

Supplementary Information

Zeolite Catalysed Method for the Preparation of 2,3-dihydroquinazolin-4(1H)-ones

Anna Takács, Anna Fodor, János Németh and Zoltán Hell*

Department of Organic Chemistry and Technology, Budapest University of Technology and
Economics

H-1521 Budapest, Hungary

E-mail: zhell@mail.bme.hu.

The commercial chemicals were purchased from Merck-Hungary Ltd. except E4 and E4a, which are the products of Erdőkémia-ker Ltd., Hungary. ^1H NMR spectra were recorded on a BRUKER Avanche-300 instrument using TMS as an internal standard in CDCl_3 . GC-MS spectra were made on Shimadzu GC-2010, GC-MS QP2010S instruments. Thin layer chromatography was carried out using Merck Kieselgel 60 F_{254} plates with eluents hexane:acetone 4:1 or hexane:acetone 2:1, detection either by UV light at 254 nm or by heating after spraying with phosphoromolybdic acid solution. Column chromatography was carried out on Merck Kieselgel 63 – 200 mesh with hexane-acetone 4:1 or 2:1 eluents. Melting points are uncorrected and were measured on Gallenkamp instrument.

Pretreatment of the catalyst:

Before each experiment the sample of E4a was powdered and heated at 100 °C for 1h.

* Corresponding author: Department of Organic Chemistry and Technology, Budapest University of Technology and Economics, H-1521 Budapest, Hungary, E-mail: zhell@mail.bme.hu

A typical protocol for the reaction:

A mixture of 0.82 g (5 mmol) of isatoic anhydride, 5 mmol of the appropriate amine, 5 mmol of the aldehyde and 0.5 g E4a in 10 cm³ ethanol was heated at 80 °C for 10-20 h (as indicated in Table 2). The solid was filtered off, washed with the same solvent, the filtrate was evaporated. Pure products were obtained by column chromatography (Kieselgel, hexanes:acetone 4:1).

3-Butyl-2-phenyl-2,3-dihydroquinazolin-4(1H)-one (4a)

Yield 95%, white solid, mp 127-130 °C (ethanol; lit. 127-128°C^[1]); ¹H NMR (300 MHz, CDCl₃^[2]) δ (ppm): 0,84 (t, 3H); 1,26-1,29 (m, 2H); 1,52-1,57 (m, 2H); 2,68-2,77 (m, 1H); 3,88-3,98 (m, 1H); 4,45 (s, 1H); 5,71 (s, 1H); 6,48 (d, 1H); 6,80 (t, 1H); 7,20-7,33 (m, 6H); 7,93 (d, 1H); ¹³C NMR (75 MHz, CDCl₃^[7]) δ (ppm): 13.9, 20.5, 30.4, 44.7, 72.5, 112.3, 114.6, 115.8, 117.6, 119.4, 119.9, 127.1, 129.6, 133.8, 142.8, 145.1, 161.4; Anal. Calcd. for C₁₈H₂₀N₂O: C 77.14, H 7.14, N 10.00%, found: C 77.23, H 7.19, N 9.74%.

3-Butyl-2-(3-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one (4b)

Yield: 98 %, white solid, mp 100-101 °C (ethanol; lit. 102-105 °C^[3]); ¹H NMR (300 MHz, CDCl₃^[4]) δ (ppm): 0,85 (t, 3H); 1,27-1,34 (m, 2H); 1,50-1,58 (m, 2H); 2,72-2,81 (m, 1H); 3,75 (s, 3H); 3,85-4,01 (m, 1H); 4,44 (s, 1H); 5,70 (s, 1H); 6,50 (d, 1H); 6,82-6,94 (m, 4H); 7,20-7,27 (m, 2H); 7,94 (d, 1H); ¹³C NMR (75 MHz, CDCl₃^[4]) δ (ppm): 14.5, 20.4, 30.2, 45.0, 55.6, 72.7, 112.5, 114.8, 115.2, 117.1, 119.0, 119.9, 129.1, 130.6, 133.9, 142.3, 145.7, 160.9, 163.1; Anal. Calcd. for C₁₉H₂₂N₂O₂: C 73.55, H 7.10, N 9.03%, found: C 73.61, H 7.21, N 8.93%.

3-Butyl-2-(4-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4c)

Yield: 96 %, white solid, mp 133-134 °C (ethanol; lit. 137-139 °C^[3]); ¹H NMR (300 MHz, CDCl₃^[4]) δ (ppm): 0,92 (t, 3H); 1,32-1,39 (m, 2H); 1,56-1,61 (m, 2H); 2,73-2,82 (m, 1H);

4,05-4,14 (m, 1H); 4,73 (s, 1H); 5,82 (s, 1H); 6,56 (d, 1H); 6,89 (t, 1H); 7,26 (t, 1H); 7,53 (d, 2H); 7,96 (d, 1H); 8,17 (d, 2H); ^{13}C NMR (75 MHz, CDCl_3 ^[4]) δ (ppm): 14.1, 20.6, 30.6, 45.3, 70.9, 112.7, 115.0, 117.1, 120.4, 124.5, 127.8, 128.9, 134.3, 144.8, 147.6, 148.6, 161.2, 163.3; Anal. Calcd. for $\text{C}_{18}\text{H}_{19}\text{N}_3\text{O}_3$: C 66.46, H 5.85, N 12.92%, found: C 66.52, H 5.99, N 12.83%.

