The synthesis of 2-arylquinoxaline derivatives

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ABSTRACT

A series of new 2-arylquinoxaline derivatives have been synthesized in high yield by condensation of aryl-1,2-diamines with arylglyoxals in DMF at 50-120 °C.

Keywords: 
Arylquinoxalines 
Arylglyoxals 
1,2-diaminobenzene derivatives

1. Introduction

Among the various classes of nitrogen-containing heterocyclic compounds, quinoxaline derivatives are an important component of pharmacologically active compounds. Quinoxaline derivatives have various pharmacological activities such as actinoleutin, hinomycin, and levomycin that are known to inhibit growth of gram positive bacteria and are active against various transplantable tumors.1-6 In addition quinoxaline derivatives are also associated with a wide spectrum of biological activities ranging from antibacterial,7-10 antifungal,7,11 antitubercular,7,12-14 analgesic8,15 and anti-inflammatory.15,16 We have reported the synthesis of quinoxaline derivatives from 2-bromo-4-chloro-indanone17 and arylaminoisoxazol-5(2H)-ones.18 Here, we report a facile method for the synthesis of 2-arylquinoxalines in good to excellent yields by reaction of 1,2-diaminobenzene derivatives with various arylglyoxals in DMF at 50-120 °C.

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2. Results and Discussion

The aryglyoxals were prepared by oxidation of the corresponding acetophenones using SeO$_2$ (Scheme 1).

![Scheme 1. Synthesis of aryglyoxals](image)

The reaction of aryglyoxals (1) with aryl-1,2-diamines (2) in DMF at 50-120 °C afforded the corresponding 2-arylquinoxalines (3a-t) in 68-96% yields (Scheme 2).

![Scheme 2. Synthesis of 2-arylquinoxalines (3a-t)](image)

The $^1$H-NMR spectra of compounds (3k-t) show two singlets in the region of $\delta = 9.23-9.32$ ppm, due to the formation of a mixture of two isomers. The proposed mechanism for the synthesis of 2-arylquinoxalines (3k-t) is shown in Scheme 3. In case of 3f-j as the amino group in position 2 is more active than the amino group in position 4 (due to the resonance affect), therefore, it condenses with the formyl group of glyoxals in the first step to form a single product as shown in Scheme 4.

![Scheme 4. Suggested mechanism for synthesis of 2-arylquinoxalines (3f-j)](image)

It should be mentioned that repeating the reactions at temperatures higher than those mentioned in Table 1 will reduce the yields, due to decomposition.
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3. Conclusions

The work reported herein provides a highly effective and simple one step method for the synthesis of new 2-arylquinoxalines, which may have pharmaceutical and biological applications.

Acknowledgements

The authors are grateful to the Urmia University for support of this work.

Experimental

**General Procedure.** \(^1\)H and \(^13\)C NMR spectra were recorded on a Bruker AM-300 spectrometer at 300 MHz and 75.5 MHz, respectively. The spectra were measured in CDCl\(_3\) or DMSO-\(d_6\) using TMS as the internal standard. Infrared spectra were determined on a Thermo Nicolet (Nexus 670) FT-IR spectrometer, using KBr disks. Microanalyses were performed on a Carlo-Erba Analyzer 1104. Melting points were determined on a digital melting point apparatus (electrothermal) and remain uncorrected.

**General Procedure for the Synthesis of 2-Arylquinoxalines (3a-t)**

A mixture of arylglyoxal 1 (1 mmol), aryl-1,2-diamine 2 (1 mmol), in DMF (5 ml) were stirred at 50-120 °C for 2-12 h. The completion of the reactions were monitored with thin-layer chromatography (TLC). After the appropriate time, water was added and the reaction mixture was stirred. The precipitate was then collected, and recrystallized from ethanol to afford pure 2-arylquinoxalines (3a-t).

