Supporting Information

One-Pot Synthesis of Polysubstituted 3-Acylpyrroles Using Cooperative Catalysis

Hai-Lei Cui and Fujie Tanaka*

Chemistry and Chemical Bioengineering Unit, Okinawa Institute of Science and Technology Graduate University, 1919-1 Tancha, Onna, Okinawa 904-0495, Japan

ftanaka@oist.jp

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1. General

TLC was performed using Merck silica gel 60 F254 TLC aluminum sheets. Flash column chromatography was performed using Merck silica gel 60 (230-400 mesh). $^1$H NMR and $^{13}$C NMR spectra were recorded on a Bruker Avance 400. Chemical shifts are reported in ppm from CDCl$_3$ as an internal standard. High-resolution mass spectra were recorded on a Thermo Scientific LTQ Orbitrap mass spectrometer. Melting points were measured on a Yanaco MP J3 melting point apparatus and recorded in °C.

$\alpha,\alpha,\alpha$-Trifluorotoluene was purchased from TCI and stored over molecular sieves 4Å under argon. Solvents used for reactions were purchased as anhydrous or low water content and used as such. All other chemicals were purchased and used without further purification.
2. Synthesis of Propargylated Amines

Propargylated amines were synthesized by reported procedures.\textsuperscript{1-6}

4-Methoxy-N-(prop-2-yn-1-yl)aniline (2a)\textsuperscript{1}

![Structure of 4-Methoxy-N-(prop-2-yn-1-yl)aniline (2a)]

Prepared by the reported procedure\textsuperscript{2} and purified by flash column chromatography (Hexane/EtOAc = 6:1); yellow oil. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \(\delta 6.85-6.81\) (m, 2H), \(6.71-6.67\) (m, 2H), \(3.91\) (d, \(J = 2.4\) Hz, 2H), \(3.77\) (s, 3H), \(3.64\) (brs, 1H), \(2.23\) (t, \(J = 2.4\) Hz, 1H). \textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): \(\delta 153.0, 140.9, 115.1, 114.8, 81.4, 71.2, 55.7, 34.6\).

\(N\)-(Prop-2-yn-1-yl)aniline\textsuperscript{2}

![Structure of \(N\)-(Prop-2-yn-1-yl)aniline]

Prepared by the reported procedure\textsuperscript{2} and purified by flash column chromatography (Hexane/EtOAc = 8:1); yellow oil. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \(\delta 7.26-7.21\) (m, 2H), \(6.83-6.79\) (m, 1H), \(6.72-6.69\) (m, 2H), \(3.96\) (d, \(J = 2.4\) Hz, 2H), \(3.89\) (brs, 1H), \(2.23\) (t, \(J = 2.4\) Hz, 1H). \textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): \(\delta 146.9, 129.3, 118.7, 113.5, 81.0, 71.3, 33.7\).

4-Chloro-N-(prop-2-yn-1-yl)aniline\textsuperscript{3}

![Structure of 4-Chloro-N-(prop-2-yn-1-yl)aniline]

Prepared by the reported procedure\textsuperscript{1} and purified by flash column chromatography (Hexane/EtOAc = 8:1); yellow oil. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): \(\delta 7.19-7.17\) (m, 2H), \(6.64-6.62\) (m, 2H), \(3.93-3.92\) (m, 3H), \(2.23\) (t, \(J = 2.0\) Hz, 1H). \textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): \(\delta 145.4, 129.1, 123.4, 114.7, 80.5, 71.5, 33.7\).
**N-Benzylprop-2-yn-1-amine**

Prepared by the reported procedure and purified by flash column chromatography (Hexane/EtOAc = 6:1); pale yellow oil. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.38-7.26 (m, 5H), 3.90 (s, 2H), 3.45 (d, $J = 2.4$ Hz, 2H), 2.28 (t, $J = 2.4$ Hz, 1H), 1.60 (brs, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 139.4, 128.5, 128.4, 127.2, 82.1, 71.6, 60.4, 37.3.

**N-Benzyl-3-phenylprop-2-yn-1-amine**

Prepared by the reported procedure and purified by flash column chromatography (Hexane/EtOAc = 4:1); pale yellow oil. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.47-7.29 (m, 10H), 3.98 (s, 2H), 3.69 (s, 2H), 1.70 (s, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 139.5, 131.7, 128.5, 128.2, 128.1, 127.2, 123.2, 87.5, 83.8, 52.5, 38.3.

