, 3H), 1.17 (d, *J* = 6.8 Hz, 3H), 1.22 (d, *J* = 6.8 Hz, 3H), 2.12 (d, *J* = 16.0 Hz, 1H), 2.26 (d, *J* = 16.0 Hz, 1H), 2.49-2.50 (m, 2H), 2.78-2.85 (m, 1H), 4.11 (s, 1H), 6.97 (s, NH_2, 2H), 7.04 (d, *J* = 7.6 Hz, 2H), 7.15 (d, *J* = 7.6 Hz, 2H)

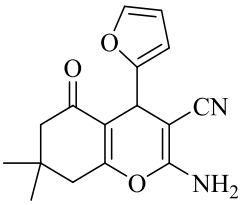


The FT-IR of 2-Amino-4-(4-isopropylphenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

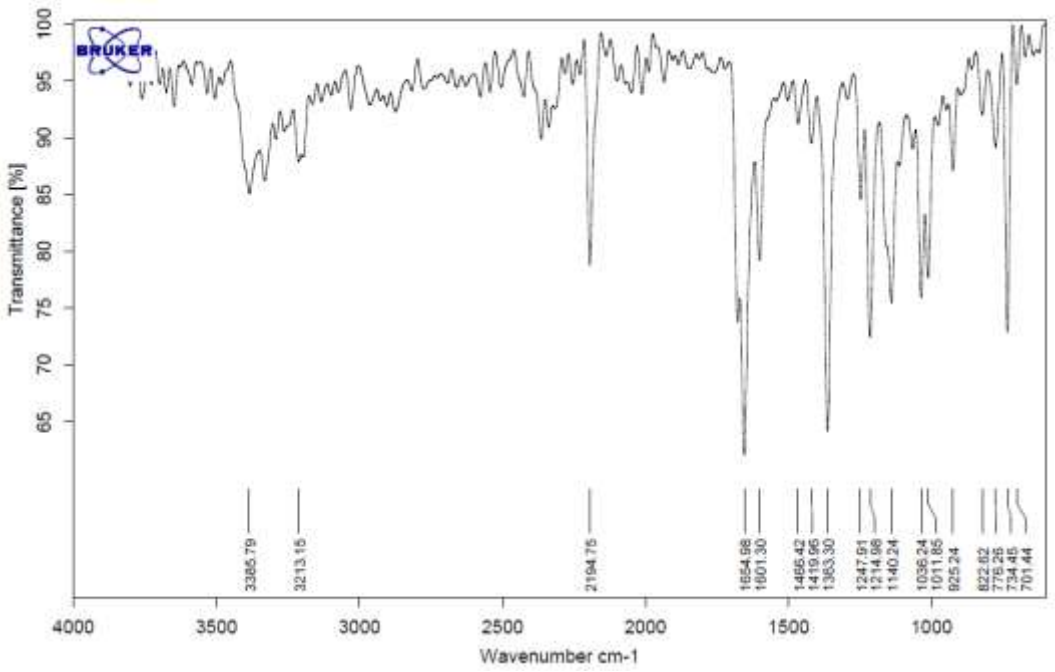


The ^{1}H NMR spectrum of 2-Amino-4-(4-isopropylphenyl)-3-cyano-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo[*b*]pyran

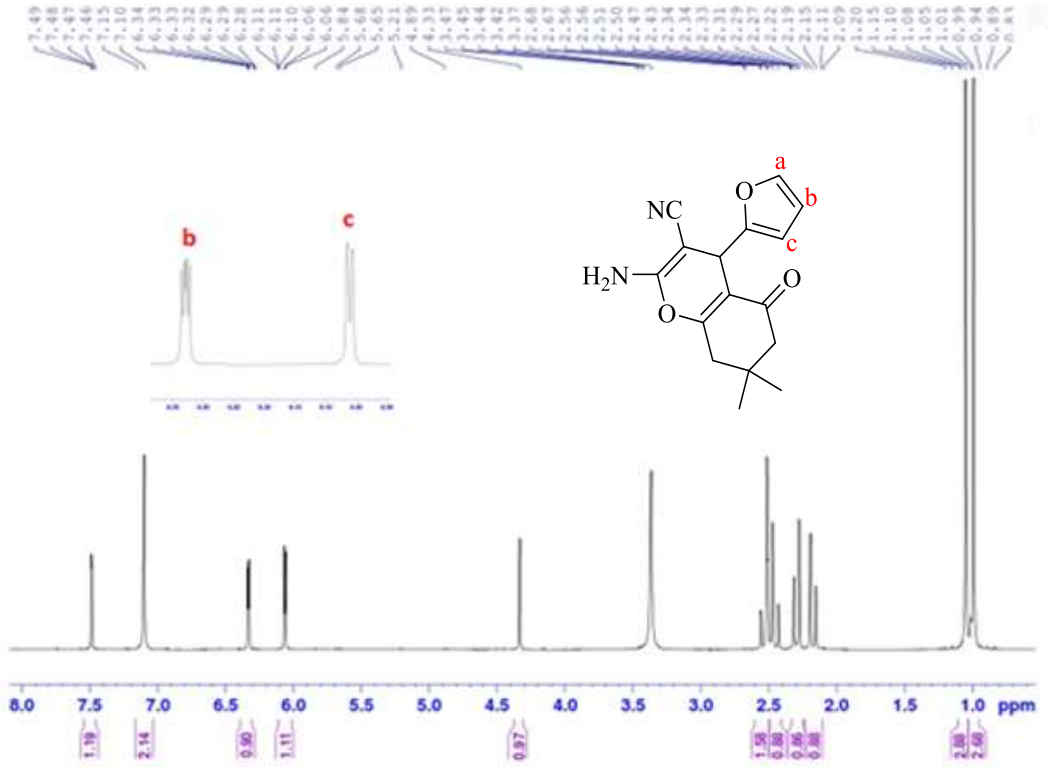
2-Amino-3-cyano-4-(furan-2-yl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo [*b*]pyran