3-Butyl-2-(3-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4d)

Yield: 97 %, beige solid, mp 109-112 °C; (ethanol; lit. 114-116 °C^[5]); ^1H NMR (300 MHz, CDCl_3 ^[5]) δ (ppm): 0.88 (t, 3H); 1,30-1,35 (m, 2H); 1,54-1,59 (m, 2H); 2,70-2,77 (m, 1H); 4,05-4,10 (m, 1H); 4,75 (s, 1H); 5,81 (s, 1H); 6,55 (d, 1H); 6,85 (t, 1H); 7,24 (s, 2H); 7,48 (t, 1H); 7,93 (d, 1H); 8,15 (d, 1H); 8,20 (s, 1H); ^{13}C NMR (75 MHz, CDCl_3 ^[5]) δ (ppm): 13.9, 20.8, 29.6, 45.2, 71.1, 112.8, 115.1, 116.9, 120.6, 124.3, 127.8, 128.7, 134.2, 144.8, 147.5, 148.3, 161.2, 162.9; Anal. Calcd for $\text{C}_{18}\text{H}_{19}\text{N}_3\text{O}_3$: C, 66.46; H, 5.85; N, 12.92; Found: C, 66.61; H, 5.97; N, 12.84%.

3-Butyl-2-(4-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one (4e)

Yield: 93 %, white solid, mp 150-154 °C; ^1H NMR (300 MHz, CDCl_3) δ (ppm): 0.86 (t, 3H); 1.29 (qa, 2H); 1.51-1.56 (m, 2H); 2.71-2.81 (m, 1H); 3.79 (s, 3H); 3.87-3.96 (m, 1H); 4.43 (s, 1H); 5.71 (s, 1H); 6.51 (d, 1H); 6.84 (m, 3H); 7.23-7.32 (m, 4H); 7.96 (t, 1H). ^{13}C NMR (75 MHz, CDCl_3) δ (ppm): 13.8, 20.2, 29.7, 44.3, 55.3, 71.7, 114.1, 114.2, 116.1, 118.8, 127.9, 128.3, 132.0, 133.2, 145.3, 160.1, 163.2; Anal. Calcd. for $\text{C}_{19}\text{H}_{22}\text{N}_2\text{O}_2$: C 73.55, H 7.10, N 9.03%, found: C 73.64, H 7.17, N 8.96%.

3-Butyl-2-(4-chlorophenyl)-2,3-dihydroquinazolin-4(1H)-one (4f)

Yield: 75 %, off-white solid; mp 144-147 °C (lit. 150-151 °C^[3]); $^1\text{H-NMR}$ (500 MHz, CDCl_3 ^[4]): d 0.95 (t, 3H), 1.37–1.39 (m, 2H, 1.53–1.59 (m, 2H), 2.71–2.77 (m, 1H), 3.95–4.00 (m, 1H), 4.76 (br s, 1H), 5.71 (s, 1H), 6.53 (d, 1H), 6.66 (m, 1H), 7.20–7.33 (m, 5H), 7.93 (d, 1H); $^{13}\text{C-NMR}$ (75 MHz, CDCl_3 ^[3]) δ (ppm): 13.7, 20.2, 30.3, 45.2, 68.0, 114.3, 116.2, 119.5,

127.8, 128.2, 130.5, 130.7, 133.6, 136.8, 144.2, 163.5; Anal. Calcd. for C₁₈H₁₉ClN₂O: C 68.68, H 6.04, N 4.45%, found: C 68.61, H 6.24, N 4.25%.

3-Butyl-2-(2-chlorophenyl)-2,3-dihydroquinazolin-4(1H)-one (4g)

Yield: 50 %; white solid, mp 143-144 °C (lit. 146-149 °C^[4]); ¹H NMR (300 MHz, CDCl₃^[4]) δ (ppm): 0.93 (t, 3H); 1.39 (q, 2H); 1.64 (m, 2H); 2.65 (m, 1H); 4.17 (m, 1H); 5.07 (s, 1H); 6.08 (s, 1H); 6.48 (d, 1H); 6.80 (t, 1H); 7.17 (m, 2H); 7.24 (m, 2H); 7.39 (d, 1H); 7.94 (d, 1H); ¹³C-NMR (75 MHz, CDCl₃) δ (ppm): 13.8, 20.1, 30.1, 45.0, 68.2, 114.5, 116.0, 119.2, 127.4, 128.4, 130.2, 130.9, 133.4, 136.6, 144.4, 163.5; Anal. Calcd. for C₁₈H₁₉ClN₂O: C 68.68, H 6.04, N 4.45%, found: C 68.59, H 6.17, N 4.27%.

2,3-Diphenyl-2,3-dihydroquinazolin-4(1H)-one (4h)

Yield: 50 %, white solid, mp 204-206 °C (ethanol; lit. 203-205 °C^[2]); ¹H NMR (300 MHz, CDCl₃^[2]) δ (ppm): 4.29 (s, 1H); 6.04 (s, 1H); 6.57 (d, 1H); 6.65-6.68 (m, 2H); 6.84 (t, 1H); 7.12-7.58 (m, 8H); 7.98 (d, 1H); 8.07 (d, 1H); ¹³C NMR (75 MHz, CDCl₃^[8]) δ (ppm): 74.2, 114.5, 117.1, 119.3, 127.4, 128.7, 129.3, 130.1, 134.1, 145.6, 163.4; Anal. Calcd. for C₂₀H₁₆N₂O: C 80.00, H 5.33, N 4.33%, found: C 80.23, H 5.42, N 4.18%.

