Supplementary Material

One-pot five-component reaction for synthesis of some novel bis-dihydroquinazolinone derivatives

Ali A. Mohammadi,* Salman Tahery, and Saber Askari

Chemistry & Chemical Engineering Research Center of Iran, P.O. Box 14335-186, Tehran, Iran
E-mail: aliamohammadi@ccerci.ac.ir

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General
Melting points were obtained in open capillary tubes and were measured on an electrothermal 9200 apparatus are uncorrected. Mass spectra were recorded on a Shimadzu QP 1100 BX mass spectrometer. IR spectra were recorded on KBr pellets on a Shimadzu IR–470 spectrophotometer. ¹H and ¹³C NMR spectra were determined on a Bruker 300 DRX Avance instrument at 300 and 75MHz. Elemental analysis for C, H and N were performed using a Heraus CHN rapid analyzer. All the reactions are monitored by thin layer chromatography (TLC) with UV light as detecting agent.

General Procedure for the synthesis of bis(1,2-dihydro quinazolinon-4(1H)-one) derivatives (4 a-r)
A mixture of, isatoic anhydride 1 (2 mmol), aldehyde 2 (2 mmol), diamine 3 (1 mmol), 0.15 g (0.3 mmol) alum, and 10 ml EtOH 96% in a 50 ml flask was stirred at reflux for the time period as indicated in table 1. After completion of the reaction (monitored by TLC, ethyl acetate /n-hexane, 4:1), the solid products obtained were just filtered off the reaction mixture. Water (25 mL) was added to the resulting solid (for removal of alum), and the resulting solid was separated by filtration. The crude product was washed with hot ethanol to afford the purified product.

Table 1: Synthesis of bisquinazolinone 4a-r using Alum as catalysts

<table>
<thead>
<tr>
<th>Products 4</th>
<th>Diamines 3</th>
<th>R</th>
<th>Time (min)</th>
<th>Yield (%)</th>
<th>Mp (°C)</th>
<th>Lit. Yield (Lit. Time)</th>
<th>Lit. Mp (°C)</th>
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<tbody>
<tr>
<td>a</td>
<td>a</td>
<td>H</td>
<td>70</td>
<td>91</td>
<td>297-9</td>
<td>88 (3h)²⁹</td>
<td>291</td>
</tr>
<tr>
<td>b</td>
<td>a</td>
<td>4-Cl</td>
<td>55</td>
<td>93</td>
<td>281-3</td>
<td>74 (3h)²⁹</td>
<td>255</td>
</tr>
<tr>
<td>c</td>
<td>a</td>
<td>4-Me</td>
<td>55</td>
<td>96</td>
<td>295-7</td>
<td>85 (3h)²⁹</td>
<td>270</td>
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<tr>
<td>d</td>
<td>a</td>
<td>4-NO₂</td>
<td>55</td>
<td>96</td>
<td>286-8 (dec)</td>
<td>61(3h)²⁹</td>
<td>275</td>
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<tr>
<td>e</td>
<td>a</td>
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<td>50</td>
<td>90</td>
<td>310-13 (dec)</td>
<td>-</td>
<td>-</td>
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<td>f</td>
<td>a</td>
<td>3-EtO,4-OH</td>
<td>70</td>
<td>88</td>
<td>262-4</td>
<td>-</td>
<td>-</td>
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<tr>
<td>g</td>
<td>a</td>
<td>3-Cl</td>
<td>55</td>
<td>93</td>
<td>264-6</td>
<td>64 (3h)²⁹</td>
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<tr>
<td>h</td>
<td>a</td>
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<td>250-2</td>
<td>69 (3h)²⁹</td>
<td>260</td>
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<td>a</td>
<td>4-CO₂H</td>
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<td>90</td>
<td>308-10</td>
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<td>j</td>
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<td>94</td>
<td>237-9</td>
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<td>-</td>
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<tr>
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<td>a</td>
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<td>88</td>
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<tr>
<td>l</td>
<td>b</td>
<td>H</td>
<td>75</td>
<td>90</td>
<td>296-8</td>
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<tr>
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<td>238-40 (dec)</td>
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<td>281-3</td>
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<td>-</td>
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<tr>
<td>o</td>
<td>b</td>
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<td>92</td>
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<tr>
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<td>b</td>
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</tr>
<tr>
<td>q</td>
<td>c</td>
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<td>90</td>
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<tr>
<td>r</td>
<td>c</td>
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<td>85</td>
<td>213-5</td>
<td>79 (6h)²⁸</td>
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Selected data for new compounds:

3,3′-(ethane-1,2-diyl)bis(2-(2,4-dichlorophenyl)-2,3-dihydroquinazolin-4(1H)-one) (4e):
White solid; Yield: 88%; mp 310-13 °C (dec); IR (KBr): νmax = 3248 (NH), 3030, 1629 (C=O), 1521 cm⁻¹; 1H NMR (DMSO-d6) δ= 2.86-2.90 (m, 2H, CH2), 3.89-3.93 (m, 1H, CH2), 3.96-4.00 (m, 1H, CH2), 6.20 (d, 1H, J=2.6Hz, CH), 6.31 (d, 1H, J=2.7Hz, CH), 6.65-6.70 (m, 4H, Ar-H), 7.18-7.27 (m, 7H, 2NH, 5Ar-H), 7.35-7.37 (m, 1H, Ar-H), 7.63-7.65 (m, 4H, Ar-H) ppm; 13C NMR (DMSO-d6) δ= 43.09, 68.3, 68.5, 114.9, 115.4, 118.3, 125.3, 128.3, 128.6, 129.2, 130.3, 134.4, 134.9, 143.9, 146.4, 163.1 ppm; MS: m/z (%)= 614; Anal. Calcd for C30H22Cl4N4O2: C, 58.84; H, 3.62; N, 9.15; Found: C, 58.76; H, 3.53; N, 9.07%.

3,3′-(ethane-1,2-diyl)bis(2-(3-ethoxy-4-hydroxyphenyl)-2,3-dihydroquinazolin-4(1H)-one) (4f):
White solid; Yield: 81%; mp 262-4 °C; IR (KBr): νmax = 3397 (OH), 3281 (NH), 2976, 2929, 1634 (C=O), 1514 cm⁻¹; 1H NMR (DMSO-d6) δ= 1.26 (t, 6H, J=7.0Hz, CH3), 2.85-2.89 (m, 2H, CH2), 3.91 (q, 4H, J=7.0Hz, CH2), 4.02-4.04 (m, 2H, CH2), 5.69 (s, 2H, CH), 6.61-6.71 (m, 8H, Ar-H), 6.90 (s, 2H, Ar-H), 7.17-7.19 (m, 4H, 2NH, 2Ar-H), 7.61 (d, 2H, J=8.0Hz, Ar-H), 8.99 (s, 2H, OH) ppm; 13C NMR (DMSO-d6) δ= 15.5, 42.8, 64.6, 71.4, 112.8, 115.0, 115.5, 116.0, 117.8, 119.6, 128.2, 132.2, 134.0, 147.4, 147.5, 147.9, 163.3 ppm; MS: m/z (%)= 594; Anal. Calcd for C34H34N4O6: C, 68.67; H, 5.76; N, 9.42; Found: C, 68.61; H, 5.66; N, 9.35%.

4,4′-(3,3′-(ethane-1,2-diyl)bis(4-oxo-1,2,3,4-tetrahydroquinazoline-3,2-diyl))dibenzoic acid (4i):
White solid; Yield: 80%; mp 308-10 °C; IR (KBr): νmax = 3414 (OH), 3325 (NH), 2894, 1709 (C=O), 1693 (C=O), 1621 (C=O), 1568 cm⁻¹; 1H NMR (DMSO-d6) δ= 2.9-3.00 (m, 2H, CH2), 4.05-4.18 (m, 2H, CH2), 5.95(d, 2H, J=2.1Hz, CH), 6.61 (d, 2H, J=8.0Hz, Ar-H), 6.66 (t, 2H, J=7.6Hz, Ar-H), 7.19 (t, 2H, J=7.0Hz, Ar-H), 7.39 (d, 4H, J=8.3Hz, Ar-H), 7.43 (d, 2H, J=2.1Hz, NH), 7.62 (d, 2H, J=6.8Hz, Ar-H), 7.86 (d, 4H, J=8.2Hz, Ar-H), 12.94 (broad, 2H, CO2H) ppm; 13C NMR (DMSO-d6) δ= 43.4, 70.6, 115.2, 115.5, 118.2, 127.2, 128.3, 130.4, 131.7, 134.2, 146.3, 147.0, 163.3, 167.6 ppm; MS: m/z (%)= 562; Anal. Calcd for C32H26N4O6: C, 68.32; H, 4.66; N, 9.96; Found: C, 68.23; H, 4.68; N, 9.88%.

