Preparation of Benzolactams by Pd(OAc)₂-Catalyzed Direct Aromatic Carbonylation

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Supporting Information

Characterization data for the substrates and products

All melting points were measured by Yanagimoto melting-point apparatus, and uncorrected. IR spectra were recorded with JASCO IR-810 spectrophotometer. ¹H NMR spectra were obtained in CDCl₃ on a JEOL JMN-EX270 (270 MHz) spectrometer using TMS as an internal reference. Mass spectra were recorded on JEOL JMS-HX110 or JEOL-FABmate spectrometer at the Analytical Laboratory of Faculty of Pharmaceutical Science, Hokkaido University. Elementary analyses were performed with Yanako MT-6 CHN CORDER and Dionex DX-500 at the Analytical Laboratory of Faculty of Pharmaceutical Science, Hokkaido University. Preparative TLC was carried out on a Merck silica gel 60 PF₂₅₄. Pd(OAc)₂ was kindly donated by NE Chemcat (Lot. No. H21-F60270). Cu(OAc)₂ was purchased from Wako Pure Chemical Industries Ltd. (Lot. No. PKN1139). Valve-to-valve distillation was carried out using a Shibata Scientific Technology Ltd. Glass Oven Model GTO-250RS.

A General Procedure for preparation of amines (1a-l, 5a-f, 6a-f, and 7a-f).

Method A. A mixture of an aldehyde (10 mmol), an amine (11 mmol) and Na₂SO₄ in CH₂Cl₂ (20 mL), unless otherwise noted, was stirred for 2 h. The precipitates were removed by filtration, and the solvent was evaporated. The residue (imine) was dissolved in MeOH (20 mL), and treated with NaBH₄ (5 mmol) at rt for 1 h. The mixture was concentrated, and the residue was dissolved in CH₂Cl₂ (30 mL), washed

with water (3 x 15 mL), dried (Na_2SO_4), and concentrated. The residue was subjected to valve-to-valve distillation.

Method B. A mixture of an alkyl chloride (10 mmol), an amine (11 mmol) and K_2CO_3 (20 mmol) in DMF (20 mL), unless otherwise noted, stirred until the chloride disappeared being monitored with TLC. The reaction mixture was dissolved in Et_2O (50 mL) and water (50 mL). Et_2O layer was separated, and washed with water (3 x 20 mL) and saturated brine (20 mL), dried (MgSO_4), and concentrated. The residue was distilled under reduced pressure to give an amine.

Method C. A mixture of phenethylamine (10 mmol) and propionic acid (12 mmol) was heated at 200 °C for 2 h, and distilled under reduced pressure to give an amide, which was treated with LiAlH_4 (10 mmol) in dry boiling THF (20 mL) for 4 h. The excess hydride reagent was decomposed by addition of THF containing water. The resulting THF solution was separated by suction filtration, dried with K_2CO_3 , and distilled under reduced pressure to give an amine.

N-Phenethylpropylamine (1a): Method A with propanal (1.43 mL, 21 mmol) and phenethylamine (2.7 mL, 20 mmol); a colorless oil (1.92 g, 59%); bp 66-69 °C/3.0 mmHg (lit.¹ bp 73-78 °C/4 mmHg); IR (neat) 3306, 1605, 1503 cm^{-1} ; ^1H NMR δ 0.89 (t, $J = 7.3$ Hz, 3H), 1.49 (sextet, $J = 7.3$ Hz, 2H), 2.58 (t, $J = 7.30$ Hz, 2H), 2.78-2.83 (m, 2H), 2.86-2.90 (m, 2H), 7.20-7.32 (m, 5H).; EI-MS m/z (relative intensity) 163 (M^+ , 1.1), 114 (40.2), 72 (100). Anal. Calcd for $\text{C}_{11}\text{H}_{17}\text{N}$: C, 80.93; H, 10.50; N, 8.58. Found: C, 80.80; H, 10.59; N, 8.60.

N-[3,4-(Methylenedioxy)phenethyl]propylamine (1b): Method C via treatment of *N*-[3,4-(methylenedioxy)phenethyl]propionamide, mp 70-72 °C, with LiAlH_4 in boiling THF; bp 110-115 °C/0.35 mmHg (1.57 g, 76%); IR (neat) 3320, 1630, 1609 cm^{-1} ; ^1H NMR δ 0.89 (t, $J = 7.3$ Hz, 3H), 1.42-1.55 (m, 2H), 2.57 (t, $J = 7.3$ Hz, 2H), 2.69-2.85 (m, 4H), 5.92 (s, 2H), 6.65 (AB type, $J = 7.6$ Hz, 1H), 6.70 (s, 1H), 6.74 (AB type, $J = 7.6$ Hz, 1H); EI-MS m/z (relative intensity) 207 (M^+ , 2.5), 178 (0.7), 149 (6.5), 72 (100).

Anal. Calcd for $C_{12}H_{17}NO_2$: C, 69.54; H, 8.27; N, 6.76. Found: C, 69.48; H, 8.22; N, 6.52.

***N*-(3,4-Dimethoxyphenethyl)propylamine (1c):** Method A with propanal and 3,4-dimethoxyphenethylamine; a colorless oil (1.40 g, 63%); bp 130-132 °C /0.3 mmHg (lit.² bp 125/3.5 mmHg); IR (neat) 3312, 1607, 1518 cm^{-1} ; 1H NMR δ 0.89 (t, $J = 7.3$ Hz, 3H), 1.49 (sextet, $J = 7.3$ Hz, 2H), 2.59 (t, $J = 7.3$ Hz, 2H), 2.73-2.61 (m, 2H), 2.73-2.79 (m, 2H), 3.86 (s, 3H), 3.88 (s, 3H), 6.72-6.83 (m, 3H); EI-MS m/z (relative intensity) 223 (M^+ , 1.1), 152 (35.5), 114 (12.0), 72 (100). Anal. Calcd for $C_{13}H_{21}NO_2$: C, 69.92; H, 9.48; N, 6.27. Found: C, 69.87; H, 9.23; N, 6.33.

***N*-Benzylpropylamine (1d):** Method A with benzaldehyde and propylamine; a colorless oil (1.40 g, 94%); bp 31 °C/0.1 mmHg (lit.³ bp 47-55 °C/0.2 mmHg; lit.⁴ bp 109-110 °C/21 mmHg; lit.⁵ bp 111-114 °C/22 mmHg); IR (neat) 3306, 1605 cm^{-1} ; 1H NMR δ 0.92 (t, $J = 7.3$ Hz, 3H), 1.53 (sextet, $J = 7.3$ Hz, 2H), 2.60 (t, $J = 6.6$ Hz, 2H), 3.79 (s, 2H), 7.21-7.37 (m, 5H); EI-MS m/z (relative intensity) 149 (M^+ , 4.0), 120 (30.7), 91 (100). Anal. Calcd for $C_{10}H_{15}N$: 80.48; H, 10.13; N, 9.39. Found: C, 80.20; H, 10.15; N, 9.52.

***N*-[3,4-(Methylenedioxy)benzyl]propylamine (1e):** Method A with piperonal and propylamine; a colorless oil (1.58 g, 82%); bp 103 °C/1.5 mmHg; IR (neat) 3310 cm^{-1} ; 1H NMR δ 1.92 (t, $J = 7.3$ Hz, 3H), 1.51 (sextet, $J = 7.3$ Hz, 2H), 2.57 (t, $J = 7.3$ Hz, 2H), 3.69 (s, 2H), 5.93 (s, 2H), 6.76 (s, 2H), 6.84 (s, 1H); EI-MS m/z (relative intensity) 193 (M^+ , 10.7), 164 (10.5), 135 (100). Anal. Calcd for $C_{11}H_{15}NO_2$: C, 68.37; H, 7.82; N, 7.25. Found: C, 68.11; H, 7.75; N, 7.07.

***N*-(3,4-Dimethoxybenzyl)propylamine (1f):** Method A with 3,4-dimethoxybenzaldehyde and propylamine; a colorless oil (1.65 g, 79 %); bp 120 °C /0.3 mmHg; IR

(neat) 3322, 1608, 1592, 1516 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.53 (sextet, $J = 7.3$ Hz, 2H), 2.60 (t, $J = 7.3$ Hz, 2H), 3.73 (s, 2H), 3.87 (s, 3H), 3.89 (s, 3H), 6.79-6.87 (m, 2H), 6.89 (s, 1H); EI-MS m/z (relative intensity) 209 (M^+ , 7.9), 151 (100), 107 (6.3). Anal. Calcd for $\text{C}_{12}\text{H}_{19}\text{NO}_2$: C, 68.87; H, 9.15; N, 6.69. Found: C, 68.87; H, 9.06; N, 6.45.