2-(3-Nitrophenyl)-3-phenyl-2,3-dihydroquinazolin-4(1H)-one (4i)

Yield: 95 %, light green solid, mp 100-102 °C (lit. 188-189 °C^[2]); ¹H NMR (300 MHz, CDCl₃^[2]) δ (ppm): 4.97 (s, 1H); 6.22 (s, 1H); 6.68 (d, 1H); 6.91 (t, 1H); 7.19 (d, 2H); 7.24 (s, 4H); 7.27-7.34 (m, 2H); 7.73 (d, 1H); 8.00 (d, 1H); 8.10 (d, 1H); ¹³C NMR (75 MHz, CDCl₃) δ (ppm): 72.6, 115.2, 118.7, 121.8, 123.2, 126.1, 126.6, 128.5, 128.9, 129.5, 132.7, 134.0, 140.7, 143.0, 145.7, 148.1, 162.8; Anal. Calcd. for C₂₀H₁₅N₃O₃: C 69.56, H 4.35, N 12.17%, found: C 69.67, H 4.46, N 12.25%.

2-(4-Methoxyphenyl)-3-phenyl-2,3-dihydroquinazolin-4(1H)-one (4j)

Yield: 78 %, white solid, mp 202-206 °C (lit. 204-205 °C^[2]); ¹H NMR (300 MHz, CDCl₃, DMSO^[2]) δ (ppm): 3.73 (s, 3H); 5.95 (s, 1H); 6.07 (s, 1H); 6.69 (d, 1H); 6.75 (d, 2H); 6.81 (t,

1H); 7,16-7,19 (m, 3H); 7,26-7,29 (m, 4H); 7,39 (s, 1H); 7,94 (d, 1H); ^{13}C NMR (75 MHz, $\text{CDCl}_3+\text{DMSO-d}_6$ ^[9]) δ (ppm): 55.3, 73.5, 113.3, 114.5, 117.4, 125.3, 126.7, 127.4, 128.5, 132.8, 133.3, 140.3, 146.6, 158.4, 162.4; Anal. Calcd. for $\text{C}_{21}\text{H}_{18}\text{N}_2\text{O}_2$: C 76.37, H 5.45, N 8.48%, found: C 76.25, H 5.46, N 8.48%.

3-Phenethyl-2-phenyl-2,3-dihydroquinazolin-4(1H)-one (4k)

Yield: 60 %, white solid, mp 143-147 °C (ethanol; Ref 145-147 °C^[6]); GC: R_t : 33.14 min; MS: m/z (%): 311, 238, 207, 175, 146, 120(100), 92, 77; ^1H NMR (300 MHz, CDCl_3 ^[6]) δ (ppm): 2,73-2,83 (m, 1H); 2,91-3,07 (m, 2H); 4,00-4,10 (m, 1H); 4,36 (s, 1H); 5,55 (s, 1H); 6,52 (d, 1H); 6,84-6,89 (m, 1H); 7,12 (t, 2H); 7,23-7,60 (m, 5H); 7,35 (s, 4H); 7,98 (d, 1H); ^{13}C NMR (75 MHz, CDCl_3 ^[6]) δ (ppm): 34.5, 46.7, 72.7, 114.5, 119.6, 126.5, 127.4, 128.3, 128.5, 129.3, 129.6, 134.0, 139.5, 139.6, 145.6, 163.1; Anal. Calcd. for $\text{C}_{22}\text{H}_{20}\text{N}_2\text{O}$: C 80.49, H 5.75, N 8.54%, found: C 80.39, H 5.66, N 8.47%.

2-Phenyl-3-(3-phenylpropyl)-2,3-dihydroquinazolin-4(1H)-one (4l)

Yield: 96 %, white solid, mp 131-133 °C; ^1H NMR (300 MHz, CDCl_3) δ (ppm): 1.88-1.91 (m, 2H); 2.59-2.60 (m, 2H); 2.87-2.89 (m, 1H); 3.91-3.95 (m, 1H); 4.48 (s, 1H); 5.69 (s, 1H); 6.51 (d, 1H); 6.85 (t, 1H); 7.11-7.26 (m, 7H); 7.33 (s, 4H); 7.96 (d, 1H); ^{13}C NMR (75 MHz, CDCl_3) δ (ppm): 29.1, 33.1, 44.5, 72.3, 114.3, 116.1, 119.1, 125.8, 126.5, 128.2, 128.3, 128.4, 128.9, 129.2, 133.4, 139.8, 141.4, 145.2, 163.3; Anal. Calcd. for $\text{C}_{23}\text{H}_{22}\text{N}_2\text{O}$: C 80.70, H 6.43, N 8.19%, found: C 80.82, H 6.26, N 8.02%.

(3-Nitrobenzylidene)aniline (5i)

White powder (crude product); ^1H NMR (300 MHz, CDCl_3) δ (ppm): 7.22-7.29 (m, 3H); 7.40 (t, 2H); 7.62 (t, 1H); 8.21 (d, 1H); 8.26-8.30 (m, 1H); 8.50 (s, 1H); 8.70 (t, 1H); ^{13}C NMR (75 MHz, CDCl_3) δ (ppm): 120.9, 123.4, 125.5, 126.8, 129.3, 129.8, 134.1, 137.8, 148.6, 150.8, 157.2.

N-benzylidene-2-tert-butyl-aniline (5m)

White powder (crude product); ^1H NMR (300 MHz, CDCl_3) δ (ppm): 1.43 (s, 9H); 6.81-6.84 (m, 1H); 7.13-7.20 (m, 2H); 7.36-7.38 (dd, 1H); 7.44-7.46 (m, 3H); 7.87-7.90 (m, 2H); 8.29 (s, 1H); ^{13}C NMR (75 MHz, CDCl_3) δ (ppm): 30.2, 35.4, 118.9, 125.3, 125.7, 126.7, 128.4, 128.5, 130.8, 136.5, 142.7, 151.2, 157.7.