**N-Benzylbut-3-yn-2-amine**

Prepared by the reported procedure and purified by flash column chromatography (Hexane/EtOAc = 4:1); pale yellow oil. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.39-7.25 (m, 5H), 4.04 (d, $J = 12.8$ Hz, 1H), 3.83 (d, $J = 12.8$ Hz, 1H), 3.51 (dq, $J = 6.8$, 2.4 Hz, 1H), 2.34 (d, $J = 2.0$ Hz, 1H), 1.44 (brs, 1H), 1.40 (d, $J = 6.8$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 139.8, 128.43, 128.40, 127.1, 86.3, 70.8, 51.4, 44.3, 22.3.
3. Synthesis of 2,5-Dihydropyrroles

General Procedure for the aza-Michael/Carbocyclization.

A mixture of Cu(OTf)$_2$ (0.01 mmol, 3.6 mg) and PPh$_3$ (0.04 mmol, 10.5 mg) in PhCF$_3$ (0.2 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, enone 1 (0.2 mmol), propargylated amine 2 (0.3 mmol) and pyrrolidine (0.04 mmol, 3.4 µL) were added. The resulting mixture was stirred at the same room temperature under Ar until enone 1 was consumed (monitored by TLC). The reaction mixture was directly purified by flash column chromatography on silica gel (Hexane/EtOAc or Hexane/Acetone) to give 3.

a) Reaction of 1 (0.2 mmol) and 2 (0.3 mmol) was performed using pyrrolidine (0.04 mmol, 20 mol% to 1), PPh$_3$ (0.04 mmol, 20 mol% to 1), and Cu(OTf)$_2$ (0.01 mmol, 5 mol% to 1) in PhCF$_3$ (0.2 mL, concentration of 1: 1 M) at rt (25 °C). b) Reaction in PhCF$_3$ (1.0 mL, concentration of 1: 0.2 M). c) Reaction in MeOH instead of in PhCF$_3$. d) Reaction at 40 °C. e) Reaction at 60 °C. ND = not detected.
Compound 3a

\[
\begin{align*}
\text{Purified by flash column chromatography (Hexane/EtOAc = 7:1); yellow oil.} \\
\text{\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): } &\delta 6.89-6.86 \text{ (m, 2H), } 6.64-6.60 \text{ (m, 2H), } 4.49-4.41 \text{ (m, 1H), } 4.31 \text{ (dd, } J = 15.6 \text{ Hz, 6.0 Hz, 1H), } 4.05 \text{ (dd, } J = 15.6 \text{ Hz, 4.0 Hz, 0.8 Hz, 1H), } 3.78 \text{ (s, 3H), } 2.66-2.53 \text{ (m, 2H), } 2.36-2.27 \text{ (m, 1H), } 2.09 \text{ (s, 3H), } 2.08-2.01 \text{ (m, 1H), } 1.92-1.80 \text{ (m, 1H), } 1.51-1.42 \text{ (m, 1H).} \\
\text{\textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): } &\delta 199.3, 151.7, 144.0, 141.9, 133.5, 115.1, 113.3, 67.3, 62.3, 55.9, 40.8, 31.8, 20.9, 13.3. \\
\text{ESI-HRMS: calcd for C\textsubscript{16}H\textsubscript{20}NO\textsubscript{2} ([M+H\textsuperscript{+}]) 258.1489, found 258.1494.}
\end{align*}
\]

Compound 3b

\[
\begin{align*}
\text{Purified by flash column chromatography (Hexane/EtOAc = 9:1); pale yellow solid; mp 136-138.} \\
\text{\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): } &\delta 7.25-7.18 \text{ (m, 2H), } 6.57-6.53 \text{ (m, 2H), } 4.52-4.40 \text{ (m, 1H), } 4.28 \text{ (dd, } J = 15.6 \text{ Hz, 6.0 Hz, 1H), } 4.06 \text{ (ddq, } J = 15.6 \text{ Hz, 3.6 Hz, 1.2 Hz, 1H), } 2.65-2.54 \text{ (m, 2H), } 2.36-2.27 \text{ (m, 1H), } 2.09-2.02 \text{ (m, 4H), } 1.92-1.82 \text{ (m, 1H), } 1.45 \text{ (dt, } J = 12.8 \text{ Hz, 3.6 Hz, 1H).} \\
\text{\textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): } &\delta 199.2, 145.5, 143.3, 133.5, 129.1, 121.8, 113.4, 67.0, 61.5, 40.7, 31.3, 20.8, 13.2. \\
\text{ESI-HRMS: calcd for C\textsubscript{15}H\textsubscript{17}ClNO ([M+H\textsuperscript{+}]) 262.0993, found 262.0970.}
\end{align*}
\]