N-Phenethylpropylamine (1g): Method A with benzaldehyde and phenethylamine; a colorless oil (1.73 g, 82%); bp 125 $^{\circ}\text{C}/1.1$ mmHg (lit.⁶ bp 124 $^{\circ}\text{C}/67$ Pa; lit.⁷ 180-182 $^{\circ}\text{C}/8.5$ mmHg); IR (neat) 3308, 1604 cm^{-1} ; ^1H NMR δ 2.79-2.85 (m, 2H), 2.88-2.94 (m, 2H), 3.80 (s, 2H), 7.17-7.34 (m, 10H); EI-MS m/z (relative intensity) 211 (M^+ , 100), 91 (83.2), 51 (6.2); HRMS calcd for $\text{C}_{15}\text{H}_{17}\text{N}$ 211.1361, found 211.1346.

3,4-(Methylenedioxy)diphenethylamine (1h): Method A with phenylacetaldehyde and 3,4-(methylenedioxy)phenethylamine; a colorless oil (2.44 g, 91%); bp 166 $^{\circ}\text{C}/1$ mmHg; IR (neat) 3206 cm^{-1} ; ^1H NMR δ 2.61-2.91 (m, 8H), 5.88 (s, 2H), 6.57-6.74 (m, 3H), 7.14-7.29 (m, 5H); EI-MS m/z (relative intensity) 269 (M^+ , 3.9), 178 (25.0), 134 (100), 105 (66.5). Anal. Calcd for $\text{C}_{17}\text{H}_{19}\text{NO}_2$: C, 75.81; H, 7.11; N, 5.20. Found: C, 76.05; H, 6.95; N, 5.39.

3,4-(Methylenedioxy)dibenzylamine (1i): Method A with 3,4-(methylenedioxy)benzaldehyde and benzylamine; a colorless oil (2.13 g, 79%); bp 130 $^{\circ}\text{C}/0.25$ mmHg; IR (Nujol) 3332 cm^{-1} ; ^1H NMR δ 3.72, 3.79, 5.94, 6.77 (each s, each 2H), 6.87 (s, 1H), 7.32-7.34 (m, 5H); EI-MS m/z (relative intensity) 269 (M^+ , 5.1), 150 (24.8), 135 (100). Anal. Calcd for $\text{C}_{15}\text{H}_{15}\text{NO}_2$: C, 74.67; H, 6.27; N, 5.81. Found: C, 74.55; H, 6.28; N, 5.69.

2,3-(Methylenedioxy)dibenzylamine (1j): Method A with 2,3-

(methylenedioxy)benzaldehyde and benzylamine; a colorless oil (1.73 g, 72%); bp 143 °C /0.5 mmHg; IR (neat) 3330, 1600 cm^{-1} ; ^1H NMR δ 1.75 (bs, 1H), 3.80 (s, 4H), 5.94 (s, 2H), 6.72-6.81 (m, 3H), 7.23-7.35 (m, 5H); EI-MS m/z (relative intensity) 241 (M^+ , 6.0), 150 (17.0), 136 (77.8), 106(100), 91 (69.2). Anal. Calcd for $\text{C}_{15}\text{H}_{15}\text{NO}_2$: C, 74.67; H, 6.27; N, 5.81. Found: C, 74.75; H, 6.42; N, 5.75.

4-Methoxy-4'-nitrodibenzylamine (1k): Method B with 4-nitrobenzylchloride (2.22 g, 13 mmol) and 4-methoxybenzylamine (1.79 g, 13 mmol); a pale yellow oil (1.60 g, 45%); bp 185 °C /0.2 mmHg; IR (neat) 3344, 1611, 1607, 1586, 1341 cm^{-1} ; ^1H NMR δ 3.75 (s, 2H), 3.82 (s, 3H), 3.89 (s, 2H), 6.88 (dd, $J = 3.0, 8.6$ Hz, 2H), 7.25 (dd, $J = 3.0, 8.6$ Hz, 2H), 7.52 (dd, $J = 2.0, 8.9$ Hz, 2H), 8.17 (dd, $J = 2.0, 8.9$ Hz, 2H); EI-MS m/z (relative intensity) 272 (M^+ , 12.9), 151 (17.3), 136 (16.7), 121 (100), 78 (10.1). Anal. Calcd for $\text{C}_{15}\text{H}_{16}\text{N}_2\text{O}_3$: C, 66.16; H, 5.92; N, 10.29. Found: C, 66.26; H, 5.96; N, 10.43.

3-Nitrodibenzylamine (1l): Method A with 3-nitrobenzaldehyde and benzylamine; a colorless oil (1.98 g, 82%); bp 175 °C /1.0 mmHg; IR (neat) 3350, 1523, 1349 cm^{-1} ; ^1H NMR δ 1.76 (br. s, 1H), 3.81 (s, 4H), 3.90 (s, 2H), 7.22-7.39 (m, 5H), 7.49 (t, $J = 7.6$ Hz, 1H), 7.70 (d, $J = 7.3$ Hz, 1H), 8.10 (d, $J = 6.6$ Hz, 1H), 8.24 (s, 1H); EI-MS m/z (relative intensity) 242 (M^+ , 13), 242 (19), 196 (8), 151 (39), 136 (38), 106 (50), 91 (100), 77 (24). Anal. Calcd for $\text{C}_{14}\text{H}_{14}\text{N}_2\text{O}_2$: C, 69.41; H, 5.82; N, 11.56. Found: C, 69.35; H, 5.72; N, 11.61.

N-(2-Methoxybenzyl)propylamine (5a): Method A with 2-methoxybenzaldehyde and propylamine; a colorless oil (2.33 g, 98%); bp 88-90 °C /0.6 mmHg; IR (neat) 3324, 1603, 1589 cm^{-1} ; ^1H NMR δ 0.91 (t, $J = 7.3$ Hz, 3H), 1.52 (sextet, $J = 7.3$ Hz, 2H), 2.56 (t, $J = 7.3$ Hz, 2H), 3.78 (s, 2H), 3.83 (s, 3H), 6.84-6.94 (m, 2H), 7.20-7.26 (m, 2H); EI-MS m/z (relative intensity) 179 (M^+ , 8.0), 150 (32.3), 121 (100), 91 (33.1), 57 (7.2). Anal. Calcd for $\text{C}_{11}\text{H}_{17}\text{NO}$: C, 73.70; H, 9.56; N, 7.81. Found: C, 73.75; H, 9.36; N,

7.69.

N-(2-Methylbenzyl)propylamine (5b): Method A with 2-methylbenzaldehyde and propylamine; a colorless oil (1.30 g, 80%); bp 52 °C /0.35 mmHg; IR (neat) 3318, 1606 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.55 (sextet, $J = 7.3$ Hz, 2H), 2.34 (s, 3H), 2.64 (t, $J = 7.3$ Hz, 2H), 3.75 (s, 2H), 3.91 (s, 3H), 7.13 (d, $J = 7.9$ Hz, 2H), 7.21 (d, $J = 7.9$ Hz, 2H); EI-MS m/z (relative intensity) 163 (M^+ , 13.6), 134 (34.8), 105 (100), 77 (5.9). Anal. Calcd for $\text{C}_{11}\text{H}_{17}\text{N}$: C, 80.93; H, 10.50; N, 8.58. Found: C, 80.82; H, 10.43; N, 8.44.

N-(2-Chlorobenzyl)propylamine (5c): Method A with 2-chlorobenzaldehyde and propylamine; a colorless oil (1.77 g, 96%); bp 65 °C /0.2 mmHg; IR (neat) 3328, 1573 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.54 (sextet, $J = 7.3$ Hz, 2H), 2.60 (t, $J = 7.3$ Hz, 2H), 3.88 (s, 2H), 7.15-7.26 (m, 2H), 7.33-7.40 (m, 2H); EI-MS m/z (relative intensity) 183 (M^+ , 5.6), 154 (58.9), 125 (100), 89 (10.6). Anal. Calcd for $\text{C}_{10}\text{H}_{14}\text{ClN}$: C, 65.39; H, 7.68; N, 7.42; Cl, 19.30. Found: C, 65.35; H, 7.73; N, 7.63; Cl, 19.37.