N-benzylidene-2-bromoaniline (5n)

Yellowish oil (crude product); ^1H NMR (300 MHz, CDCl_3 ^[10]) δ (ppm): 6.71 (d, 1H); 7.03-7.08 (m, 2H); 7.37 (d, 1H); 7.44-7.47 (m, 3H); 7.58-7.61 (m, 1H); 7.90-7.93 (m, 1H); 8.31 (s, 1H).

2-Amino-N-(1-phenylethyl)benzamide (6o)

^1H NMR (crude product, 300 MHz, CDCl_3 ^[11]) δ (ppm): 1.57 (d, 3H); 5.24-5.27 (m, 1H); 6.13 (s, 1H); 6.60-6.65 (m, 2H); 7.16-7.27 (m, 4H); 7.30-7.39 (m, 5H) ^{13}C NMR (750MHz, CDCl_3 ^[12]) δ (ppm): 22.2, 48.5, 116.7, 116.8, 117.2, 126.0, 127.1, 127.6, 128.9, 132.4, 143.3, 148.8, 168.5.

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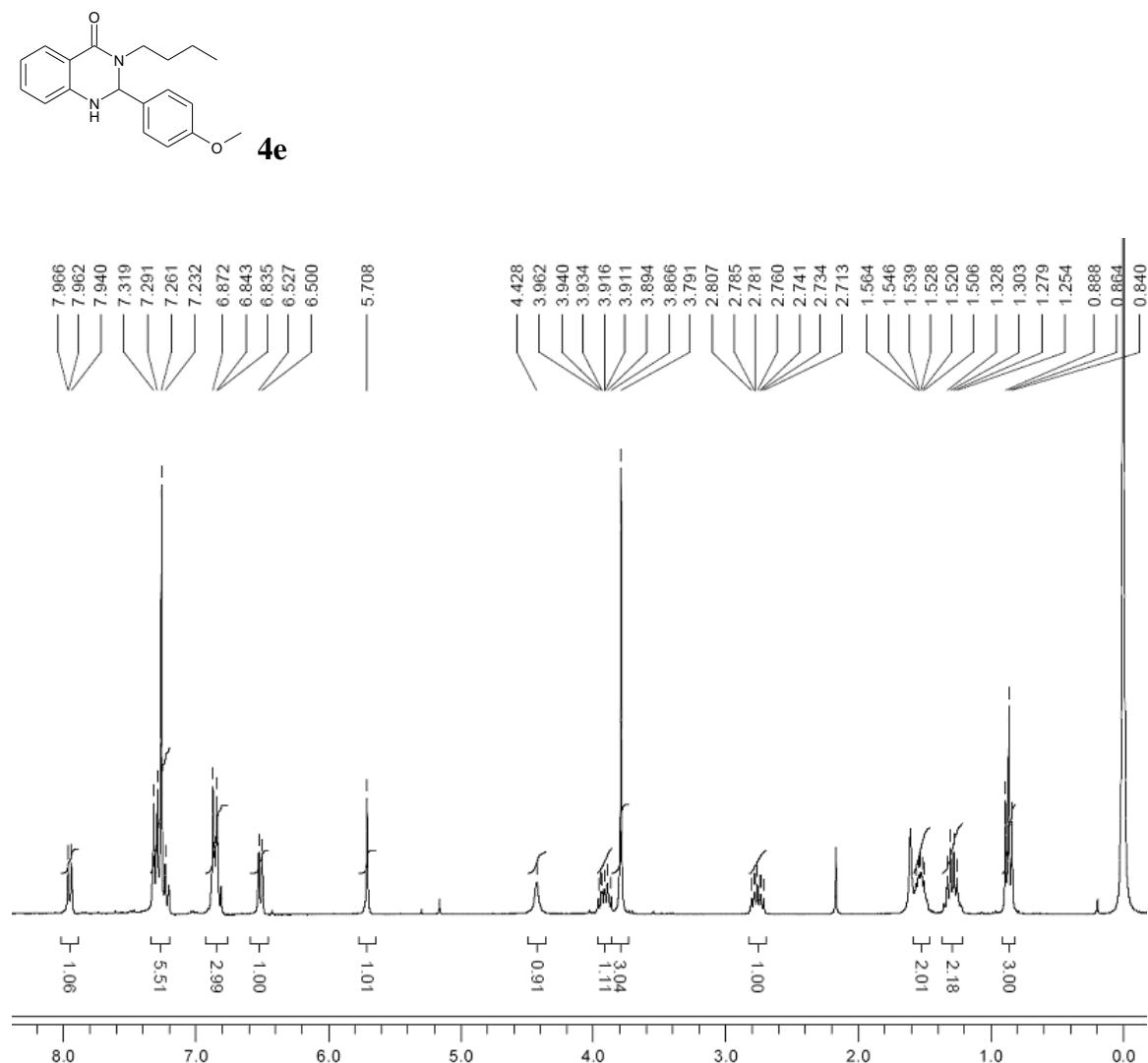
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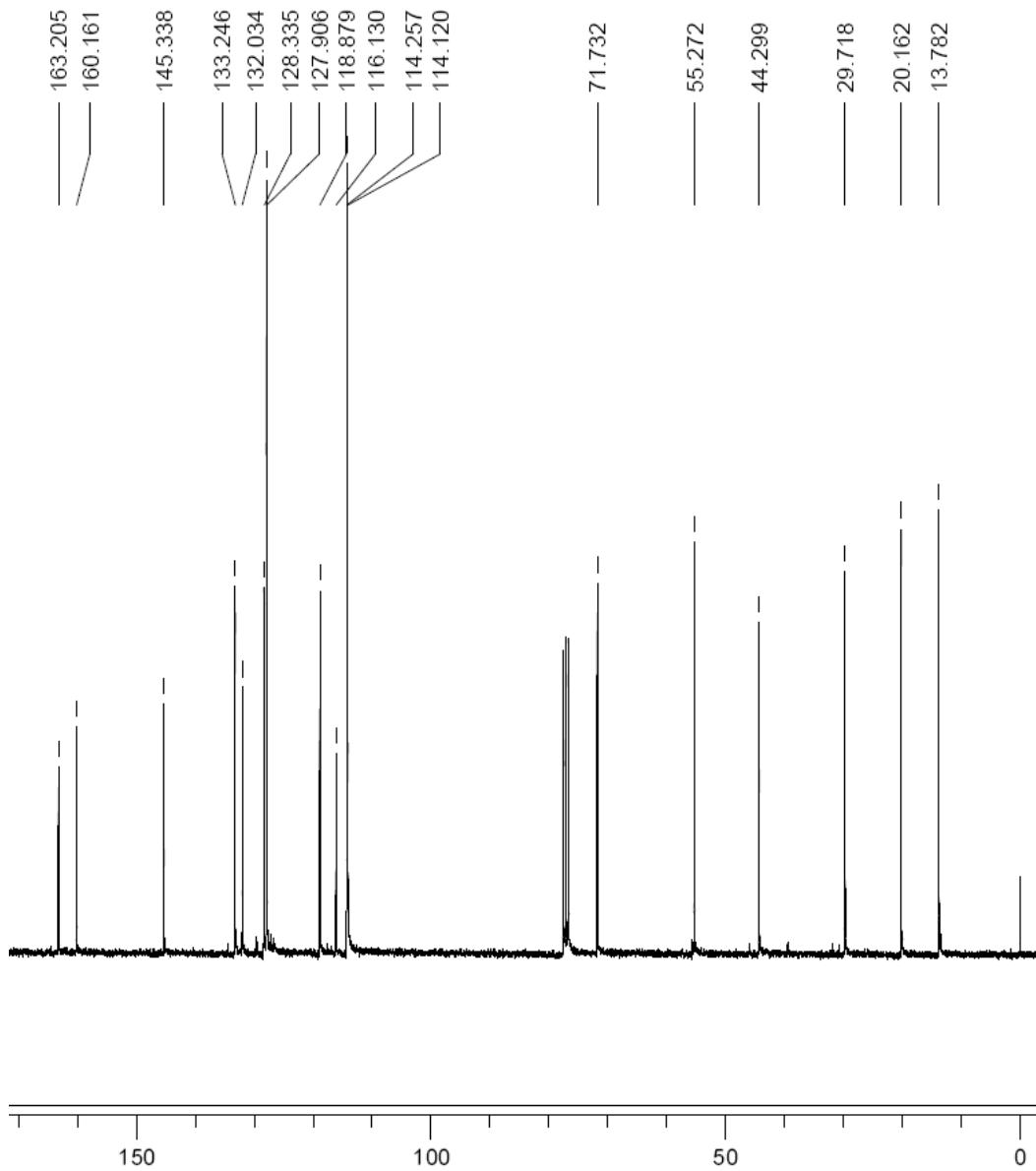
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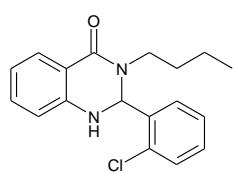
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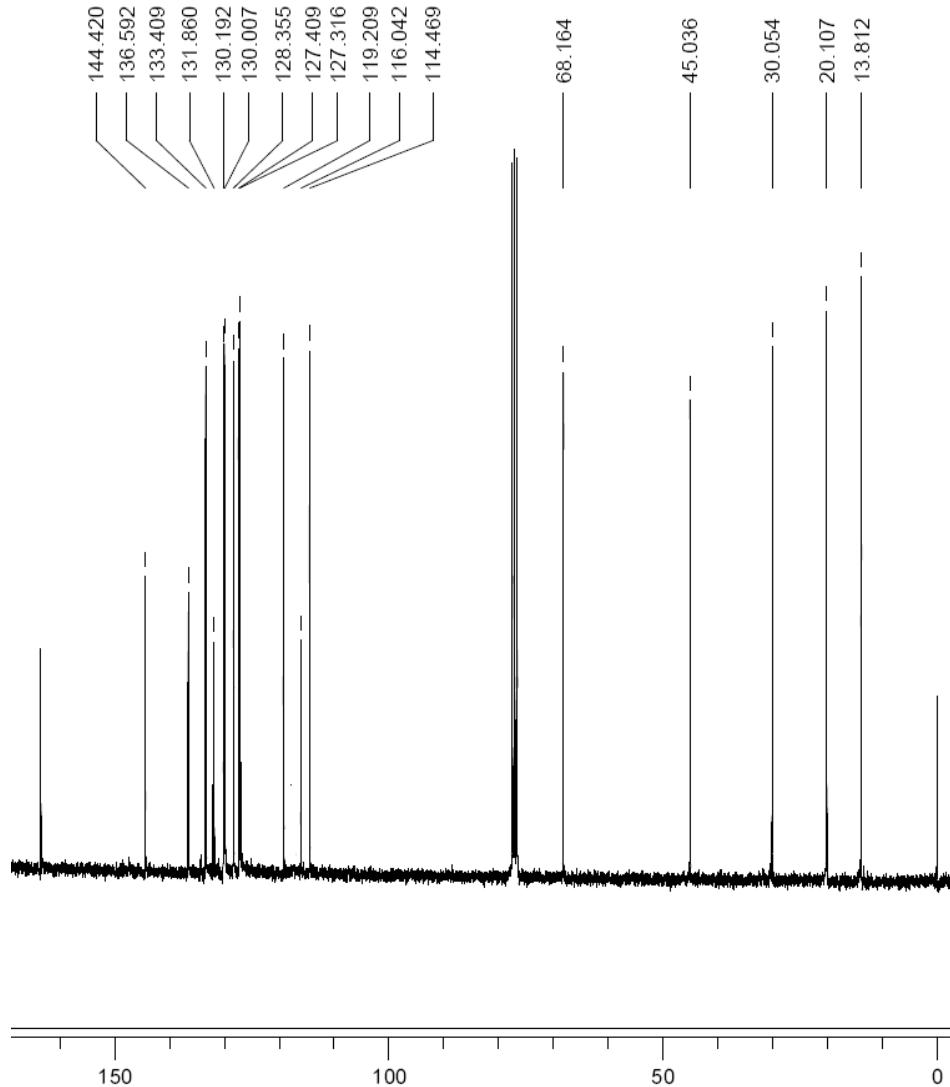
¹H and ¹³C NMR spectra of prepared compounds