Compound 3c

\[
\begin{align*}
\text{Purified by flash column chromatography (Hexane/EtOAc = 3:1 to 2:1); colorless solid; mp 188-190.} \\
\text{\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}): } &\delta 7.72 \text{ (d, } J = 8.0 \text{ Hz, 2H), } 7.34 \text{ (d, } J = 8.0 \text{ Hz, 2H), } 4.31-4.24 \text{ (m, 1H), } 4.13 \text{ (dd, } J = 16.0 \text{ Hz, 5.6 Hz, 1H), } 4.10-3.97 \text{ (m, 1H), } 2.72-2.62 \text{ (m, 1H), } 2.49-2.43 \text{ (m, 1H), } 2.45 \text{ (s, 3H), } 2.29-2.17 \text{ (m, 1H), } 2.07-1.98 \text{ (m, 1H), } 1.90 \text{ (d, } J = 0.8 \text{ Hz, 2H), } 1.79-1.66 \text{ (m, 2H).} \\
\text{\textsuperscript{13}C NMR (100 MHz, CDCl\textsubscript{3}): } &\delta 198.5, 144.0, 142.2, 133.2, 131.9, 129.9,
\end{align*}
\]
127.7, 67.6, 59.3, 40.5, 33.2, 21.5, 20.9, 12.9. ESI-HRMS: calcd for C_{16}H_{20}NO_{3}S ([M+H]⁺) 306.1158, found 306.1165.

**Compound 3d**

![Compound 3d structure](image)

Purified by flash column chromatography (Hexane/EtOAc = 5:1); yellow gum; ¹H NMR (400 MHz, CDCl₃): δ 7.28-7.17 (m, 5H), 3.98 (d, J = 12.8 Hz, 1H), 3.58-3.50 (m, 1H), 3.48-3.43 (m, 2H), 3.17 (ddq, J = 15.6 Hz, 6.0 Hz, 1.6 Hz, 1H), 2.41-2.33 (m, 1H), 2.23-2.13 (m, 1H), 2.06-2.00 (m, 1H), 1.95 (d, J = 0.8 Hz, 3H), 1.93-1.87 (m, 1H), 1.68-1.56 (m, 1H), 1.45-1.35 (m, 1H). ¹³C NMR (100 MHz, CDCl₃): δ 199.1, 148.6, 139.0, 133.1, 128.8, 128.4, 127.2, 70.9, 64.4, 58.3, 40.6, 31.2, 21.2, 14.0. ESI-HRMS: calcd for C_{16}H_{20}NO ([M+H]⁺) 242.1539, found 242.1538.

**Compound 3e**

![Compound 3e structure](image)

Purified by flash column chromatography (Hexane/Acetone = 9:1); pale yellow solid; mp 123-125. ¹H NMR (400 MHz, CDCl₃): δ 6.90-6.86 (m, 2H), 6.63-6.59, (m, 2H), 4.68-4.60 (m, 1H), 4.32 (dd, J = 15.6 Hz, 5.6 Hz, 1H), 4.04 (dd, J = 15.2 Hz, 3.6 Hz, 1H), 3.78 (s, 3H), 2.42-2.33 (m, 2H), 2.22 (d, J = 16.4 Hz, 1H), 2.06 (s, 3H), 1.48 (t, J = 12.0 Hz, 1H), 1.16 (s, 3H), 1.08 (s, 3H). ¹³C NMR (100 MHz, CDCl₃): δ 199.3, 148.6, 139.0, 133.1, 128.8, 128.4, 127.2, 70.9, 64.4, 55.9, 54.9, 44.8, 33.0, 31.9, 27.3, 13.1. ESI-HRMS: calcd for C_{18}H_{24}NO₂ ([M+H]⁺) 286.1804, found 286.1784.