N-(2-Bromobenzyl)propylamine (5d): Method A with 2-bromobenzaldehyde and propylamine; a colorless oil (2.16 g, 95%); bp 90 °C /0.4 mmHg; IR (neat) 3306, 1568 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.56 (sextet, $J = 7.3$ Hz, 2H), 2.59 (t, $J = 7.3$ Hz, 2H), 3.86 (s, 2H), 7.12 (dt, 7.6, 7.6, 1.7 Hz, 1H), 7.28 (dt, $J = 7.6$, 7.6, 1.7 Hz, 1H), 7.39 (dd, $J = 7.6$, 1.7 Hz, 1H), 7.54 (dd, $J = 7.6$, 1.7 Hz, 1H); EI-MS m/z (relative intensity) 229 (M^+ , 14.6), 227 (M^+ , 12.2), 220 (99.2), 198 (100), 171 (97.4), 169 (98.3), 118 (4.2), 90 (9.7). Anal. Calcd for $\text{C}_{10}\text{H}_{14}\text{BrN}$: C, 52.65; H, 6.19; N, 6.14, Br, 35.03. Found: C, 52.61; H, 6.17; N, 5.97, Br, 35.03.

N-(2-Nitrobenzyl)propylamine (5f): Method A with 2-nitrobenzaldehyde and propylamine; a pale yellow oil (1.19 g, 97%); bp 110 °C /0.5 mmHg; IR (neat) 3324, 1611, 1540, 1350 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.54 (sextet, $J = 7.3$ Hz, 2H),

1.64 (br. s, 1H), 2.61 (t, $J = 7.3$ Hz, 2H), 4.03 (s, 2H), 7.41 (dt, $J = 6.9, 6.9, 1.7$ Hz, 1H), 7.55-7.66 (m, 2H), 7.95 (dd, $J = 1.3, 7.9$ Hz, 1H); EI-MS m/z (relative intensity) 195 (M^+ , 28.4), 176 (39.6), 165 (61.4), 159 (100), 134 (31.6). Anal. Calcd for $C_{10}H_{14}N_2O_2$: C, 61.84; H, 7.27; N, 14.42. Found: C, 61.84; H, 7.33; N, 14.35

N-(3-Methoxybenzyl)propylamine (6a): Method A with 3-methoxybenzaldehyde and propylamine; a colorless oil (1.73 g, 97%); bp 100 °C /0.6 mmHg; IR (neat) 3318, 1597, 1587 cm^{-1} ; 1H NMR δ 0.92 (t, $J = 7.6$ Hz, 3H), 1.53 (sextet, $J = 7.6$ Hz, 2H), 2.60 (t, $J = 7.6$ Hz, 2H), 3.77 (s, 2H), 3.80 (s, 3H), 6.77-6.81 (m, 1H), 6.88-6.91 (m, 2H), 7.21-7.26 (m, 1H); EI-MS m/z (relative intensity) 179 (M^+ , 2.7), 150 (22.3), 121 (100), 91 (11.2), 58 (19.6). Anal. Calcd for $C_{11}H_{17}NO$: C, 73.70; H, 9.56; N, 7.81. Found: C, 73.61; H, 9.33; N, 7.78.

N-(3-Methylbenzyl)propylamine (6b): Method A with 3-methylbenzaldehyde and propylamine; a colorless oil (1.49 g, 92%); bp 71 °C /0.9 mmHg; IR (neat) 3294, 1610 cm^{-1} ; 1H NMR δ 0.91 (t, $J = 7.3$ Hz, 3H), 1.52 (sextet, $J = 7.3$ Hz, 2H), 2.33 (s, 3H), 2.59 (t, $J = 7.3$ Hz, 2H), 3.75 (s, 2H), 7.15-7.18 (m, 3H), 7.27-7.31 (m, 1H); EI-MS m/z (relative intensity) 163 (M^+ , 6.3), 149 (14.9), 134 (31.7), 105 (100). Anal. Calcd for $C_{11}H_{17}N$: C, 80.93; H, 10.50; N, 8.58. Found: C, 80.85; H, 10.36; N, 8.43.

N-(3-Chlorobenzyl)propylamine (6c): Method A with 3-chlorobenzaldehyde and propylamine; a colorless oil (1.78 g, 97 %); bp 84 °C /0.5 mmHg; IR (neat) 3374, 1599, 1577; 1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.54 (sextet, $J = 7.3$, 2H), 2.60 (t, $J = 7.3$, 2H), 3.88 (s, 2H), 7.15-7.26 (m, 2H), 7.33-7.40 (m, 2H); EI-MS m/z (relative intensity) 183 (M^+ , 6.2), 154 (55.6), 125 (100), 89 (9.5). Anal. Calcd for $C_{10}H_{14}ClN$: C, 65.39; H, 7.68; N, 7.42; Cl, 19.30. Found: C, 65.26; H, 7.68; N, 7.59; Cl, 19.35.

N-(3-Bromobenzyl)propylamine (6d): Method A with 3-bromobenzaldehyde and propylamine; a colorless oil (2/21 g, 96%); bp 97 °C /0.4 mmHg; IR (neat) 3306, 1596, 1569 cm^{-1} ; 1H NMR δ 0.94 (t, $J = 7.3$ Hz, 2H), 1.53 (sextet, $J = 7.3$ Hz, 2H), 2.58 (t, $J =$

7.3 Hz, 2H), 3.76 (s, 2H), 7.15-7.26 (m, 2H), 7.37 (dt, $J = 7.6, 7.6, 1.7$ Hz, 1H), 7.49 (d, $J = 1.7$ Hz, 1H); EI-MS m/z (relative intensity) 229 (M^+ , 14.6), 227 (M^+ , 15.2), 200 (87.5), 198 (89.7), 171 (97.9), 169 (100), 99 (5.6), 90 (18.5). Anal. Calcd for $C_{10}H_{14}BrN$: C, 52.65; H, 6.19; N, 6.14; Br, 35.03. Found: C, 52.38; H, 6.20; N, 5.97, Br, 35.16.

***N*-(3-Cyanobenzyl)propylamine (6e):** Method A with 3-cyanobenzaldehyde and propylamine; a colorless oil (1.45 g, 85%); bp 98°C/0.4 mmHg; IR (neat) 3318, 2228, 1603, 1584 cm^{-1} ; ^1H NMR δ 0.93 (t, $J = 7.3$ Hz, 3H), 1.53 (sextet, $J = 7.3$ Hz, 2H), 2.58 (t, $J = 7.3$ Hz, 2H), 3.82 (s, 2H), 7.39-7.45 (m, 1H), 7.52-7.59 (m, 2H), 7.65 (s, 1H); EI-MS m/z (relative intensity) 174 (M^+ , 4.4), 145 (63.8), 119 (100), 89 (16.9). Anal. Calcd for $C_{11}H_{14}N_2$: C, 75.82; H, 8.10; N, 16.08. Found: C, 75.71; H, 8.22; N, 15.98.

***N*-Propyl-3-nitrobenzylamine (6f):** Method A with 3-nitrobenzaldehyde and propylamine; a colorless oil (1.87 g, 96%); bp 135-140 °C /0.35 mmHg; IR (neat) 3326, 1538, 1350 cm^{-1} ; ^1H NMR δ 0.94 (t, $J = 7.3$ Hz, 2H), 1.56 (sextet, $J = 7.3$ Hz, 2H), 2.61 (t, $J = 7.3$ Hz, 2H), 3.90 (s, 2H), 7.49 (t, $J = 7.9$ Hz, 1H), 7.69 (d, $J = 7.6$ Hz, 1H), 8.10 (ddd, $J = 8.3, 2.3, 1.0$ Hz, 1H), 8.21 (d, $J = 1.7$ Hz, 1H); EI-MS m/z (relative intensity) 194 (M^+ , 7.6), 65 (100), 136 (97.8), 90 (26.8). Anal. Calcd for $C_{10}H_{14}N_2O_2$: C, 61.84; H, 7.27; N, 14.42. Found: C, 61.71; H, 7.15; N, 14.53.

***N*-(4-Methoxybenzyl)propylamine (7a):** Method A with 4-methoxybenzaldehyde and propylamine; a colorless oil (3.25 g, 91 %); bp 100 °C /1.0 mmHg; IR (neat) 3308, 1612, 1586, 1511 cm^{-1} ; ^1H NMR δ 0.91 (t, $J = 7.3$ Hz, 3H), 1.52 (sextet, $J = 7.3$ Hz, 2H), 2.58 (t, $J = 7.3$ Hz, 2H), 3.72 (s, 2H), 3.79 (s, 3H), 6.86 (d, $J = 8.6$ Hz, 2H), 7.23 (d, $J = 8.6, 2\text{H}$); EI-MS m/z (relative intensity) 179 (M^+ , 12.8), 150 (16.8), 121 (100), 91 (2.5). Anal. Calcd for $C_{11}H_{17}NO$: C, 73.70; H, 9.56; N, 7.81. Found: C, 73.66; H, 9.53; N, 7.69.