3,3′-(ethane-1,2-diyl)bis(2-(3-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one) (4j):
White solid; Yield: 94%; mp 237-9 °C; IR (KBr): νmax = 3240 (NH), 3002, 2930, 2828, 1631 (C=O), 1609 (C=O), 1514 cm⁻¹; 1H NMR (DMSO-d6) δ= 2.89-2.94 (m, 1H, CH2), 2.97-3.03 (m, 1H, CH2), 3.68 (s, 6H, 2CH3), 3.99-4.06 (m, 1H, CH2), 4.10-4.18 (m, 1H, CH2), 5.84 (d, 1H, J=1.5Hz, CH), 5.89 (d, 1H, J=1.7Hz, CH), 6.44 (t, 2H, J=8.3Hz, Ar-H), 6.69 (s, 2H, Ar-H), 6.85-6.89 (m, 6H, Ar-H), 7.18-7.27 (m, 4H, Ar-H), 7.36 (s, 1H, NH), 7.37 (s, 1H, NH), 7.63-7.65 (m, 2H, Ar-H) ppm; 13C NMR (DMSO-d6) δ= 43.2, 43.4, 55.8, 71.2, 71.5, 113.13, 113.18, 114.3, 114.4, 115.1, 115.4, 115.5, 118.0, 119.0, 128.2, 130.5, 130.6, 134.1, 143.3, 147.3, 160.2, 163.3,
163.4 ppm; MS: m/z (%) = 534; Anal. Calcd for C_{32}H_{30}N_{4}O_{4}: C, 71.89; H, 5.66; N, 10.48; Found: C, 71.81; H, 5.59; N, 10.42%.

3,3’-(ethane-1,2-diyl)bis(2-(2,4-dimethoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one) (4k):
White solid; Yield: 90%; mp 247-9 °C; IR (KBr): v_{max} = 3384 (NH), 3067, 2936, 2837, 1649 (C=O), 1610, 1497 cm^{-1}; ^1H NMR (DMSO-d_{6}) δ = 2.78-2.82 (m, 2H, CH_{2}), 3.68 (s, 3H, OCH_{3}), 3.81 (s, 3H, OCH_{3}), 3.96-4.00 (m, 2H, CH_{2}), 6.02 (d, 2H, J=1.9Hz, CH), 6.35 (d, d, 2H, J=2.3Hz, J=8.5Hz, Ar-H), 6.57 (d, 2H, J=2.3Hz, Ar-H), 6.62 (t, 2H, J=7.1Hz, Ar-H), 6.65 (d, 2H, J=8.0Hz, Ar-H), 6.92 (d, 2H, J=8.4Hz, Ar-H), 7.16 (t, 2H, J=8.3Hz, Ar-H), 7.61 (d, 2H, J=7.7Hz, Ar-H) ppm; ^13C NMR (DMSO-d_{6}) δ = 42.9, 56.0, 56.5, 66.3, 99.6, 105.2, 115.2, 117.6, 120.9, 121.2, 127.7, 128.1, 133.9, 141.6, 158.5, 161.5, 163.7 ppm; MS: m/z (%) = 594; Anal. Calcd for C_{34}H_{34}N_{4}O_{6}: C, 68.67; H, 5.76; N, 9.42; Found: C, 68.58; H, 5.68; N, 9.34%.

3,3’-(1,4-phenylene)bis(2-phenyl-2,3-dihydroquinazolin-4(1H)-one) (4l):
Cream solid; Yield: 82%; mp 296-8 °C; IR (KBr): v_{max} = 3305 (NH), 1638 (C=O), 1612, 1512 cm^{-1}; ^1H NMR (DMSO-d_{6}) δ = 6.26 (s, 2H, CH), 6.70-6.75 (m, 4H, Ar-H), 7.24 (s, 4H, Ar-H), 7.29-7.33 (m, 12H, Ar-H), 7.66-7.70 (m, 4H, 2NH, 2Ar-H) ppm; MS: m/z (%) = 522; Anal. Calcd for C_{34}H_{26}N_{2}O_{2}: C, 78.14; H, 5.01; N, 10.72; Found: C, 78.07; H, 4.92; N, 10.64%.

^13C NMR (125 MHz, DMSO-d_{6}) δ: very low soluble in DMSO

3,3’-(1,4-phenylene)bis(2-(4-chlorophenyl)-2,3-dihydroquinazolin-4(1H)-one) (4m):
White solid; Yield: 87%; mp 238-40 °C(dec); IR (KBr): v_{max} = 3305 (NH), 1641 (C=O), 1512 cm^{-1}; ^1H NMR (DMSO-d_{6}) δ = 6.29 (d, 2H, J=2.3Hz, CH), 6.72 (t, 2H, J=7.3Hz, Ar-H), 6.74 (d, 2H, J=8.1Hz, Ar-H), 7.22 (s, 4H, Ar-H), 7.23-7.29 (m, 2H, Ar-H), 7.34-7.73 (m, 8H, Ar-H), 7.67 (d, 2H, J=2.3Hz, NH), 7.07 (d, 2H, J=7.0Hz, Ar-H) ppm; ^13C NMR (DMSO-d_{6}) δ = 72.5, 115.7, 116.1, 118.6, 127.0, 128.8, 129.2, 129.3, 133.7, 134.8, 139.0, 140.5, 147.1, 162.9 ppm; MS: m/z (%) = 590; Anal. Calcd for C_{34}H_{24}Cl_{2}N_{2}O_{2}: C, 69.04; H, 4.09; N, 9.47; Found: C, 68.95; H, 3.99; N, 9.39%.

