An Efficient Synthesis of Phenol via
CuI/8-Hydroxyquinoline-Catalyzed Hydroxylation of Aryl
Halides and Potassium Hydroxide

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General procedure for the synthesis of phenol: An oven-dried Schlenk tube was charged with CuI (19 mg, 0.1 mmol), aryl halide (1 mmol), 8-hydroxyquinoline (29 mg, 0.2 mmol) and KOH (224 mg, 4 mmol). The tube was evacuated and backfilled with argon, and DMSO (1 mL), t-BuOH (1 mL) and H₂O (0.1 mL) were added. The reaction mixture was stirred at 100°C till the material was completely converted (monitored by TLC). Then the mixture was acidified to pH~1 (for 2q, pH~5) with 1 N HCl and extracted with EtOAc (10 mL *3). The combined organic phases were successively washed with H₂O and brine, then dried over Na₂SO₄. After removal of the solvent in vacuo, the residue was purified with flash chromatography to get the corresponding phenol.

![2a](image)

4-Methoxyphenol (2a)¹²¹H NMR (300 MHz, CDCl₃): δ 6.79 (d, J = 8.7 Hz, 2H), 6.76 (d, J = 9.0 Hz, 2H), 4.69 (br s, 1H), 3.76 (s, 3H). MS (EI) m/z: 124 (M⁺).

![2b](image)

2-Methoxyphenol (2b)¹¹H NMR (400 MHz, CDCl₃): δ 6.82 (d, J = 7.2 Hz, 1H), 6.69-6.74 (m, 3H), 5.75 (s, 1H), 3.67 (s, 3H). MS (EI) m/z: 124 (M⁺).

![2c](image)

Pyrocatechol (2c)¹¹H NMR (300 MHz, DMSO): δ 8.79 (s, 2H), 6.67-6.71 (m, 2H), 6.55-6.59 (m, 2H). MS (EI) m/z: 110 (M⁺).

![2d](image)

Phenol (2d)¹¹H NMR (400 MHz, CDCl₃): δ 7.13-7.18 (m, 2H), 6.85 (t, J = 7.2 Hz, 1H), 6.73-6.76 (m, 2H), 5.22 (br s, 1H). MS (EI) m/z: 94 (M⁺).
Naphthalen-1-ol (2e)\(^1\) \(^1\)H NMR (300 MHz, CDCl\(_3\)): \(\delta\) 8.16-8.19 (m, 1H), 7.80-7.83 (m, 1H), 7.47-7.50 (m, 2H), 7.45 (d, \(J = 8.4\) Hz, 1H), 7.29 (t, \(J = 7.8\) Hz, 1H), 6.82 (d, \(J = 7.5\) Hz, 1H), 5.25 (s, 1H) . MS (EI) \(m/z\): 144 (M\(^+\)).

Biphenyl-4-ol (2f)\(^2\) \(^1\)H NMR (300 MHz, CDCl\(_3\)): \(\delta\) 7.54 (d, \(J = 7.5\) Hz, 2H), 7.48 (d, \(J = 8.7\) Hz, 2H), 7.38-7.43 (t, \(J = 7.6\) Hz, 2H), 7.30 (t, \(J = 7.2\) Hz, 1H), 6.91 (d, \(J = 8.7\) Hz, 2H), 4.85 (s, 1H) . MS (EI) \(m/z\): 170 (M\(^+\)).

\(p\)-Cresol (2g)\(^{1,2}\) \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.04 (d, \(J = 8.4\) Hz, 2H), 6.73 (d, \(J = 8.4\) Hz, 2H), 4.62 (s, 1H), 2.27 (s, 3H) . MS (EI) \(m/z\): 108 (M\(^+\)).

3,5-Dimethylphenol (2h)\(^2\) \(^1\)H NMR (300 MHz, CDCl\(_3\)): \(\delta\) 6.58 (s, 1H), 6.46 (s, 2H), 4.58 (s, 1H), 2.26 (s, 6H) . MS (EI) \(m/z\): 122 (M\(^+\)).