***N*-(4-Methylbenzyl)propylamine (7b):** Method B with 4-methylbenzylchloride (2.6 mL, 20 mmol) and propylamine (3.3 mL, 40 mmol); a colorless oil (1.69 g, 52%); bp 80 °C /0.3 mmHg; IR (neat) 3308, 1516 cm⁻¹; ¹H NMR δ 0.91 (t, *J* = 7.3 Hz, 3H), 1.52 (sextet, *J* = 7.3 Hz, 2H), 2.33 (s, 3H), 2.59 (t, *J* = 7.3 Hz, 2H), 3.75 (s, 2H), 7.13 (d, *J* = 7.9 Hz, 2H), 7.21 (d, *J* = 7.9 Hz, 2H); EI-MS *m/z* (relative intensity): 207 (M⁺, 8.7), 178 (65.3), 149 (100), 121 (12.5), 90 (7.1), 74 (6.9). Anal. Calcd for C₁₁H₁₇N: C, 80.93; H, 10.50; N, 8.58. Found: C, 80.72; H, 10.27; N, 8.63.

***N*-(4-Chlorobenzyl)propylamine (7c):** Method A with 4-chlorobenzaldehyde and propylamine; a colorless oil (1.76 g, 94%); bp 68 °C /0.2 mmHg; IR (neat) 3312 cm⁻¹; ¹H NMR δ 0.92 (t, *J* = 7.3 Hz, 3H), 1.52 (sextet, *J* = 7.3 Hz, 2H), 2.58 (t, *J* = 7.3 Hz, 2H), 3.76 (s, 2H), 7.24-7.27 (m, 2H), 7.28-7.31 (m, 2H); EI-MS *m/z* (relative intensity) 183 (M⁺, 5.4), 154 (34.1), 125 (100), 89 (11.1). Anal. Calcd for C₁₀H₁₄ClN: C, 65.39; H, 7.68; N, 7.42; Cl, 19.30. Found: C, 65.27; H, 7.55; N, 7.42; Cl, 19.22.

***N*-(4-Bromobenzyl)propylamine (7d):** Method A with 4-bromobenzaldehyde and propylamine; a colorless oil (2.16 g, 95%) as a colorless oil; bp 105 °C /0.4 mmHg; IR (neat) 3304, 1593, 1489 cm⁻¹; ¹H NMR δ 0.92 (t, *J* = 7.3 Hz, 3H), 1.52 (sextet, *J* = 7.3, 2H), 2.57 (t, *J* = 7.3 Hz, 2H), 3.74 (s, 2H), 7.20 (dd, *J* = 8.6, 2.0 Hz, 2H), 7.44 (dd, *J* = 8.3, 2.0 Hz, 2H); EI-MS *m/z* (relative intensity) 229 (M⁺, 6.6), 227 (M⁺, 7.2), 200 (40.7), 198 (42.6), 171 (97.9), 169 (100), 149 (11.1), 90 (27.9). Anal. Calcd for C₁₀H₁₄BrN: C, 52.65; H, 6.19; N, 6.14; Br, 35.03. Found: C, 52.57; H, 6.19; N, 5.92; Br, 35.22.

***N*-(4-Cyanobenzyl)propylamine (7e):** Method A with 4-cyanobenzaldehyde and propylamine; a colorless oil (1.67 g, 91%); bp 105 °C /0.35 mmHg; IR (neat) 3346, 2226, 1609, 1507 cm⁻¹; ¹H NMR δ 0.93 (t, *J* = 7.3 Hz, 3H), 1.53 (sextet, *J* = 7.3 Hz, 2H), 2.58 (t, *J* = 7.3 Hz, 2H), 3.85 (s, 2H), 7.45 (d, *J* = 8.6 Hz, 2H), 7.62 (dd, *J* = 2.0, 8.6 Hz, 2H); EI-MS *m/z* (relative intensity) 174 (M⁺, 4.3), 145 (56.6), 116 (100), 89 (17.9). Anal. Calcd for C₁₁H₁₄N₂: C, 75.82; H, 8.10; N, 16.08. Found: C, 75.85; H, 8.27; N, 16.10.

***N*-(4-Nitrobenzyl)propylamine (7f):** Method B with 4-nitrobenzyl chloride and propylamine; a pale yellow oil (1.59 g, 80%); bp 114 °C /0.7 mmHg; IR (neat) 3340, 1604, 1523, 1344 cm^{-1} ; ^1H NMR δ 0.94 (t, J = 7.3 Hz, 2H), 1.54 (sextet, J = 7.3 Hz, 2H), 2.60 (t, J = 7.3 Hz, 2H), 3.90 (s, 2H), 7.51 (d, J = 8.6 Hz, 2H), 8.18 (dd, J = 8.6, 1.7 Hz, 2H); EI-MS m/z (relative intensity) 294 (M^+ , 6.87), 165 (100), 149 (10.4), 136 (51.3), 106 (16.7), 90 (12.9), 78 (16.7). Anal. Calcd for $\text{C}_{10}\text{H}_{14}\text{N}_2\text{O}_2$: C, 61.84; H, 7.27; N, 14.42. Found: C, 61.59; H, 7.18; N, 14.39.

A General Procedure for Preparation of Benzolactams (2-4, and 8-11) by $\text{Pd}(\text{OAc})_2$ -Catalyzed Carbonylation of Benzylic Amines and Phenethylamines (1a-l, 5a-f, 6a-f and 7a-f). A stirred mixture of freshly prepared amine (41.4 mg, 0.2 mmol), $\text{Pd}(\text{OAc})_2$ (2.24 mg, 0.01 mmol), and $\text{Cu}(\text{OAc})_2$ (18.1 mg, 0.1 mmol) in toluene (2 mL) was refluxed in an oil bath at 120 °C in an atmosphere of carbon monoxide (ca. 1~1.5 L) containing air (12 mL, corresponding to 0.1 mmol of O_2) delivered from a toy balloon for 2 h. The reaction mixture was cooled to room temperature, and filtered through a thin pad of powdered MgSO_4 . Toluene was removed in a rotary evaporator. The residue was crystallized from the appropriate solvents or subjected to preparative TLC on silica gel to afford the corresponding benzolactam.

2-Propyl-3,4-dihydro-1(2H)-isoquinolinone (2a). a colorless oil⁸ (64%); IR (neat) 1605 cm^{-1} ; ^1H NMR δ 0.96 (t, J = 7.3 Hz, 3H), 1.65 (sextet, J = 7.26 Hz, 2H), 2.98 (t, J = 7.3 Hz, 2H), 3.44-3.57 (m, 4H), 7.18 (dd, J = 7.3, 0.7 Hz, 1H), 7.33 (dt, J = 7.3, 7.3, 0.7 Hz, 1H), 7.40 (dt, J = 7.3, 7.3, 1.7 Hz, 1H), 8.08 (dd, J = 7.3, 1.7 Hz, 1H).

7,8-(Methylenedioxy)-2-propyl-3,4-dihydro-1(2H)-isoquinolinone (2b): a colorless oil (86%); R_f 0.71 (3% MeOH- CH_2Cl_2); IR (neat) 1650, 1599 cm^{-1} ; ^1H NMR δ 0.96 (t, J

=7.3 Hz, 3H), 1.64 (sextet, $J = 7.3$ Hz, 2H), 2.89, 3.47 (each t, $J = 6.6$ Hz, each 2H), 3.52 (t, $J = 7.3$ Hz, 2H), 6.09 (s, 2H), 6.60, 6.81 (each d, $J = 7.6$ Hz, each 1H); EI-MS m/z (relative intensity) 233 (M^+ , 93.2), 204 (100); HRMS calcd for $C_{13}H_{15}NO_3$ 233.1052, found 233.1047.