**2-(4-bromophenyl)quinoxaline (3a):**
Cream solid; mp: 135 °C. \(^1\)H NMR (CDCl\(_3\)): \(\delta\) 7.70-7.84 (m, 4H, ArH), 8.09-8.15 (m, 4H, ArH), 9.32 (s, 1H, ArH) ppm; \(^13\)C NMR (CDCl\(_3\)): \(\delta\) 125.01, 128.96, 129.09, 129.58, 129.83, 130.50, 132.33, 135.53, 141.53, 142.20,142.65, 150.58 ppm; FT-IR (KBr): \(\nu\) 3050, 2921, 1586, 1510, 1485, 1312, 1072, 1009, 828, 757 cm\(^{-1}\). Anal. Calc. for C\(_{14}\)H\(_9\)BrN\(_2\): C, 58.97; H, 3.18; N, 9.82. Found: C, 58.74; H, 3.35; N, 9.77%.

**2-(4-chlorophenyl)quinoxaline (3b):**
Pale yellow solid; mp: 138 °C. \(^1\)H NMR (CDCl\(_3\)): \(\delta\) 7.53 (d, \(J\) = 8.4 Hz, 2H, ArH), 7.77 (bs, 2H, ArH), 8.13-8.15 (m, 4H, ArH), 9.29 (bs, 1H, ArH) ppm; \(^13\)C NMR (CDCl\(_3\)): \(\delta\) 128.74, 129.14, 129.37, 129.58, 129.77, 130.46, 135.13, 136.57, 141.60, 142.23, 142.77, 150.55 ppm; FT-IR (KBr): \(\nu\) 2963, 2936, 2834, 1580, 1489, 1452, 1427, 1313, 1093, 832, 755, 548 cm\(^{-1}\). Anal. Calc. for C\(_{14}\)H\(_9\)ClN\(_2\): C, 69.86; H, 3.77; N, 11.64. Found: C, 69.66; H, 3.81; N, 11.71%.

**2-(4-methoxyphenyl)quinoxaline (3c):**
Cream solid; mp: 92 °C. \(^1\)H NMR (CDCl\(_3\)): \(\delta\) 3.90 (s, 3H, OCH\(_3\)), 7.08 (d, \(J\) =8.4 Hz, 2H, ArH), 7.69-7.78 (m, 2H, ArH), 8.18 (d, \(J\) = 8.4 Hz, 2H, ArH), 9.30 (s, 1H, ArH) ppm; \(^13\)C NMR (CDCl\(_3\)): \(\delta\) 55.43, 114.60, 128.98, 129.03, 129.08, 129.22, 130.21, 141.14, 142.27, 143.00, 151.40, 161.49 ppm; FT-IR (KBr): \(\nu\) 3056, 2934, 2833, 1606, 1520, 1427, 1313, 1093, 832, 755, 548 cm\(^{-1}\). Anal. Calc. for C\(_{15}\)H\(_{12}\)N\(_2\)O: C, 76.25; H, 5.12; N, 11.86. Found: C, 76.39; H, 5.01; N, 11.74%.