**Compound 3f**

![Compound 3f structure](image)

Purified by flash column chromatography (Hexane/EtOAc = 10:1); pale yellow oil. ¹H NMR (400 MHz, CDCl₃): δ 7.41-7.24, (m, 5H), 4.23 (d, J = 14.0 Hz, 1H), 3.71-3.65 (m, 2H), 3.59 (d, J =
14.0 Hz, 1H), 3.29-3.22 (m, 1H), 2.39-2.35 (m, 2H), 1.97 (s, 3H), 1.74-1.56 (m, 2H), 1.13 (s, 3H), 1.01 (s, 3H). \(^{13}\text{C} \text{NMR (100 MHz, CDCl}_3\):} \(\delta\) 200.1, 147.7, 140.4, 131.5, 129.4, 127.9, 126.8, 80.1, 66.7, 61.9, 37.2, 36.4, 35.7, 28.4, 18.5, 13.4. ESI-HRMS: calcd for C\(_{18}\)H\(_{24}\)NO \([\text{M+H}]^+\) 270.1858, found 270.1853.

**Compound 3g**

![Diagram](image)

Purified by flash column chromatography (Hexane/EtOAc = 8:1); colorless oil. \(^1\text{H} \text{NMR (400 MHz, CDCl}_3\):} \(\delta\) 7.34-7.25 (m, 5H), 4.10 (d, \(J = 13.2 \text{ Hz}, 1\text{H}\), 3.83-3.75 (m, 1H), 3.63 (dd, \(J = 16.4 \text{ Hz}, 4.4 \text{ Hz}, 1\text{H}\), 3.51 (d, \(J = 13.2 \text{ Hz}, 1\text{H}\), 3.28 (ddd, \(J = 16.4 \text{ Hz}, 4.8 \text{ Hz}, 0.8 \text{ Hz}, 1\text{H}\), 2.55-2.42 (m, 2H), 2.14-2.07 (m, 1H), 2.04 (s, 3H), 2.02-1.92 (m, 2H), 1.62-1.43 (m, 3H). \(^{13}\text{C} \text{NMR (100 MHz, CDCl}_3\):} \(\delta\) 200.6, 150.9, 139.2, 136.3, 128.6, 128.4, 127.1, 71.7, 64.6, 58.0, 46.0, 36.5, 28.4, 25.6, 14.4. ESI-HRMS: calcd for C\(_{17}\)H\(_{22}\)NO \([\text{M+H}]^+\) 256.1696, found 256.1698.

**Compound 3h**

![Diagram](image)

Purified by flash column chromatography (Hexane/EtOAc = 1:1); yellow gum. \(^1\text{H} \text{NMR (400 MHz, CDCl}_3\):} \(\delta\) 7.35-7.26, (m, 5H), 3.78 (s, 2H), 3.76-3.73 (m, 2H), 3.60-3.57 (m, 2H), 2.23 (s, 3H), 2.07 (m, 3H). \(^{13}\text{C} \text{NMR (100 MHz, CDCl}_3\):} \(\delta\) 195.9, 150.0, 138.8, 133.6, 128.6, 128.5, 127.2, 66.3, 60.7, 60.0, 30.1, 14.7. ESI-HRMS: calcd for C\(_{16}\)H\(_{18}\)NO \([\text{M+H}]^+\) 216.1383, found 216.1381.

**Compound 3i**

![Diagram](image)

Purified by flash column chromatography (Hexane/EtOAc = 3:1); yellow gum. \(^1\text{H} \text{NMR (400 MHz, CDCl}_3\):} \(\delta\) 7.35-7.24, (m, 5H), 4.58-4.55 (m, 1H), 3.97 (d, \(J = 13.2 \text{ Hz}, 1\text{H}\), 3.91-3.85 (m, 1H), 3.78 (d, \(J = 13.2 \text{ Hz}, 1\text{H}\), 3.69 (s, 3H), 3.54 (ddd, \(J = 16.4 \text{ Hz}, 3.2 \text{ Hz}, 0.8 \text{ Hz}, 1\text{H}\), 2.32 (s, 3H), 2.10 (d, \(J = 0.8 \text{ Hz}, 3\text{H}\). \(^{13}\text{C} \text{NMR (100 MHz, CDCl}_3\):} \(\delta\) 195.1, 172.6, 151.7, 138.2, 134.3, 128.7, 128.4, 127.3, 73.1, 65.9, 57.6, 52.0, 30.0, 14.7. ESI-HRMS: calcd for C\(_{16}\)H\(_{20}\)NO\(_3\) \([\text{M+H}]^+\)
2.74.1438, found 2.74.1437.