6,7-Dimethoxy-2-propyl-3,4-dihydro-1(2H)-isoquinolinone (3c): colorless crystals (24%); mp 77-78 °C (Et₂O-petroleum ether) (lit.⁹ mp 77 °C); R_f 0.27 (1:1 AcOEt/hexane); IR (Nujol) 1647, 1601, 1587, 1515 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.65 (sextet, $J = 7.3$ Hz, 2H), 2.91 (t, $J = 7.3$ Hz, 1H), 3.49-3.56 (m, 4H), 3.92, 3.93 (s, 3H), 6.63, 7.60 (each s, each 1H); EI-MS m/z (relative intensity) 223 (M^+ , 1.1), 152 (35.5), 114 (12.0), 72 (100).

2-Propylisoindolin-1-one (2d): a colorless oil (87%); (lit.¹⁰ mp 33.1-34.7 °C); IR (neat) 1680 cm^{-1} ; 1H NMR δ 0.97 (t, $J = 7.3$ Hz, 3H), 1.70 (sextet, $J = 7.3$ Hz, 2H), 3.59 (t, $J = 7.3$ Hz, 2H), 4.38 (s, 2H), 7.43-7.56 (m, 3H), 7.85 (dd, $J = 6.6, 1.7$ Hz, 1H).

6,7-(Methylenedioxy)-2-propylisoindolin-1-one (2e): a colorless oil (21%); R_f 0.14 (1:3 AcOEt/hexane); IR (neat) 1685, 1553, 1501 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.68 (sextet, $J = 7.3$ Hz, 2H), 3.54 (t, $J = 7.3$ Hz, 2H), 4.33 (s, 2H), 6.12 (s, 2H), 6.84, 6.94 (each d, $J = 7.9$ Hz, each 1H); EI-MS m/z (relative intensity) 219 (M^+ , 38.0), 190 (100), 177 (15.8), 163 (6.2), 135 (11.1); HRMS calcd for $C_{12}H_{13}NO_3$ 219.0895, found 219.0892.

6,7-(Methylenedioxy)-2-propylisoindolin-1-one (3e): a colorless oil (7%); R_f 0.16 (1:3 AcOEt/hexane); IR (neat) 1677, 1624 cm^{-1} ; 1H NMR δ 0.95 (t, $J = 7.3$ Hz, 3H), 1.66 (sextet, $J = 7.3$ Hz, 2H), 3.54 (t, $J = 7.3$ Hz, 2H), 4.25 (s, 2H), 6.05 (s, 2H), 6.84, 6.84 (s,

1H), 7.22 (s, 1H); EI-MS m/z (relative intensity) 219 (M^+ , 35.9), 190 (100), 177 (15.8), 135 (14.7); HRMS calcd for $C_{12}H_{13}NO_3$ 219.0895, found 219.0891.

6,7-Dimethoxy-2-propylisoindolin-1-one (2f): a colorless oil (21%); R_f 0.34 (1:1 AcOEt/hexane); IR (neat) 1684 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.68 (sextet, $J = 7.3$ Hz, 2H), 3.54 (t, $J = 7.3$ Hz, 2H), 3.89 (s, 3H), 4.09 (s, 3H), 4.28 (s, 2H), 7.07 (s, 2H); EI-MS m/z (relative intensity) 235 (M^+ , 78.0), 206 (100), 193 (77.3); HRMS calcd for $C_{13}H_{17}NO_3$ 235.1208, found 235.1207.

5,6-Dimethoxy-2-propylisoindolin-1-one (3f): a colorless oil (52%); R_f 0.14 (1:1 AcOEt/hexane); IR (neat) 1673, 1615 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.68 (sextet, $J = 7.3$ Hz, 2H), 3.56 (t, $J = 7.3$ Hz, 2H), 3.94 (s, 3H), 3.95 (s, 3H), 4.29 (s, 2H), 6.92 (s, 1H), 7.31 (s, 1H); EI-MS m/z (relative intensity) 235 (M^+ , 40.0), 206 (100), 193 (12.3); HRMS calcd for $C_{13}H_{17}NO_3$ 235.1208, found 235.1211.

2-Benzyl-3,4-dihydro-1(2H)-isoquinolinone (2g): a colorless oil¹¹ (3.4%); R_f 0.65-0.73 (1:1 AcOEt/hexane) and then R_f 0.26 on alumina (1:5 AcOEt/hexane); IR (neat) 1649, 1605, 1579 cm^{-1} ; 1H NMR δ 2.94 (t, $J = 6.6$ Hz, 2H), 3.49 (t, $J = 6.6$ Hz, 2H), 4.81 (s, 2H), 7.16 (dd, $J = 7.3, 0.7$ Hz, 1H), 7.20-7.46 (m, 7H), 8.18 (dd, 1H, $J = 6.6, 1.7$ Hz, 1H); EI-MS m/z (relative intensity) 237 (M^+ , 100), 160 (12.5), 146 (100), 133 (51.2), 118 (43.9), 91 (15.5); HRMS calcd for $C_{16}H_{15}NO$ 237.1154, found 237.1154.

2-(2-Phenylethyl)isoindolin-1-one (3g): A less mobile fraction with R_f 0.43-0.58 was further purified by alumina TLC plate (1:3 AcOEt/hexane) to afford benzolactam **3g** (R_f 0.28-0.43); as colorless plates (38%); mp 94-95 $^{\circ}C$ (MeOH-Et₂O) (lit.¹² mp 92 $^{\circ}C$); IR

(Nujol) 1683, 1619, 1601 cm^{-1} ; ^1H NMR δ 2.99 (t, $J = 7.3$ Hz, 2H), 3.87 (t, $J = 7.3$ Hz, 2H), 4.19 (s, 2H), 7.40-7.52 (m, 2H), 7.36 (d, $J = 7.3$ Hz, 1H), 7.18-7.31 (m, 5H), 7.84 (d, $J = 7.3$ Hz, 1H); EI-MS m/z (relative intensity) 237 (M^+ , 11.8), 146 (100), 91 (15.5); HRMS calcd for $\text{C}_{16}\text{H}_{15}\text{NO}$ 237.1154, found 237.1158.

7,8-(Methylenedioxy)-2-(2-phenylethyl)-3,4-dihydro-1(2H)-isoquinolinone (2h):

colorless crystals (58%); R_f 0.35 (1:1 AcOEt:hexane); mp 99-101 $^{\circ}\text{C}$ (MeOH-Et₂O); IR (Nujol) 1636 cm^{-1} ; ^1H NMR δ 2.74 (t, $J = 6.6$ Hz, 2H), 2.96 (t, $J = 6.9$ Hz, 2H), 3.33 (t, $J = 6.6$ Hz, 2H), 3.75 (t, $J = 6.9$ Hz, 2H), 6.10 (s, 2H), 6.57 (d, $J = 7.9$ Hz, 1H), 6.81 (d, $J = 7.9$ Hz, 1H), 7.18-7.32 (m, 5H); EI-MS m/z (relative intensity) 295 (M^+ , 24.3), 204 (100), 91 (6.1); HRMS calcd for $\text{C}_{17}\text{H}_{18}\text{NO}_3$ 295.1208, found 295.1200. Anal. Calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_3$: C, 73.20; H, 5.80; N, 4.74. Found: C, 73.01; H, 5.58; N, 4.45.

2-[3,4-(Methylenedioxy)phenethyl]-1-oxo-3,4-dihydro-1(2H)-isoquinolinone (3h):

colorless crystals (7%); R_f 0.63 (1:1 AcOEt/hexane); mp 97-99 $^{\circ}\text{C}$ (MeOH-Et₂O); IR (Nujol) 1642 cm^{-1} ; ^1H NMR δ 2.83-2.91 (m, 4H), 3.41 (t, $J = 6.6$ Hz, 2H), 3.74 (t, $J = 7.4$ Hz, 2H), 5.93 (s, 2H), 6.69-6.76 (m, 3H), 7.14 (d, $J = 7.2$ Hz, 1H), 7.18-7.32 (m, 5H), 8.07 (d, $J = 1.3$ Hz, 1H); EI-MS m/z (relative intensity) 295 (M^+ , 6.4), 160 (35.2), 148 (100); HRMS calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_3$ 295.1208, found 295.1198. Anal. Calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_3$: C, 73.20; H, 5.80; N, 4.74. Found: C, 73.13; H, 5.92; N, 4.52.