**2-(3,4-dibromophenyl)quinoxaline (3d):**
Orang solid; mp: 115 °C. \(^1\)H NMR (CDCl\(_3\)): \(\delta\) 7.81 (bs, 2H, ArH), 7.66 (d, \(J\) = 6.3 Hz, 1H, ArH), 7.81 (bs, 2H, ArH), 8.17 (bs, 2H, ArH), 8.40 (bs, 1H, ArH), 9.31 (bs, 1H, ArH) ppm; \(^13\)C NMR (CDCl\(_3\)): \(\delta\) 116.30, 116.58, 123.87, 126.03, 128.87, 129.70, 130.27, 130.64, 130.77, 133.25, 138.32, 142.34, 142.57, 150.34 ppm; FT-IR (KBr): \(\nu\) 3058, 1549, 1479, 1311, 1080, 960, 758, 687 cm\(^{-1}\). Anal. Calc. for C\(_{14}\)H\(_8\)Br\(_2\)N\(_2\): C, 46.19; H, 2.22; N, 7.70. Found: C, 46.01; H, 2.51; N, 7.62%. 
2-(3,4-dimethoxyphenyl)quinoxaline (3e): Yellow solid; mp: 105 °C. $^1$H NMR (CDCl$_3$): δ 4.00 (s, 3H, OCH$_3$), 4.08 (s, 3H, OCH$_3$), 7.05 (d, $J=8.4$ Hz, 1H, ArH), 7.74-7.82 (m, 3H, ArH), 7.89 (s, 1H, ArH), 8.11-8.18 (m, 2H, ArH), 9.33 (s, 1H, ArH) ppm; $^{13}$C NMR (CDCl$_3$): δ 56.04, 56.10, 110.17, 111.15, 120.50, 129.00, 129.19, 129.27, 129.39, 130.30, 141.12, 142.12, 143.00, 149.74, 151.19, 151.26 ppm; FT-IR (KBr): ν 3057, 2925, 2836, 1598, 1518, 1461, 1430, 1285, 1250, 1026, 764 cm$^{-1}$. Anal. Calc. for C$_{16}$H$_{14}$N$_2$O$_2$: C, 72.16; H, 5.30; N, 10.52. Found: C, 72.02; H, 5.41; N, 10.63%.

2-(3-bromophenyl)-6-nitroquinoxaline (3f): Yellow solid; mp: 226-228 oC. $^1$H NMR (CDCl$_3$): δ 7.60 (t, $J=7.8$ Hz, 1H, ArH), 7.82 (d, $J=8.1$ Hz, 1H, ArH), 8.34-8.43 (m, 2H, ArH), 8.57 (d, $J=8.1$ Hz, 1H, ArH), 8.92 (s, 1H, ArH) ppm; $^{13}$C NMR (CDCl$_3$): δ 123.15, 123.91, 124.51, 125.40, 125.74, 127.53, 131.33, 131.86, 134.52, 137.96, 140.79, 144.42, 146.73, 152.57 ppm; FT-IR (KBr): ν 3054, 1551, 1524, 1484, 1350, 1304, 1286, 1193, 1076, 795, 691 cm$^{-1}$. Anal. Calc. for C$_{14}$H$_8$BrN$_3$O$_2$: C, 50.93; H, 2.44; N, 12.73. Found: C, 50.77; H, 2.32; N, 12.82%.

2-(4-chlorophenyl)-6-nitroquinoxaline (3g): Cream solid; mp: 261-263 °C. $^1$H NMR (DMSO-d$_6$): δ 7.71 (d, $J=8.4$ Hz, 2H, ArH), 8.35 (d, $J=8.7$ Hz, 1H, ArH), 8.46-8.51 (m, 3H, ArH), 8.92 (s, 1H, ArH), 9.81 (s, 1H, ArH) ppm; FT-IR (KBr): ν 3052, 2981, 1622, 1592, 1489, 1435, 1311, 834, 780 cm$^{-1}$ Owing to extreme insolubility, its $^{13}$C NMR spectrum could not be measured in any solvent. Anal. Calc. for C$_{14}$H$_8$ClN$_3$O$_2$: C, 58.86; H, 2.82; N, 14.71. Found: C, 58.75; H, 2.78; N, 14.88%.

2-(4-fluorophenyl)-6-nitroquinoxaline (3h): Yellow solid; mp: 234-236 oC. $^1$H NMR (DMSO-d$_6$): δ 7.48 (t, $J=8.7$ Hz, 2H, ArH), 8.33 (d, $J=9.3$ Hz, 1H, ArH), 8.46-8.51 (m, 3H, ArH), 8.90 (d, $J=2.1$ Hz, 1H, ArH), 9.79 (s, 1H, ArH) ppm; $^{13}$C NMR (DMSO-d$_6$): δ 116.67, 116.96, 123.53, 124.44, 125.39, 125.52, 130.88, 131.01, 131.13, 131.31, 131.49, 134.84, 146.61, 147.39, 147.64 ppm; FT-IR (KBr): ν 3055, 2925, 2853, 1555, 1524, 1484, 1350, 1304, 1286, 1193, 1076, 795, 691 cm$^{-1}$. Anal. Calc. for C$_{14}$H$_8$FN$_3$O$_2$: C, 62.46; H, 3.00; N, 15.61. Found: C, 62.54; H, 2.98; N, 15.48%.