**Compound 3j**

![Chemical structure of Compound 3j]

Purified by flash column chromatography (Hexane/Acetone = 1:1); brown solid. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.55 (d, $J = 6.0$ Hz, 2H), 7.30-7.16 (m, 7H), 4.86-4.84 (m, 1H), 3.82 (dd, $J = 16.4$, 4.4, 0.8 Hz, 1H), 2.11 (d, $J = 0.8$ Hz, 3H), 2.06 (s, 3H) ppm; $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 195.9, 151.4, 150.0, 149.7, 138.4, 137.3, 128.5, 128.3, 127.2, 123.8, 74.2, 64.8, 56.8, 30.5, 14.6. ESI-HRMS: calcd for C$_{19}$H$_{21}$N$_2$O ([M+H]$^+$) 293.1648, found 293.1648.

**Compound 3k**

![Chemical structure of Compound 3k]

Purified by flash column chromatography (Hexane/EtOAc = 3:1); 8.7:1 dr; colorless oil. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.42-7.40 (m, 2H), 7.35-7.32 (m, 2H), 7.28-7.24 (m, 1H), 3.95-3.91 (m, 2H), 3.78-3.74 (m, 2H), 2.25 (dd, $J = 16.4$ Hz, 2.0 Hz, 1H), 2.20 (dd, $J = 16.4$ Hz, 2.0 Hz, 1H), 2.00 (d, $J = 6.8$ Hz, 3H), 1.94-1.87 (m, 1H), 1.47 (t, $J = 12.0$ Hz, 1H), 1.05 (s, 3H), 1.02 (d, $J = 6.8$ Hz, 3H), 1.00 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 199.8, 153.0, 139.4, 133.6, 128.4, 128.3, 126.9, 65.6, 64.2, 54.7, 51.4, 43.9, 33.1, 32.0, 26.7, 13.4, 11.7. ESI-HRMS: calcd for C$_{19}$H$_{26}$NO ([M+H]$^+$) 284.2014, found 284.2007.

4. **One-Pot Synthesis of 3-Acylpyrroles**

**General Procedure for the One-Pot aza-Michael/Carbocyclization-Oxidation (Table 2).**

![Chemical reaction scheme]

A mixture of Cu(OTf)$_2$ (3.6 mg, 0.01 mmol) and PPh$_3$ (10.5 mg, 0.04 mmol) in PhCF$_3$ (0.2 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, enone 1 (0.2 mmol),
propargylated amine 2 (0.3 mmol), and pyrrolidine (3.4 µL, 0.04 mmol) were added. The resulting mixture was stirred at the same room temperature or 40 °C as indicated under Ar until enone 1 was consumed (monitored by TLC). To the mixture, MnO₂ (4.0 mmol) and CH₂ClCH₂Cl (DCE) (2 mL) were added. The mixture was stirred at 40 °C until dihydropyrrole 3 was consumed. The mixture was filtered through Celite. The filtrate was concentrated in vacuo and purified by flash column chromatography on silica gel to give product 4. When the dihydropyrrole was synthesized in MeOH, the solvent was removed before addition of MnO₂ and DCE.

**Compound 4a**

![Chemical structure of 4a](image)

Synthesis of dihydropyrrole at rt for 23 h; oxidation in CH₂Cl₂ at rt for 5 h; flash column chromatography (Hexane/EtOAc = 3:1). ¹H NMR (400 MHz, CDCl₃): δ 7.22-7.19 (m, 2H), 6.99-6.96 (m, 2H), 6.50 (m, 1H), 3.86 (s, 3H), 2.69 (t, J = 6.4 Hz, 2H), 2.48 (t, J = 6.4 Hz, 2H), 2.35 (d, J = 0.8 Hz, 3H), 2.08 (pentet, J = 6.4 Hz, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 195.5, 158.9, 143.5, 131.8, 126.2, 121.0, 119.7, 119.5, 114.5, 55.6, 38.5, 24.0, 23.1, 11.5. ESI-HRMS: calcd for C₁₆H₁₈NO₂ ([M+H]⁺) 256.1332, found 256.1313.