3,3’-(1,4-phenylene)bis(2-(p-tolyl)-2,3-dihydroquinazolin-4(1H)-one) (4n):
White solid; Yield: 92%; mp 281-3 °C; IR (KBr): v_{max} = 3308 (NH), 3022, 2926, 1642 (C=O), 1611, 1512 cm^{-1}; ^1H NMR (DMSO-d_{6}) δ = 2.22 (s, 6H, 2CH_{3}), 6.20 (s, 2H, CH), 6.70-6.72 (m, 4H, Ar-H), 7.09-7.23 (m, 10H, Ar-H), 7.54-7.77 (m, 8H, 2NH, 6Ar-H) ppm; MS: m/z (%) = 550; Anal. Calcd for C_{36}H_{30}Cl_{2}N_{2}O_{2}: C, 78.52; H, 5.49; N, 10.17; Found: C, 78.44; H, 5.40; N, 10.10%.

^13C NMR (125 MHz, DMSO-d_{6}) δ: very low soluble in DMSO

3,3’-(1,4-phenylene)bis(2-(4-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one) (4o):
Yellow solid; Yield: 90%; mp 291-3 °C; IR (KBr): $v_{\text{max}} = 3401 \text{ (NH)}$, 3102, 3071, 1662 (C=O), 1614, 1513 cm$^{-1}$; $^1$H NMR (DMSO-$d_6$) $\delta$ = 6.48 (d, 2H, J=2.1Hz, CH), 6.73 (t, 2H, J=7.4Hz, Ar-H), 6.76 (d, 2H, J=8.1Hz, Ar-H), 7.28 (t, 2H, J=7.2Hz, Ar-H), 7.33 (s, 4H, Ar-H), 7.62 (d, 4H, J=8.6Hz, Ar-H), 7.73 (d, 2H, J=7.6Hz, Ar-H), 7.82 (d, 2H, J=2.1Hz, 2NH), 8.15 (d, 4H, J=8.6Hz, Ar-H) ppm; $^{13}$C NMR (DMSO-$d_6$) $\delta$ = 72.3, 115.9, 116.0, 118.9, 124.5, 127.0, 128.6, 128.9, 134.9, 139.0, 146.8, 148.2, 148.8, 162.8 ppm; MS: m/z (%) = 612; Anal. Calcd for C$_{34}$H$_{24}$N$_6$O$_6$: C, 66.66; H, 3.95; N, 13.72; Found: C, 66.56; H, 3.87; N, 13.63%.

3,3'-(1,4-phenylene)bis(2-(4-methoxyphenyl)-2,3-dihydroquinoxalin-4(1H)-one) (4p):
White solid; Yield: 88%; mp 251-3 °C; IR (KBr): $v_{\text{max}} = 3307 \text{ (NH)}$, 2948, 2925, 2833, 1638, 1613, 1512 cm$^{-1}$; $^1$H NMR (DMSO-$d_6$) $\delta$ = 3.68 (s, 6H, CH$_3$), 6.19 (d, 2H, J=2.5Hz, CH), 6.68 (t, 2H, J=7.1Hz, Ar-H), 6.74 (d, 2H, J=8Hz, Ar-H), 6.85 (d, 4H, J=8.7, Ar-H), 7.21 (s, 4H, Ar-H), 7.23-7.27 (m, 6H, Ar-H), 7.58 (d, 2H, J=2.4Hz, 2NH), 7.71 (d, 2H, J=7.0Hz, Ar-H) ppm; $^{13}$C NMR (DMSO-$d_6$) $\delta$ = 55.9, 72.9, 114.5, 115.6, 116.1, 118.3, 126.9, 128.5, 128.8, 133.5, 134.6, 139.2, 147.4, 159.9, 163.1 ppm; MS: m/z (%) = 582; Anal. Calcd for C$_{36}$H$_{30}$N$_4$O$_4$: C, 74.21; H, 5.19; N, 9.62; Found: C, 74.14; H, 5.10; N, 9.54%.