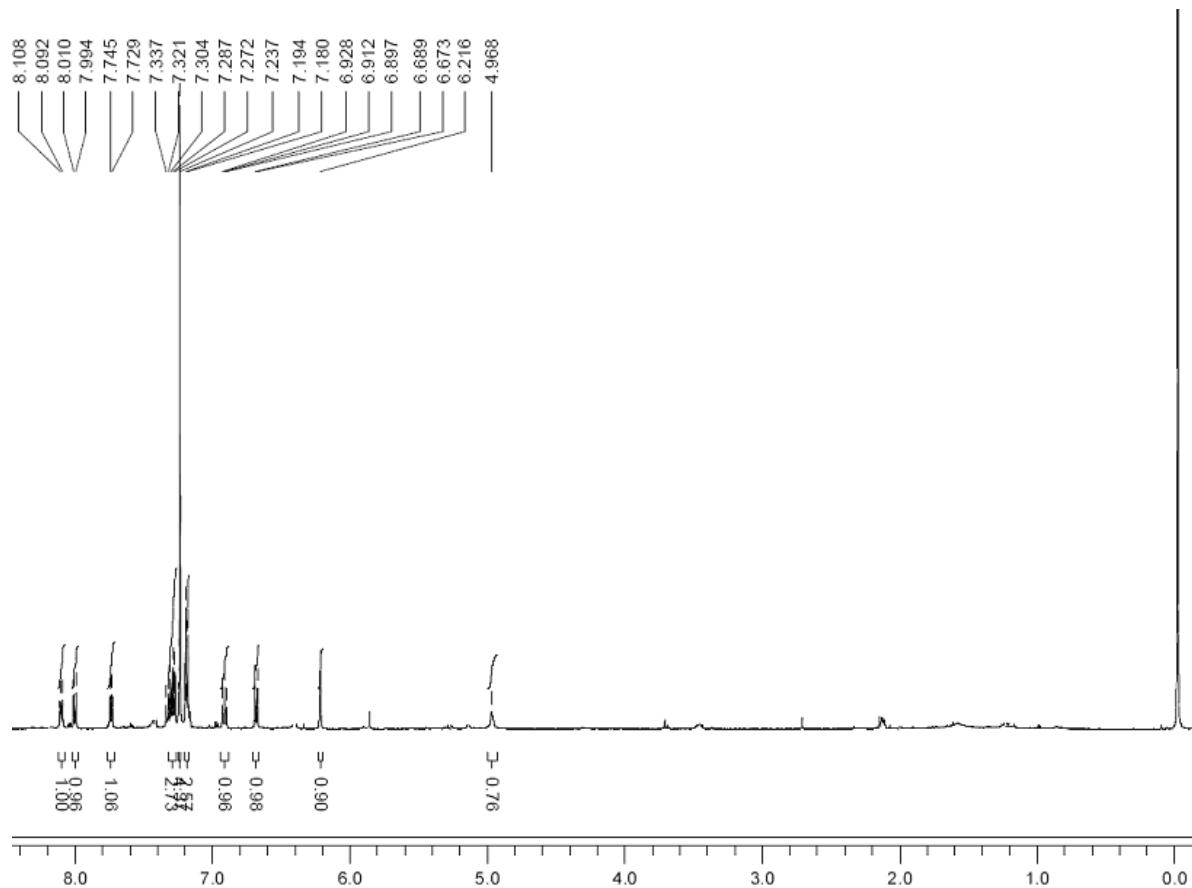
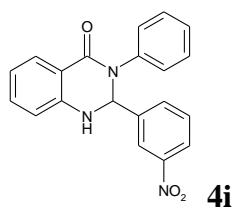