2-Benzyl-6,7-(methylenedioxy)isoindolin-1-one (2i): colorless crystals (28%); R_f 0.56, (1:1 AcOEt/hexane); mp 133-134 $^{\circ}\text{C}$ (MeOH); IR (Nujol) 1638 cm^{-1} ; ^1H NMR δ 4.22, 4.75, 6.14 (each s, each 2H), 6.75 (d, $J = 7.9$ Hz, 1H), 6.94 (d, $J = 7.9$ Hz, 1H), 7.27-7.34 (m, 5H); EI-MS m/z (relative intensity) 267 (M^+ , 100), 239 (8.8), 190 (7.0), 176 (36.8), 163 (61.7), 134 (12.3). Anal. Calcd for $\text{C}_{16}\text{H}_{13}\text{NO}_3$: C, 71.90; H, 4.90; N, 5.24; Found: C, 71.82; H, 5.15; N, 5.30.

2-Benzyl-5,6-(methylenedioxy)isoindolin-1-one (3i): colorless crystals (4%); R_f 0.65 (1:1 AcOEt/hexane); mp 167-168 °C (MeOH); IR (Nujol) 1667, 1638, 1501 cm^{-1} ; ^1H NMR δ 4.14, 4.66, 6.05 (each s, each 2H), 6.75-6.80 (m, 5H); EI-MS m/z (relative intensity) 267 (M^+ , 100), 239 (8.8), 190 (7.0), 176 (36.8), 163 (61.7), 134 (12.3). Anal. Calcd for $\text{C}_{16}\text{H}_{13}\text{NO}_3$: C, 71.90; H, 4.90; N, 5.24. Found: C, 71.82; H, 5.15; N, 5.30.

2-[3,4-(Methylenedioxy)benzyl]isoindolin-1-one (4i): colorless crystals (12%); R_f 0.72 (1:1 AcOEt/hexane); mp 87-89 °C (MeOH); IR (Nujol) 1675 cm^{-1} ; ^1H NMR δ 4.26, 4.75, 5.93 (each s, each 2H), 7.25-7.39 (m, 4H), 7.43-7.54 (m, 2H), 7.87 (d, J = 6.9 Hz, 1H); EI-MS m/z (relative intensity) 267 (M^+ , 11.8), 146 (100), 91 (15.5). Anal. Calcd for $\text{C}_{16}\text{H}_{13}\text{NO}_3$: C, 71.90; H, 4.90; N, 5.24. Found: C, 71.64; H, 5.04; N, 5.00.

2-Benzyl-4,5-(methylenedioxy)isoindolin-1-one (2j): colorless crystals (34%); R_f 0.47 (1:1 AcOEt/hexane); mp 142.5-144.3 °C (EtOH-hexane); IR (Nujol) 1680 cm^{-1} ; ^1H NMR δ 4.22 (s, 2H), 4.77 (s, 2H), 6.04 (s, 2H), 6.94 (d, J = 7.9 Hz, 1H), 7.29-7.36 (m, 5H), 7.46 (d, J = 7.9 Hz, 1H); EI-MS m/z (relative intensity): 267 (M^+ , 100), 192 (28.5), 176 (34.0), 135 (17.7), 91 (65.4), 77 (28.7). Anal. Calcd for $\text{C}_{16}\text{H}_{13}\text{NO}_3$: C, 71.90; H, 4.90; N, 5.24. Found: C, 71.86; H, 5.09; N, 4.98.

2-[2,3-(Methylenedioxy)benzyl]isoindolin-1-one (3j): a colorless oil (39%); R_f 0.37 (1:1 AcOEt/hexane); IR (neat) 1687, 1619 cm^{-1} ; ^1H NMR δ 4.33 (s, 2H), 4.80 (s, 2H), 5.97 (s, 2H), 6.76-6.82 (m, 3H), 7.39-7.87 (m, 3H), 7.88 (dd, J = 1.3, 6.9 Hz, 1H); EI-MS m/z (relative intensity): 267 (M^+ , 100), 249 (13.5), 145 (26.2), 135 (67.3), 119

(28.5), 91 (28.3), 77 (28.4). HRMS calcd for $C_{16}H_{13}NO_3$ 267.0895, found 267.0895.

6-Methoxy-2-(4-nitrobenzyl)isoindolin-1-one (2k): a colorless oil (41%); R_f 0.46 (1:1 AcOEt/hexane); IR (neat) 1698, 1691, 1520, 1493 cm^{-1} ; 1H NMR δ 3.80 (s, 3H), 4.36 (s, 2H), 4.77 (s, 2H), 6.88 (dt, $J = 2.0, 3.0, 8.6$ Hz, 2H), 7.25 (dt, $J = 2.0, 3.0, 8.6$ Hz, 2H), 7.55 (d, $J = 8.3$ Hz, 1H), 8.40 (dd, $J = 2.0, 8.3$ Hz, 1H), 8.71 (d, $J = 2.3$ Hz, 1H); EI-MS m/z (relative intensity) 298 (M^+ , 94.2), 162 (36.9), 149 (100); HRMS calcd for $C_{16}H_{14}N_2O_4$ 298.0954, found 193.0961.

2-(4-Methoxybenzyl)-6-nitroisoindolin-1-one (3k): a colorless oil (24%); R_f 0.32 (1:1 AcOEt/hexane); IR (neat) 1697, 1611, 1530, 1514, 1349 cm^{-1} ; 1H NMR δ 3.80 (s, 3H), 4.36 (s, 2H), 4.77 (s, 2H), 6.88 (dt, $J = 2.0, 3.0, 8.6$ Hz, 2H), 7.25 (dt, $J = 2.0, 3.0, 8.6$ Hz, 2H), 7.55 (d, $J = 8.3$ Hz, 1H), 8.40 (dd, $J = 2.0, 8.3$ Hz, 1H), 8.71 (d, $J = 2.3$ Hz, 1H); EI-MS m/z (relative intensity) 298 (M^+ , 84.5), 251 (15.2), 164 (37.3), 121 (100); HRMS calcd for $C_{16}H_{14}N_2O_4$ 298.0954, found 193.0960.

2-(3-Nitrobenzyl)isoindolin-1-one (2l): a colorless oil (34%); R_f 0.38 (1:1 hexane/EtOAc); IR (neat) 1689, 1530, 1348 cm^{-1} ; 1H NMR δ 4.34 (s, 2H), 4.91 (s, 2H), 7.43 (d, $J = 7.3$ Hz, 1H), 7.46-7.60 (m, 3H), 7.67 (d, $J = 7.6$ Hz, 1H), 7.92 (d, $J = 7.6$ Hz, 1H), 8.16 (d, $J = 7.9$ Hz, 1H), 8.17 (s, 1H); EI-MS m/z (relative intensity) 268 (M^+ , 28), 252 (18), 251 (100), 222 (17), 221 (98), 146 (18), 136 (10), 132 (9); HRMS calcd for $C_{15}H_{12}N_2O_3$ 268.0848, found 268.0842.

2-Benzyl-5-nitroisoindolin-1-one (3l): a colorless oil (15%); R_f 0.49 (1:1 AcOEt/hexane); IR (neat) 1694, 1529, 1347 cm^{-1} ; 1H NMR δ 4.38 (s, 2H), 4.84 (s, 2H), 7.22-7.41 (m, 5H), 8.05 (d, $J = 8.6$ Hz, 1H), 8.26 (s, 1H), 8.36 (dd, $J = 8.3, 2.0$ Hz,

1H); EI-MS m/z (relative intensity) 268 (M^+ , 37), 221 (10), 164 (16), 91 (100), 77 (10); HRMS calcd for $C_{15}H_{12}N_2O_3$ 268.0848, found 268.0861.

4-Methoxy-2-propylisoindolin-1-one (8a). A colorless oil (67%) from **5a**; R_f 0.54 (1:1 AcOEt/hexane); IR (neat) 1699 cm^{-1} ; 1H NMR δ 0.95 (t, $J = 7.3$ Hz, 3H), 1.67 (sextet, $J = 7.3$ Hz, 2H), 3.54 (t, $J = 7.3$ Hz, 2H), 3.96 (s, 3H), 4.32 (s, 2H), 6.88 (t, $J = 8.6$ Hz, 1H), 7.00 (d, $J = 7.6$ Hz, 1H), 7.45 (t, $J = 8.3$ Hz, 1H); EI-MS m/z (relative intensity) 205 (M^+ , 36.8), 176 (100), 169 (13.1), 121 (33.8); HRMS calcd for $C_{12}H_{15}NO_2$ 205.1103, found 205.1102.