Gram-scale synthesis of 4a: A mixture of Cu(OTf)₂ (180.8 mg, 0.5 mmol) and PPh₃ (524.6 mg, 2.0 mmol) in PhCF₃ (10.0 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, cyclohexanone (0.971 mL, 10.0 mmol), propargylated amine 2a (1.93 g, 12.0 mmol), and pyrrolidine (165.4 µL, 2.0 mmol) were added. The resulting mixture was stirred at the room temperature until the enone was consumed (monitored by TLC, 51 h). To the mixture, MnO₂ (2.6 g, 30.0 mmol) and CH₂ClCH₂Cl (DCE) (30.0 mL) was added. The mixture was stirred at 40 °C until dihydropyrrole was consumed (68 h). The mixture was cooled to rt, diluted with EtOAc and filtered through Celite. The filtrate was washed with water (x 2) and brine (x 2), dried over Na₂SO₄, concentrated in vacuo, and purified by flash column chromatography on silica gel (Hexane/EtOAc = 3:1) to give 4a (1.69 g, 66%) as a pink solid. Recrystallization (Hexane/EtOAc = 16 mL/6 mL) gave 4a (1.24 g) as pale pink crystals; mp 106-108.
Compound 4b

Synthesis of dihydropyrrole at rt for 45 h; oxidation at 40 °C for 44 h; flash column chromatography (Hexane/EtOAc = 3:1); pale yellow solid. \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.49-7.46 (m, 2H), 7.40-7.36 (m, 1H), 7.31-7.28 (m, 2H), 6.57 (m, 1H), 2.75 (t, \(J = 6.4\) Hz, 2H), 2.49 (dd, \(J = 6.4\) Hz, 6.0 Hz, 2H), 2.36 (d, \(J = 0.8\) Hz, 3H), 2.09 (dq, \(J = 6.0\) Hz, 6.4 Hz, 2H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 195.6, 143.2, 138.8, 129.4, 127.5, 124.8, 120.7, 120.1, 119.9, 38.6, 24.1, 23.4, 11.5. ESI-HRMS: calcd for C\(_{15}\)H\(_{16}\)NO \([\text{M+H}]^+\) 226.1226, found 226.1230.

Compound 4c

Synthesis of dihydropyrrole at rt for 67 h; oxidation at 40 °C for 31 h; flash column chromatography (Hexane/EtOAc = 2:1); yellow gum. \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.47-7.43 (m, 2H), 7.26-7.22 (m, 2H), 6.53 (q, \(J = 0.8\) Hz, 1H), 2.73 (t, \(J = 6.0\) Hz, 2H), 2.49 (dd, \(J = 7.2\) Hz, 6.0 Hz, 2H), 2.35 (d, \(J = 0.8\) Hz, 3H), 2.10 (dq, \(J = 7.2\) Hz, 6.0 Hz, 2H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 195.6, 143.2, 138.8, 129.4, 127.5, 124.8, 120.7, 120.1, 119.9, 38.6, 24.0, 23.3, 11.5. ESI-HRMS: calcd for C\(_{15}\)H\(_{15}\)NOCl \([\text{M+H}]^+\) 260.0837, found 260.0844.

Compound 4d

Synthesis of dihydropyrrole at rt for 24 h; oxidation at 40 °C for 24 h; flash column chromatography (Hexane/EtOAc = 2:1); pale yellow gum. \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.37-7.28 (m, 3H), 7.06-7.05 (m, 2H), 6.36 (s, 1H), 4.97 (s, 2H), 2.64 (t, \(J = 6.0\) Hz, 2H), 2.43 (dd, \(J = 6.4\) Hz, 6.0 Hz, 2H), 2.31 (d, \(J = 1.2\) Hz, 3H), 2.10 (dq, \(J = 6.0\) Hz, 6.4 Hz, 2H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 195.1, 143.4, 136.8, 128.9, 127.9, 126.6, 120.4, 119.4, 119.3, 50.2,
38.4, 23.7, 22.0, 11.6. ESI-HRMS: calcd for C_{16}H_{18}NO ([M+H]^+) 240.1383, found 240.1382.

**Compound 4e**

![Compound 4e](image)

Synthesis of dihydropyrrole at 40 °C for 22 h; oxidation at 40°C for 66 h; flash column chromatography (Hexane/EtOAc = 1:1); colorless solid; mp 124-126. 1H NMR (400 MHz, CDCl3): δ 6.28 (s, 1H), 3.48 (s, 3H), 2.69 (t, J = 6.0 Hz, 2H), 2.42 (dd, J = 6.8 Hz, 6.2 Hz, 2H), 2.28 (d, J = 0.8 Hz, 3H), 2.12 (dq, J = 6.8 Hz, 6.2 Hz, 2H). 13C NMR (100 MHz, CDCl3): δ = 194.9, 143.5, 120.8, 118.96, 118.93, 38.3, 33.1, 23.6, 21.7, 11.4. ESI-HRMS: calcd for C_{10}H_{14}NO ([M+H]^+) 164.1070, found 164.1070.