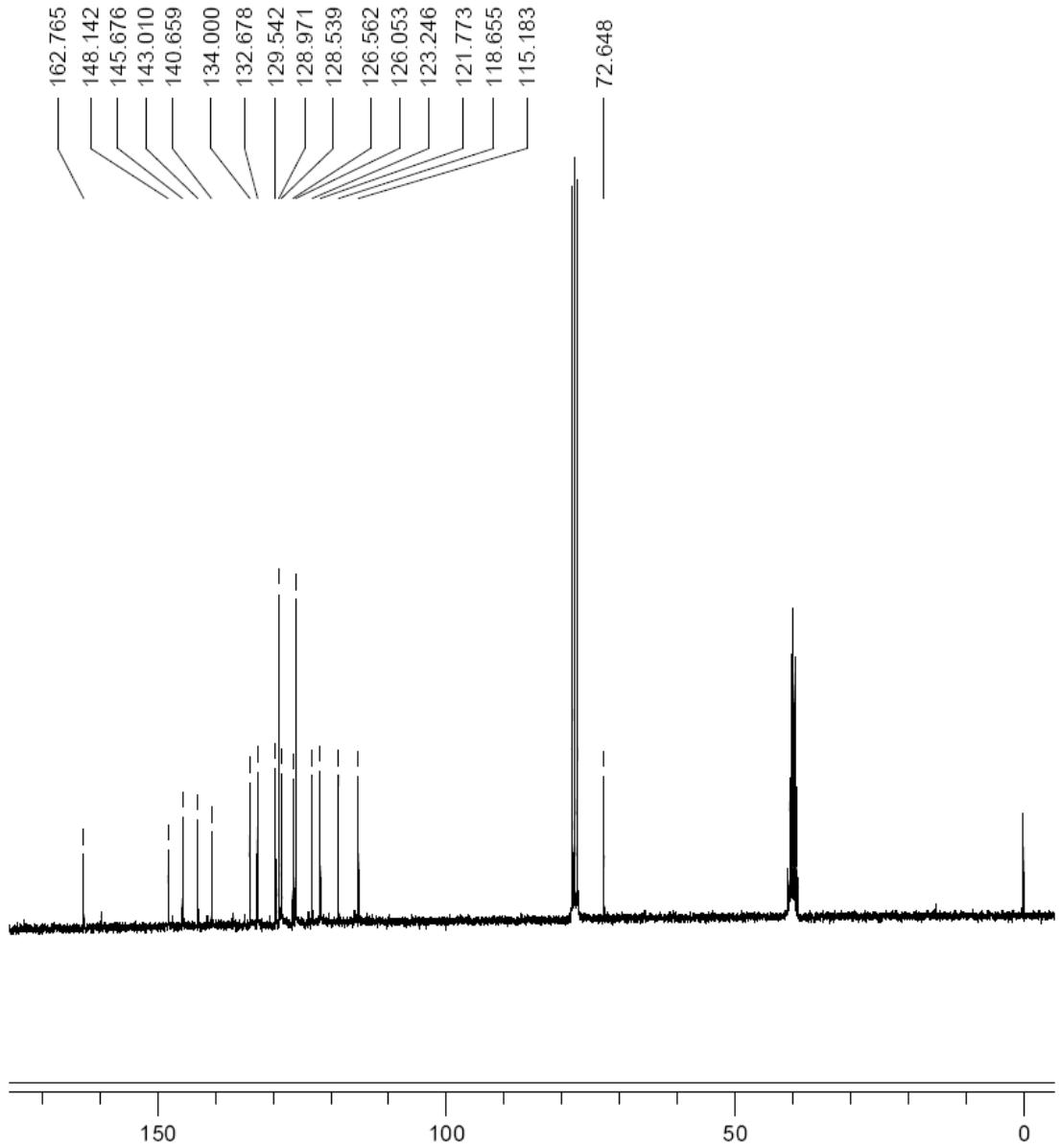


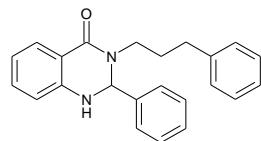


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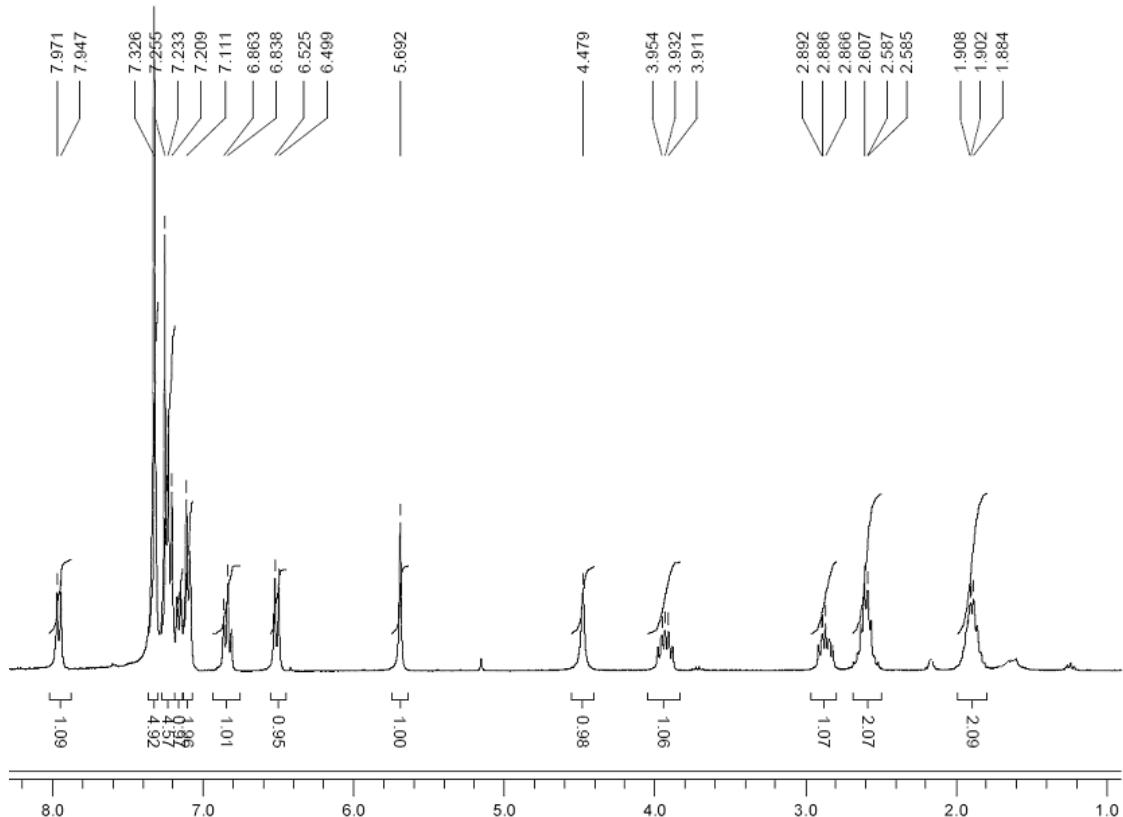