2-(4-nitrophenyl)-6-nitroquinoxaline (3i): Cream brown solid; mp: 237-239 °C. $^1$H NMR (DMSO-d$_6$): δ 8.37-8.44 (m, 3H, ArH), 8.57-8.65 (m, 3H, ArH), 8.93 (bs, 1H, ArH), 9.87 (bs, 1H, ArH) ppm; $^{13}$C NMR (DMSO-d$_6$): δ 124.66, 125.42, 129.81, 131.40, 131.85, 140.68, 141.47, 146.89, 147.68, 148.22, 149.41, 152.08 ppm; FT-IR (KBr): ν 3093, 2942, 1555, 1519, 1347, 854, 755, 692 cm$^{-1}$. Anal. Calc. for C$_{14}$H$_8$N$_4$O$_4$: C, 56.76; H, 2.72; N, 18.91. Found: C, 56.66; H, 2.63; N, 18.98%.

2-(1,1'-biphenyl)-4-yl)-6-nitroquinoxaline (3j): Green yellow; mp: 171-174 °C. $^1$H NMR (DMSO-d$_6$): δ 7.40-7.49 (m, 3H, ArH), 7.77 (d, $J=6.8$ Hz, 2H, ArH), 7.91 (d, $J=7.5$ Hz, 2H, ArH), 8.32 (d, $J=9.3$ Hz, 1H, ArH), 8.48 (bs, 3H, ArH), 8.89 (s, 1H, ArH); $^{13}$C NMR (DMSO-d$_6$): δ 123.48, 124.42, 125.56, 127.31, 127.90, 128.67, 128.89, 129.11, 129.56, 131.31, 134.54, 139.45, 143.15, 143.97, 147.50, 148.45 ppm; FT-IR (KBr): ν 3055, 2930, 1605, 1547, 1465, 1522, 1345, 1191, 1050, 766, 728 cm$^{-1}$. Anal. Calc. for C$_{20}$H$_{13}$N$_3$O$_4$: C, 73.38; H, 4.00; N, 12.84. Found: C, 73.25; H, 3.88; N, 12.95%.

2-phenyl-6/7-methylquinoxaline (3k): Cream solid; mp: 89-93 °C, isomers ratio (67:33). $^1$H NMR (CDCl$_3$): δ 2.62 (s, 3H, CH$_3$), 7.55-7.64 (m, 4H, ArH), 7.95-8.03 (m, 2H, ArH), 8.20 (d, $J=6.3$ Hz, 2H, ArH), 9.27 (s, 1H, H-3, one isomer), 9.29 (s, 1H, H-3, other isomer) ppm; $^{13}$C NMR (CDCl$_3$): δ 21.87, 127.43, 127.51, 127.90, 128.46, 128.58, 129.13, 129.99, 130.08, 131.92, 132.67, 138.31, 142.40 ppm; FT-IR (KBr): ν 3055, 2917,
2-(3-bromophenyl)-6/7-methylquinoxaline (3l):
Cream brown solid; mp: 101-104 °C, isomers ratio (66:34). 1H NMR (CDCl3): δ 2.63 (s, 3H, CH3), 7.44 (t, J = 7.8 Hz, 1H, ArH), 7.67-7.69 (m, 2H, ArH), 7.93 (d, J = 7.8 Hz, 1H, ArH), 8.05 (d, J = 8.1 Hz, 1H, ArH), 8.08-8.11 (m, 1H, ArH), 8.38 (s, 1H, ArH), 9.23 (s, 1H, H-3, one isomer), 9.26 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3): δ 21.92, 123.45, 125.82, 125.92, 127.76, 128.47, 129.13, 130.45, 130.54, 130.59, 138.44, 132.95, 133.02, 141.49, 142.45 ppm; FT-IR (KBr): ν 3058, 2913, 1620, 1538, 1439, 1288, 1058, 966, 822, 774, 689 cm⁻¹. Anal. Calc. for C15H11BrN2: C, 60.22; H, 3.71; N, 9.36. Found: C, 60.39; H, 3.63; N, 9.17%.