**Compound 4f**

![Compound 4f](image)

Synthesis of dihydropyrrole at rt for 24 h; oxidation in CH2Cl2 at rt for 25 h; flash column chromatography (Hexane/EtOAc = 4:1). 1H NMR (400 MHz, CDCl3): δ 7.20-7.18 (m, 2H), 6.99-6.49 (m, 2H), 6.49 (m, 1H), 3.86 (s, 3H), 2.55 (s, 2H), 2.34 (s, 2H), 2.34 (s, 3H), 1.06 (s, 6H). 13C NMR (100 MHz, CDCl3): δ 194.8, 158.9, 142.4, 131.8, 126.3, 121.3, 119.3, 118.6, 114.5, 55.6, 52.6, 37.0, 35.5, 28.5, 11.4. ESI-HRMS: calcd for C_{18}H_{22}NO2 ([M+H]^+) 284.1645, found 284.1646.

Gram-scale synthesis of 4f: A mixture of Cu(OTf)2 (180.8 mg, 0.5 mmol) and PPh3 (524.6 mg, 2.0 mmol) in PhCF3 (10.0 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, 3,3-dimethylcyclohexenone (1.24 g, 10.0 mmol), propargylated amine 2a (1.93 g, 12.0 mmol), and pyrrolidine (165.4 µL, 2.0 mmol) were added. The resulting mixture was stirred at the room temperature until the enone was consumed (monitored by TLC, 54 h). To the mixture, MnO2 (2.6 g, 30.0 mmol) and CH2ClCH2Cl (DCE) (30.0 mL) was added. The mixture was stirred at 40 °C until dihydropyrrole was consumed (50 h). The mixture was cooled to rt, diluted with EtOAc, and filtered through Celite. The filtrate was washed with water (x 2) and brine (x 2), dried over Na2SO4, concentrated in vacuo, and purified by flash column chromatography on silica gel (Hexane/EtOAc = 4:1) to give 4f (2.30 g, 80%) as an orange solid. Recrystallization (Hexane/EtOAc = 20 mL/5 mL) gave 4f (1.46 g) as pale yellow crystals; mp: 160-162.
Compound 4g

Synthesis of dihydropyrrole at rt for 20 h; oxidation at 40°C for 43 h; flash column chromatography (Hexane/EtOAc = 4:1). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.37-7.26 (m, 3H), 7.05-7.04 (m, 2H), 6.22 (m, 1H), 5.19 (s, 2H), 2.50 (t, \(J = 6.4\) Hz, 2H), 2.28 (d, \(J = 0.8\) Hz, 3H), 1.95 (t, \(J = 6.4\) Hz, 2H), 1.32 (s, 6H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 195.4, 148.9, 137.5, 128.8, 127.7, 126.4, 122.3, 119.2, 118.4, 51.5, 41.2, 35.6, 32.6, 27.4, 11.7. ESI-HRMS: calcd for C\(_{18}\)H\(_{22}\)NO ([M+H\(^+\)]) 268.1701, found 268.1695.

Gram-scale synthesis of 4g: A mixture of Cu(OTf)\(_2\) (180.8 mg, 0.5 mmol) and PPh\(_3\) (524.6 mg, 2.0 mmol) in PhCF\(_3\) (10.0 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, 4,4-dimethylcyclohexenone (1.3 mL, 10.0 mmol), N-benzylprop-2-yn-1-amine (1.74 g, 12.0 mmol), and pyrrolidine (165.4 µL, 2.0 mmol) were added. The resulting mixture was stirred at the room temperature until the enone was consumed (monitored by TLC, 69 h). To the mixture, MnO\(_2\) (4.3 g, 50.0 mmol) and CH\(_2\)ClCH\(_2\)Cl (DCE) (30.0 mL) was added. The mixture was stirred at 40 °C. After 72 h, another portion of MnO\(_2\) (4.3 g, 50.0 mmol) was added. The mixture was stirred at 60 °C for 24 h, then cooled to rt, diluted with EtOAc, and filtered through Celite. The filtrate was washed with water (x 2) and brine (x 2), dried over Na\(_2\)SO\(_4\), concentrated in vacuo, and purified by flash column chromatography on silica gel (Hexane/EtOAc = 4:1) to give 4g (1.64 g, 61%) as a yellow solid. Recrystallization (Hexane/EtOAc/Toluene = 5 mL/1 mL/1 mL) gave 4g (1.04 g) as pale yellow crystals; mp: 79-81.