4-Methyl-2-propylisoindolin-1-one (8b): A colorless oil (76%) from **5b**; R_f 0.57 (1:1 AcOEt/hexane); IR (neat) 1687, 1609 cm^{-1} ; 1H NMR δ 0.97 (t, $J = 7.3$ Hz, 3H), 1.71 (sextet, $J = 7.3$ Hz, 2H), 2.49 (s, 3H), 3.62 (t, $J = 7.3$ Hz, 2H), 4.32 (s, 2H), 7.29-7.40 (m, 2H), 7.67 (d, $J = 6.9$, 1H); EI-MS m/z (relative intensity) 189 (M^+ , 35.8), 160 (100), 105 (11.6); HRMS calcd for $C_{12}H_{15}NO$ 189.1154, found 189.1155.

4-Chloro-2-propylisoindolin-1-one (8c): a colorless oil (73%) from **5c**; R_f 0.50 (1:1 AcOEt/hexane); IR (neat) 1697, 1589 cm^{-1} ; 1H NMR δ 0.98 (t, $J = 7.3$ Hz, 3H), 1.72 (sextet, $J = 7.3$ Hz, 2H), 3.61 (t, $J = 7.3$ Hz, 2H), 4.37 (s, 2H), 7.43 (t, $J = 7.3$ Hz, 1H), 7.49 (dd, $J = 1.3, 8.0$ Hz, 1H), 7.75 (dd, $J = 1.3, 7.3$ Hz, 1H); EI-MS m/z (relative intensity): 209 (M^+ , 36.6), 180 (100), 125 (11.7); HRMS calcd for $C_{11}H_{12}ClNO$ 209.0607, found 209.0607.

4-Bromo-2-propylisoindolin-1-one (8d): a colorless oil (50%) from **5d**; R_f 0.43 (1:1 AcOEt/hexane); IR (neat) 1695 cm^{-1} ; $^1\text{H NMR}$ δ 0.98 (t, $J = 7.3\text{ Hz}$, 3H), 1.73 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.61 (t, $J = 7.3\text{ Hz}$, 2H), 4.31 (s, 2H), 7.36 (t, $J = 7.7\text{ Hz}$, 1H), 7.65 (dd, $J = 1.0, 7.9\text{ Hz}$, 1H), 7.80 (d, $J = 6.9\text{ Hz}$, 1H); EI-MS m/z (relative intensity) 255 (M^+ , 34.6), 253 (M^+ , 35.9), 226 (100), 224 (99.4), 171 (11.3), 169 (12.1), 89 (19.5); HRMS calcd for $\text{C}_{11}\text{H}_{12}\text{BrNO}$ 253.0102, found 253.0114.

4-Nitro-2-propylisoindolin-1-one (8f): a colorless oil (69%) from **5f**; R_f 0.45 (1:1 AcOEt/hexane); IR (neat) $1684, 1531, 1341\text{ cm}^{-1}$; $^1\text{H NMR}$ δ 1.00 (t, $J = 7.3\text{ Hz}$, 3H), 1.76 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.65 (t, $J = 7.3\text{ Hz}$, 2H), 4.87 (s, 2H), 7.70 (t, $J = 7.6\text{ Hz}$, 1H), 8.19 (d, $J = 7.6\text{ Hz}$, 1H), 8.40 (d, $J = 2.0\text{ Hz}$, 1H); EI-MS m/z (relative intensity) 220 (M^+ , 38.0), 191 (100), 145 (45.7), 89 (21.8); HRMS calcd for $\text{C}_{11}\text{H}_{12}\text{N}_2\text{O}_3$; 220.0848, found 220.0835.

7-Methoxy-2-propylisoindolin-1-one (9a): A colorless oil (36%) from **6a**; R_f 0.19 (1:1 AcOEt/hexane); IR (neat) $1711, 1613\text{ cm}^{-1}$; $^1\text{H NMR}$ δ 0.95 (t, $J = 7.3\text{ Hz}$, 3H), 1.67 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.54 (t, $J = 7.3\text{ Hz}$, 2H), 3.96 (s, 3H), 4.32 (s, 2H), 6.88 (d, $J = 8.3, 1\text{H}$), 6.98 (d, $J = 7.7, 1\text{H}$), 7.45 (t, $J = 7.7, 1\text{H}$); EI-MS m/z (relative intensity) 205 (M^+ , 51.7), 176 (100), 148 (26.2), 77 (20.4); HRMS calcd for $\text{C}_{12}\text{H}_{15}\text{NO}_2$ 205.1103, found 205.1100.

5-Methoxy-2-propylisoindolin-1-one (10a): A colorless oil (38%) from **6a** (lit.¹³ mp $91\text{--}93\text{ }^\circ\text{C}$); R_f 0.34 (1:1 AcOEt/hexane); IR (neat) $1682, 1617\text{ cm}^{-1}$; $^1\text{H NMR}$ δ 0.96 (t, J

= 7.3 Hz, 3H), 1.68 (sextet, $J = 7.3$ Hz, 2H), 3.55 (t, $J = 7.3$ Hz, 2H), 3.87 (s, 3H), 4.32 (s, 2H), 6.93 (s, 1H), 6.98 (dd, $J = 8.3, 2.0$, 1H), 7.75 (d, $J = 8.3$, 1H); EI-MS m/z (relative intensity) 205 (M^+ , 31.7), 176 (100), 163 (12.1), 121 (26.2); HRMS calcd for $C_{12}H_{15}NO_2$ 205.1103, found 205.1108.

7-Methyl-2-propylisoindolin-1-one (9b): A colorless oil (18%) from **6b**; R_f 0.76 (1:1 AcOEt/hexane); IR (neat) 1680, 1605, 1532 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.67 (sextet, $J = 7.3$ Hz, 2H), 2.73 (s, 3H), 3.55 (t, $J = 7.3$ Hz, 2H), 4.32 (s, 2H), 7.17-7.25 (m, 2H), 7.38 (t, $J = 7.3$ Hz, 1H); EI-MS m/z (relative intensity) 189 (M^+ , 36.8), 160 (100), 105 (12.1); HRMS calcd for $C_{12}H_{15}NO$ 189.1154, found 189.1154.

5-Methyl-2-propylisoindolin-1-one (10b): A colorless oil (59%) from **6b**; R_f 0.54 (1:1 AcOEt/hexane); IR (neat) 1680, 1624 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.69 (sextet, $J = 7.3$ Hz, 2H), 2.74 (s, 3H), 3.57 (t, $J = 7.3$ Hz, 2H), 4.33 (s, 2H), 7.24-7.27 (m, 2H), 7.72 (d, $J = 7.6$, 1H); EI-MS m/z (relative intensity) 189 (M^+ , 34.1), 160 (100), 105 (21.3); HRMS calcd for $C_{12}H_{15}NO$ 189.1154, found 189.1152.

7-Chloro-2-propylisoindolin-1-one (9c): A colorless oil (21%) from **6c**; R_f 0.61 (1:1 AcOEt/hexane); IR (neat) 1689, 1609 cm^{-1} ; 1H NMR δ 0.97 (t, $J = 7.3$ Hz, 3H), 1.70 (sextet, $J = 7.3$ Hz, 2H), 3.58 (t, $J = 7.3$ Hz, 2H), 4.34 (s, 2H), 7.31-7.47 (m, 3H); EI-MS m/z (relative intensity) 209 (M^+ , 42.9), 180 (100), 125 (12.2), 89 (11.5); HRMS calcd for $C_{11}H_{12}ClNO$ 209.0607, found 209.0600.

5-Chloro-2-propylisoindolin-1-one (10c): A colorless oil (31%) from **6c**; R_f 0.60 (1:1 AcOEt/hexane); IR (neat) 1687 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.70 (sextet, $J = 7.3$ Hz, 2H), 3.58 (t, $J = 7.3$ Hz, 2H), 4.36 (s, 2H), 7.42-7.47 (m, 2H), 7.77 (d, $J = 8.6$,

1H); EI-MS m/z (relative intensity) 209 (M^+ , 36.7), 180 (100), 125 (14.9), 89 (9.2); HRMS calcd for $C_{11}H_{12}ClNO$ 209.0607, found 209.0594.

7-Bromo-2-propylisoindolin-1-one (9d): A colorless oil (22%) from **6d**; R_f 0.56 (1:1 AcOEt/hexane); IR (neat) 1697, 1605 cm^{-1} ; 1H NMR δ 0.97 (t, $J = 7.3$ Hz, 3H), 1.69 (sextet, $J = 7.3$ Hz, 2H), 3.58 (t, $J = 7.3$ Hz, 2H), 4.33 (s, 2H), 7.34-7.41 (m, 2H), 7.60 (dd, $J = 1.6, 6.6$ Hz, 1H); EI-MS m/z (relative intensity) 255 (M^+ , 48.6), 253 (M^+ , 49.0), 226 (100), 224 (99.6), 171 (26.4), 169 (28.2), 89 (33.4); HRMS calcd for $C_{11}H_{12}BrNO$ 253.0102, found 253.0112.