2-(3-methoxyphenyl)-6/7-methylquinoxaline (3m):
Cream solid; mp: 84-87 °C, isomers ratio (68:32). 1H NMR (CDCl3): δ 2.61 (s, 3H, CH3), 3.94 (s, 3H, OCH3), 7.07 (d, J = 8.1 Hz, 1H, ArH), 7.47 (t, J = 7.8 Hz, 1H, ArH), 7.72-7.76 (m, 2H, ArH), 7.88-8.07 (m, 2H, ArH), 9.25 (s, 1H, H-3, one isomer), 9.26 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3): δ 21.87, 55.45, 112.50, 112.59, 116.03, 116.12, 119.77, 119.85, 127.88, 128.45, 128.55, 129.12, 130.11, 131.59, 132.65, 138.29, 140.07, 140.25, 140.70, 140.97, 142.28, 142.45, 143.19, 151.52, 160.28 ppm; FT-IR (KBr): ν 2919, 2835, 1607, 1584, 1542, 1507, 1484, 1460, 1041, 829, 784, 625 cm⁻¹. Anal. Calc. for C16H14N2O: C, 76.78; H, 5.64; N, 11.19. Found: C, 76.84; H, 5.52; N, 11.03%.

2-(4-bromophenyl)-6/7-methylquinoxaline (3n):
Cream gray solid; mp: 135-137 °C, isomers ratio (66:34). 1H NMR (CDCl3): δ 2.63 (s, 3H, CH3), 7.62 (d, J = 8.7 Hz, 1H, ArH), 7.70 (d, J = 8.7 Hz, 2H, ArH), 7.93 (bs, 1H, ArH), 8.03 (d, J = 8.1 Hz, 1H, ArH), 8.09 (d, J = 8.7 Hz, 2H, ArH), 9.25 (s, 1H, H-3, one isomer), 9.26 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3): δ 21.80, 21.72, 127.94, 128.10, 128.49, 128.61, 128.93, 128.99, 131.52, 132.16, 132.29, 132.67, 138.29, 140.07, 140.70, 140.97, 142.28, 142.45, 143.19, 145.28, 151.23, 161.49 ppm; FT-IR (KBr): ν 3050, 2915, 1621, 1586, 1488, 1072, 833, 823, 777, 492 cm⁻¹. Anal. Calc. for C15H11BrN2: C, 60.22; H, 3.71; N, 9.36. Found: C, 60.32; H, 3.61; N, 9.18%.

2-(4-chlorophenyl)-6-methylquinoxaline (3o):
Yellow solid; mp: 169-172 °C. 1H NMR (CDCl3): δ 2.63 (s, 3H, CH3), 7.54 (d, J = 8.4 Hz, 2H, ArH), 7.61 (d, J = 8.7 Hz, 1H, ArH), 7.70 (d, J = 8.7 Hz, 2H, ArH), 7.93 (bs, 1H, ArH), 8.03 (d, J = 8.1 Hz, 1H, ArH), 9.16 (d, J = 8.4 Hz, 2H, ArH), 9.24 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3): δ 21.89, 128.39, 128.54, 128.72, 129.09, 129.36, 132.20, 135.27, 136.46, 141.17, 141.80, 142.29, 150.52 ppm; FT-IR (KBr): ν 3052, 2921, 1489, 1435, 1311, 1092, 834, 780 cm⁻¹. Anal. Calc. for C15H11ClN2: C, 70.73; H, 4.35; N, 11.00. Found: C, 70.66; H, 4.22; N, 11.16%.