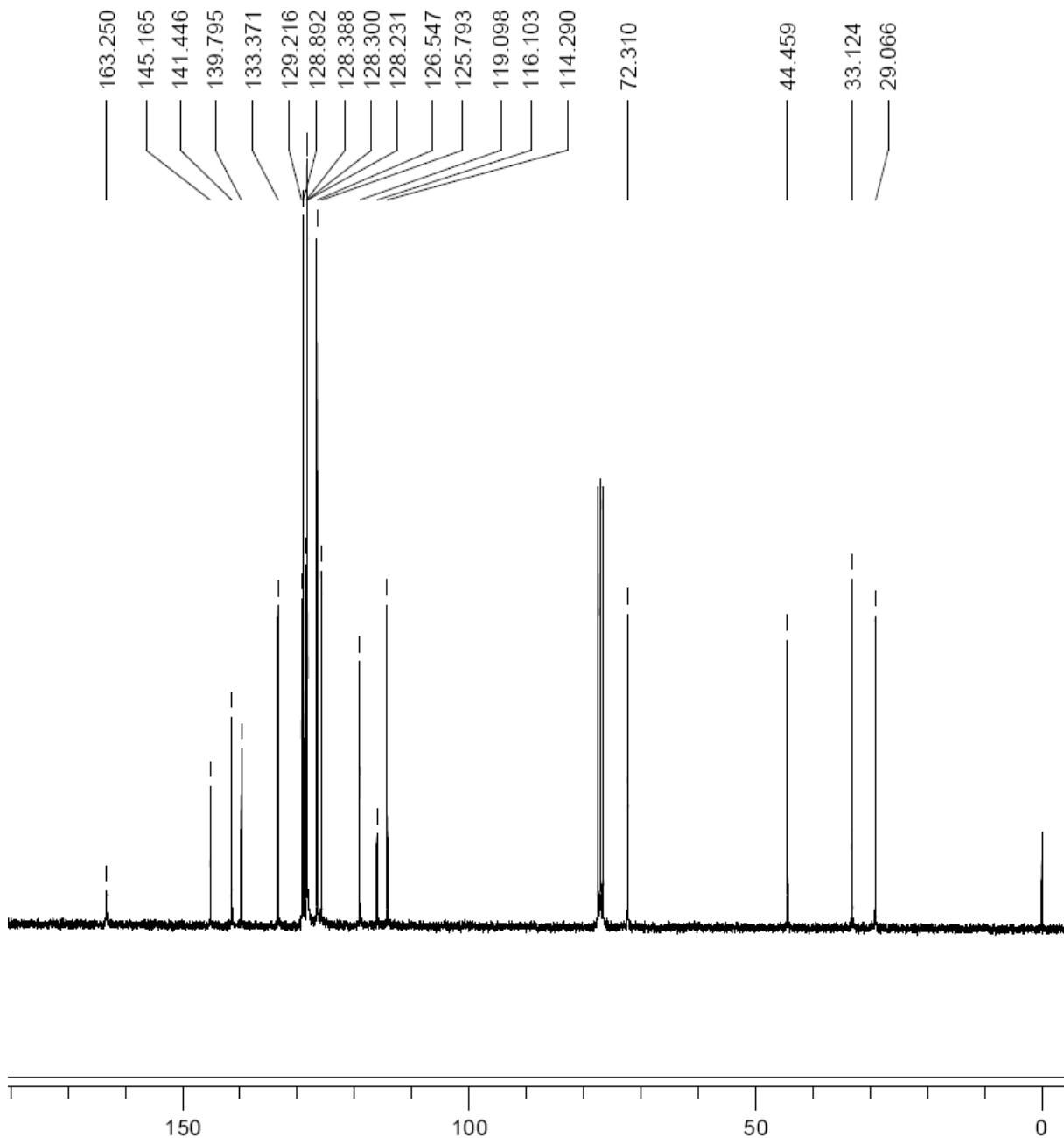


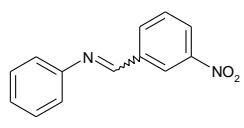




4l







5i