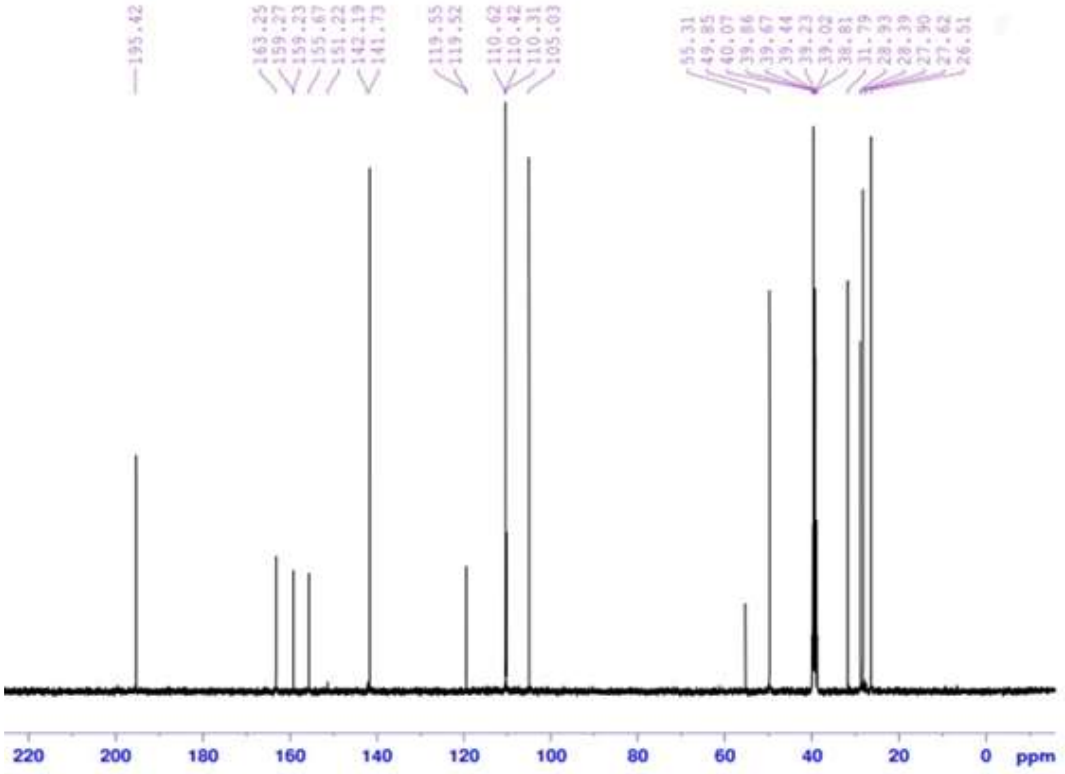
Cream powder, m.p. 217-219 ºC. FT-IR (ATR) ῡ (cm^{-1}): 3385, 3213, 2194, 1654, 1601, 1214 . ^{1}H NMR (400 MHz, DMSO-d_6)/ δ ppm: 0.99 (s, 3 H), 1.05 (s, 3H), 2.15 (d, *J* = 16.0 Hz, 1H), 2.29 (d, *J* = 16.0 Hz, 1H), 2.43–2.68 (m, 2H), 4.33 (s, 1H), 6.09 (d, *J* = 4.0 Hz, 1H), 6.31 (m, 1H), 7.12 (s, NH_2, 2H), 7.47 (d, *J* = 4.0 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6)/ δ ppm: 26.51, 28.39, 28.93, 31.79, 49.85, 55.31, 105.03, 110.31, 110.42, 119.52, 141.73, 155.67, 159.23, 163.25, 195.42



The FT-IR of 2-Amino-3-cyano-4-(furan-2-yl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo [*b*]pyran



The ^{1}H NMR spectrum of 2-Amino-3-cyano-4-(furan-2-yl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo [*b*]pyran



The ^{1}H NMR spectrum of 2-Amino-3-cyano-4-(furan-2-yl)-7,7-dimethyl-5-oxo-4*H*-5,6,7,8-tetrahydrobenzo [*b*]pyran