2-(4-fluorophenyl)-6/7-methylquinoxaline (3p):
Cream solid; mp: 118-121 °C. 1H NMR (CDCl3): δ 2.62 (s, 3H, CH3), 7.23-7.28 (m, 2H, ArH), 7.60 (d, J = 8.7 Hz, 1H, ArH), 7.92 (s, 1H, ArH), 8.02 (bd, J = 7.5 Hz, 1H, ArH), 8.19 (t, J = 6.3 Hz, 2H, ArH), 9.23 (s, 1H, H-3, one isomer, ArH), 9.25 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3): δ 21.90, 116.18, 116.47, 126.88, 127.96, 128.20, 128.99, 129.39, 129.52, 129.64, 132.53, 133.47, 138.83, 140.96, 141.73, 142.27, 150.74, 162.71, 166.03 ppm; FT-IR (KBr): ν 3052, 2921, 1489, 1435, 1311, 1092, 834, 780 cm⁻¹. Anal. Calc. for C15H11FN2: C, 75.62; H, 4.65; N, 11.00. Found: C, 75.87; H, 4.54; N, 11.65%.

2-(4-methoxyphenyl)-6/7-methylquinoxaline (3q):
Cream solid; mp: 94-96 °C, isomers ratio (60:40). 1H NMR (CDCl3): δ 2.60 (s, 3H, CH3), 3.90 (s, 3H, OCH3), 7.07 (d, J = 8.4 Hz, 2H, ArH), 7.52-7.60 (m, 1H, ArH), 7.86-8.02 (m, 2H, ArH), 8.14-8.18 (m, 2H, ArH), 9.23 (s, 1H, H-3, one isomer), 9.24 (s, 1H, H-3, other isomer) ppm; 13C NMR (CDCl3):
\[ \delta 21.80, 55.43, 114.55, 127.84, 128.20, 128.82, 128.86, 128.93, 129.35, 131.42, 132.54, 139.60, 140.77, 142.07, 142.27, 142.81, 150.64, 151.29, 161.30, 161.40 \text{ ppm}; \text{FT-IR (KBr)}: \nu 2921, 2852, 1605, 1433, 1325, 1254, 1179, 1027, 831 \text{ cm}^{-1}. \]

Anal. Calc. for \( \text{C}_{16}\text{H}_{14}\text{N}_{2}\text{O} \): C, 76.78; H, 5.64; N, 11.19. Found: C, 76.85; H, 5.55; N, 11.25%.

2-(4-nitrophenyl)-6/7-methylquinoxaline (3r):

Gray solid; \( \text{mp: 145-148} \text{ °C}, \text{isomers ratio (64:36)}. \)

\[ \delta 2.63 (s, 3H, \text{CH}_3), 7.65 (d, \text{J} = 6.9 \text{ Hz}, 1H, \text{ArH}), 7.93 (d, \text{J} = 9 \text{ Hz}, 1H, \text{ArH}), 8.05 (d, \text{J} = 7.8 \text{ Hz}, 1H, \text{ArH}), 8.30-8.38 (m, 4H, \text{ArH}), 9.30 (s, 1H, H-3, one isomer), 9.32 (s, 1H, H-3, other isomer) \text{ ppm}; \text{13C NMR (CDCl}_3): \delta 21.91, 124.25, 128.04, 128.13, 128.24, 128.58, 128.73, 129.33, 133.07, 133.25, 141.58, 141.88, 142.69 \text{ ppm}; \text{FT-IR (KBr)}: \nu 2922, 1600, 1518, 1490, 1345, 1049, 960, 854, 692 \text{ cm}^{-1}. \]

Anal. Calc. for \( \text{C}_{15}\text{H}_{11}\text{N}_{3}\text{O}_2 \): C, 67.92; H, 4.18; N, 15.84. Found: C, 67.85; H, 4.22; N, 15.92%.