\(o\)-Cresol (2i)\(^2\) \(^1\)H NMR (300 MHz, CDCl\(_3\)): \(\delta\) 7.08-7.13 (m, 2H), 6.82-6.87 (t, \(J = 7.5\) Hz, 1H), 6.75-6.77 (d, \(J = 7.8\) Hz, 1H), 4.74 (s, 1H), 2.25 (s, 3H) . MS (EI) \(m/z\): 108 (M\(^+\)).
3-(Hydroxymethyl)phenol (2j): $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.21 (d, $J = 7.8$ Hz, 1H), 6.92 (d, $J = 6.0$ Hz, 1H), 6.86 (s, 1H), 6.76 (d, $J = 8.1$ Hz, 1H), 5.03 (br s, 1H), 4.66 (s, 2H), 1.70 (br s, 1H). MS (EI) $m/z$: 124 (M$^+$).

4-Fluorophenol (2k): $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 6.92 (t, $J = 8.6$ Hz, 2H), 6.74-6.79 (m, 2H), 4.72 (s, 1H). MS (EI) $m/z$: 112 (M$^+$).

3-Hydroxybenzoic acid (2l): $^1$H NMR (300 MHz, DMSO): $\delta$ 12.83 (s, 1H), 9.74 (s, 1H), 7.25-7.38 (m, 3H), 7.00 (d, $J = 1.5$ Hz, 1H). MS (EI) $m/z$: 138 (M$^+$).

4-bromophenol (2m): $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.33 (d, $J = 9.0$ Hz, 2H), 6.73 (d, $J = 8.7$ Hz, 2H), 4.87 (s, 1H). MS (EI) $m/z$: 173 (M$^+$).

4-Nitrophenol (2n): $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 8.18 (d, $J = 9.0$ Hz, 2H), 6.92 (d, $J = 9.3$ Hz, 2H), 5.87 (br s, 1H). MS (EI) $m/z$: 139 (M$^+$).

1-(4-Hydroxyphenyl)ethanone (2o): $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.91 (d, $J$
= 8.7 Hz, 2H), 6.91 (d, J = 8.7 Hz, 2H), 6.04 (s, 1H), 2.57 (s, 3H). MS (EI) m/z: 136 (M⁺).

3-(Trifluoromethyl)phenol (2p) ¹H NMR (400 MHz, CDCl₃): δ 7.35 (t, J = 7.8 Hz, 1H), 7.19 (d, J = 8.0 Hz, 1H), 7.08 (s, 1H), 7.00 (dd, J = 2.4, 8.4 Hz, 1H), 5.29 (s, 1H). MS (EI) m/z: 162 (M⁺).

2-(2-Hydroxyphenyl)acetic acid (2q) ¹H NMR (400 MHz, DMSO): δ 12.08 (s, 1H), 9.40 (s, 1H), 7.03-7.09 (m, 2H), 6.79 (d, J = 7.6 Hz, 1H), 6.72 (t, J = 7.4 Hz, 1H), 3.46 (s, 2H). MS (EI) m/z: 152 (M⁺).

4-Hydroxybenzoic acid (2r) ¹H NMR (400 MHz, DMSO): δ 12.27 (br s, 1H), 10.38 (br s, 1H), 7.79 (d, J = 9.2 Hz, 2H), 6.82 (d, J = 8.8 Hz, 2H). MS (EI) m/z: 138 (M⁺).

4-Vinylphenol (2s) ¹H NMR (300 MHz, CDCl₃): δ 7.31 (d, J = 8.4 Hz, 2H), 6.79 (d, J = 8.7 Hz, 2H), 6.65 (dd, J = 11.1, 17.7 Hz, 1H), 5.61 (d, J = 17.4 Hz, 1H), 5.12 (d, J = 10.8 Hz, 1H), 4.82 (s, 1H). MS (EI) m/z: 120 (M⁺).

References:


$2o$

$2p$