5-Bromo-2-propylisoindolin-1-one (10d): A colorless oil (54%) from **6d**; R_f 0.56 (1:1 AcOEt/hexane); IR (neat) 1681, 1610 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.69 (sextet, $J = 7.3$ Hz, 2H), 3.57 (t, $J = 7.3$ Hz, 2H), 4.36 (s, 2H), 7.58-7.61 (m, 2H), 7.69-7.72 (m, 1H); EI-MS m/z (relative intensity) 255 (M^+ , 33.5), 253 (M^+ , 34.1), 226 (100), 224 (99.2), 171 (35.3), 169 (37.0), 89 (33.8); HRMS calcd for $C_{11}H_{12}BrNO$ 253.0102, found 253.0108.

7-Cyano-2-propylisoindolin-1-one (9e): A colorless oil (27%) from **6e**; R_f 0.33 (1:1 AcOEt/hexane); IR (neat) 2234, 1682, 1597 cm^{-1} ; 1H NMR δ 0.98 (t, $J = 7.3$ Hz, 3H), 1.72 (sextet, $J = 7.3$ Hz, 2H), 3.62 (t, $J = 7.3$ Hz, 2H), 4.42 (s, 2H), 7.64-7.76 (m, 2H), 7.78 (d, $J = 1.0$ Hz, 1H); EI-MS m/z (relative intensity) 200 (M^+ , 37.5), 171 (100), 145 (13.6), 116 (21.9); HRMS calcd for $C_{12}H_{12}N_2O$ 200.0950, found 200.0946.

5-Cyano-2-propylisoindolin-1-one (10e): A colorless oil (24%) from **6e**; R_f 0.39 (1:1 AcOEt/hexane); IR (neat) 2226, 1681 cm^{-1} ; 1H NMR δ 0.98 (t, $J = 7.3$ Hz, 3H), 1.72 (sextet, $J = 7.3$ Hz, 2H), 3.62 (t, $J = 7.3$ Hz, 2H), 4.45 (s, 2H), 7.76-7.78 (m, 2H), 7.96

(d, $J = 8.3$ Hz, 1H); EI-MS m/z (relative intensity) 200 (M^+ , 34.1), 171 (100), 144 (8.3), 116 (15.8); HRMS calcd for $C_{12}H_{12}N_2O$ 200.0950, found 200.0944.

5-Nitro-2-propylisoindolin-1-one (10f): A colorless oil (68%) from **6f**; R_f 0.32 (1:1 AcOEt/hexane); IR (neat) 1679, 1535, 1342 cm^{-1} ; 1H NMR δ 0.99 (t, $J = 7.3$ Hz, 3H), 1.74 (sextet, $J = 7.3$ Hz, 2H), 3.64 (t, $J = 7.3$ Hz, 2H), 4.51 (s, 2H), 8.00 (d, $J = 7.9$ Hz, 1H), 8.34-8.38 (m, 2H); EI-MS m/z (relative intensity) 220 (M^+ , 39.1), 191 (100), 145 (49.4), 89 (12.9); HRMS calcd for $C_{11}H_{12}N_2O_3$ 220.0848, found 220.0831.

6-Methoxy-2-propylisoindolin-1-one (11a): A colorless oil (67%) from **7a**; R_f 0.14 (1:1 AcOEt/hexane); IR (neat) 1693, 1624, 1611 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.69 (sextet, $J = 7.3$ Hz, 2H), 3.58 (t, $J = 7.3$ Hz, 2H), 3.86 (s, 3H), 4.31 (s, 2H), 7.08 (dd, $J = 8.0, 2.3$ Hz, 1H), 7.31 (s, 1H), 7.34 (d, $J = 2.0$ Hz, 1H); EI-MS m/z (relative intensity) 205 (M^+ , 39.6), 176 (100), 169 (25.0), 121 (16.4); HRMS calcd for $C_{12}H_{15}NO_2$ 205.1103, found 205.1102.

6-Methyl-2-propylisoindolin-1-one (11b): A colorless oil (72%) from **7b**; R_f 0.44 (1:1 AcOEt/hexane); IR (neat) 1685 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.69 (sextet, $J = 7.3$ Hz, 2H), 2.44 (s, 3H), 3.58 (t, $J = 7.3$ Hz, 2H), 4.34 (s, 2H), 7.33 (d, $J = 1.0$ Hz, 2H), 7.65 (s, 1H); EI-MS m/z (relative intensity) 183 (M^+ , 36.0), 160 (100), 134 (27.9), 120 (20.4), 105 (100); HRMS calcd for $C_{12}H_{15}NO$ 189.1154, found 189.1154.

6-Chloro-2-propylisoindolin-1-one (11c): A colorless oil (71%) from **7c**; R_f 0.66 (1:1 AcOEt/hexane); IR (neat) 1682 cm^{-1} ; 1H NMR δ 0.96 (t, $J = 7.3$ Hz, 3H), 1.70 (sextet, $J = 7.3$ Hz, 2H), 3.58 (t, $J = 7.3$ Hz, 2H), 4.36 (s, 2H), 7.38 (dd, $J = 0.7, 8.0$ Hz, 1H), 7.49 (dd, $J = 2.0, 8.0$ Hz, 1H), 7.82 (d, $J = 1.7$ Hz, 1H); EI-MS m/z (relative intensity) 209

(M^+ , 38.2), 180 (100), 125 (14.3); HRMS calcd for $C_{11}H_{12}ClNO$ 209.0607, found 209.0605.

6-Bromo-2-propylisoindolin-1-one (11d): A colorless oil (68%) from **7d**; R_f 0.58 (1:1 AcOEt/hexane); IR (neat) 1693 cm^{-1} ; $^1\text{H NMR}$ δ 0.96 (t, $J = 7.3\text{ Hz}$, 3H), 1.69 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.58 (t, $J = 7.3\text{ Hz}$, 2H), 4.33 (s, 2H), 7.32 (d, $J = 8.3\text{ Hz}$, 1H), 7.64 (dd, $J = 8.3, 1.7\text{ Hz}$, 1H), 7.97 (d, $J = 1.7\text{ Hz}$, 1H); EI-MS m/z (relative intensity) 255 (M^+ , 35.2), 253 (M^+ , 37.5), 226 (99.8), 224 (100), 171 (19.1), 169 (19.9), 89 (25.0); HRMS calcd for $C_{11}H_{12}BrNO$ 253.0102, found 253.0116.

6-Cyano-2-propylisoindolin-1-one (11e): A colorless oil (74%) from **7e**; R_f 0.35 (1:1 AcOEt/hexane); IR (neat) $2230, 1685, 1628\text{ cm}^{-1}$; $^1\text{H NMR}$ δ 0.98 (t, $J = 7.3\text{ Hz}$, 3H), 1.71 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.61 (t, $J = 7.3\text{ Hz}$, 2H), 4.47 (s, 2H), 7.59 (d, $J = 7.9$, 1H), 7.81 (dd, $J = 1.3, 7.9\text{ Hz}$, 1H), 8.13 (s, 1H); EI-MS m/z (relative intensity) 200 (M^+ , 35.0), 171 (100), 144 (8.5), 116 (16.1); HRMS calcd for $C_{12}H_{12}N_2O$ 200.0950, found 200.0948.

6-Nitro-2-propylisoindolin-1-one (11f): A colorless oil (72%) from **7f**; R_f 0.32 (1:1 AcOEt/hexane); IR (neat) $1677, 1534, 1341\text{ cm}^{-1}$; $^1\text{H NMR}$ δ 0.99 (t, $J = 7.3\text{ Hz}$, 3H), 1.73 (sextet, $J = 7.3\text{ Hz}$, 2H), 3.62 (t, $J = 7.3\text{ Hz}$, 2H), 4.51 (s, 2H), 7.64 (d, $J = 8.3$, 1H), 8.42 (dd, $J = 8.3, 2.0\text{ Hz}$, 1H), 7.49 (d, $J = 2.0\text{ Hz}$, 1H); EI-MS m/z (relative intensity) 220 (M^+ , 39.5), 191 (100), 132 (21.6), 90 (13.3); HRMS calcd for $C_{11}H_{12}N_2O_3$ 220.0848, found 220.0830.

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