2-(3,4-dimethoxyphenyl)-6/7-methylquinoxaline (3s):

Cream brown solid; \( \text{mp: 97-100} \text{ °C}, \text{isomers ratio (56:44)}. \)

\[ \delta 2.61 (s, 3H, \text{CH}_3), 3.98 (s, 3H, \text{OCH}_3), 4.06 (s, 3H, \text{OCH}_3), 7.03 (d, \text{J} = 8.4 \text{ Hz}, 1H, \text{ArH}), 7.54-7.62 (m, 1H, \text{ArH}), 7.72 (d, \text{J} = 7.2 \text{ Hz}, 1H, \text{ArH}), 7.80-7.99 (m, 3H, \text{ArH}), 8.04 (d, \text{J} = 7.8 \text{ Hz}, 1H, \text{ArH}), 8.29 (d, \text{J} = 7.8 \text{ Hz}, 2H, \text{ArH}), 9.24 (s, 1H, H-3, one isomer), 9.26 (s, 1H, H-3, other isomer) \text{ ppm}; \text{13C NMR (CDCl}_3): \delta 21.79, 21.86, 56.01, 56.06, 110.02, 110.10, 111.12, 120.23, 120.36, 127.88, 128.16, 128.51, 129.60, 131.46, 132.55, 139.65, 140.59, 140.79, 141.16, 142.12, 142.88, 149.67, 150.50, 150.93, 151.03, 141.15 \text{ ppm}; \text{FT-IR (KBr)}: \nu 3081, 2934, 2837, 1600, 1519, 1288, 1249, 1173, 1023 \text{ cm}^{-1}. \]

Anal. Calc. for \( \text{C}_{17}\text{H}_{16}\text{N}_{2}\text{O}_2 \): C, 72.84; H, 5.75; N, 9.99. Found: C, 72.75; H, 5.64; N, 9.78%.

2-(\[1,1\prime\]-biphenyl]-4-yl)-6/7-methylquinoxaline (3t);

Cream solid; \( \text{mp: 84-87} \text{ °C}, \text{isomers ratio (65:35)}. \)

\[ \delta 2.64 (s, 3H, \text{CH}_3), 7.42 (d, \text{J} = 6.9 \text{ Hz}, 1H, \text{ArH}), 7.50 (t, \text{J} = 6.3 \text{ Hz}, 2H, \text{ArH}), 7.61 (d, \text{J} = 8.4 \text{ Hz}, 1H, \text{ArH}), 7.69 (d, \text{J} = 7.2 \text{ Hz}, 2H, \text{ArH}), 7.80-7.99 (m, 3H, \text{ArH}), 8.04 (d, \text{J} = 7.8 \text{ Hz}, 1H, \text{ArH}), 8.29 (d, \text{J} = 7.8 \text{ Hz}, 2H, \text{ArH}), 9.32 (s, 1H, H-3, one isomer), 9.34 (s, 1H, H-3, other isomer) \text{ ppm}; \text{13C NMR (CDCl}_3): \delta 22.04, 126.13, 127.18, 127.46, 127.98, 128.01, 128.13, 128.97, 132.94, 133.92, 134.50, 140.01, 140.58, 141.16, 142.27, 143.55, 151.28 \text{ ppm}; \text{FT-IR (KBr)}: \nu 3029, 2934, 2837, 1600, 1519, 1501, 1288, 1249, 1173, 1023 \text{ cm}^{-1}. \]

Anal. Calc. for \( \text{C}_{21}\text{H}_{16}\text{N}_{2} \): C, 85.11; H, 5.44; N, 9.45. Found: C, 85.30; H, 5.34; N, 9.32%.

References