Compound 4h

Synthesis of dihydropyrrole in MeOH at rt for 55 h; oxidation at 40 °C for 24 h; flash column chromatography (Hexane/EtOAc = 4:1); pale yellow oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.36-7.28 (m, 3H), 7.01-7.00 (m, 2H), 6.39 (q, \(J = 0.8\) Hz, 1H), 5.02 (s, 2H), 2.74 (t, \(J = 6.0\) Hz, 2H), 2.69-2.66 (m, 2H), 2.28 (d, \(J = 0.8\) Hz, 3H), 1.85-1.75 (m, 4H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 198.8, 139.9, 137.3, 128.9, 127.7, 126.2, 122.6, 121.0, 120.6, 50.5, 43.1, 25.1, 24.8, 22.1, 12.4. ESI-HRMS: calcd for C\(_{17}\)H\(_{20}\)NO ([M+H\(^+\)]) 254.1539, found 254.1539.
**Compound 4i**

Synthesis of dihydropyrrole at rt for 47 h; oxidation at 40 °C for 7 h; flash column chromatography (Hexane/EtOAc = 4:1); pale yellow gum. $^1$H NMR (400 MHz, CDCl$_3$): δ 7.39-7.33 (m, 3H), 7.24 (d, $J = 2.0$ Hz, 1H), 7.17-7.15 (m, 2H), 6.43 (m, 1H), 5.00 (s, 2H), 2.36 (s, 3H), 2.29 (d, $J = 0.4$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ = 194.0, 136.7, 128.9, 128.1, 127.7, 127.2, 124.2, 121.7, 121.6, 53.7, 27.8, 12.3 ppm; ESI-HRMS: calcd for C$_{14}$H$_{16}$NO ([M+H]$^+$) 214.1226, found 214.1229.

**Compound 4j**

Synthesis of dihydropyrrole at rt for 48 h; oxidation at 40 °C for 30 h; flash column chromatography (Hexane/EtOAc = 4:1); pale yellow oil. $^1$H NMR (400 MHz, CDCl$_3$): δ 7.35-7.27 (m, 3H), 7.13-7.11 (m, 2H), 6.61 (d, $J = 0.8$ Hz, 1H), 5.41 (s, 2H), 3.77 (s, 3H), 2.44 (s, 3H), 2.25 (d, $J = 0.8$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 200.8, 161.0, 137.4, 132.4, 128.7, 127.7, 127.0, 126.6, 120.2, 118.4, 52.0, 51.5, 31.9, 10.4. ESI-HRMS: calcd for C$_{16}$H$_{18}$NO$_3$ ([M+H]$^+$) 272.1281, found 272.1292.

**Compound 4k**

Synthesis of dihydropyrrole at 40 °C for 22 h; oxidation at 40 °C for 66 h; flash column chromatography (Hexane/EtOAc = 3:1); yellow oil. $^1$H NMR (400 MHz, CDCl$_3$): δ 6.26 (q, $J = 0.8$ Hz, 1H), 3.49 (s, 3H), 2.88-2.84 (m, 2H), 2.42 (s, 3H), 2.25 (d, $J = 0.8$ Hz, 3H), 1.60-1.54 (m, 2H), 0.99 (t, $J = 7.2$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 195.2, 140.9, 120.9, 120.6, 118.8, 33.1, 31.0, 27.8, 22.6, 14.2, 13.8. ESI-HRMS: calcd for C$_{11}$H$_{18}$NO ([M+H]$^+$) 180.1383, found 180.1385.
**Compound 4l**

![Image of Compound 4l](image)

Synthesis of dihydropyrrole in MeOH at 40 °C for 52 h; oxidation at 40 °C for 42 h; flash column chromatography (Hexane/EtOAc = 5:1); colorless solid. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 6.28 (brq, $J = 0.8$ Hz, 1H), 3.47 (s, 3H), 2.74 (q, $J = 7.2$ Hz, 2H), 2.48 (s, 3H), 2.26 (d, $J = 0.8$ Hz, 3H), 1.17 (t, $J = 7.2$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 198.6, 136.0, 121.1, 120.4, 118.5, 35.5, 33.3, 13.8, 12.2, 8.4. ESI-HRMS: calcd for C$_{10}$H$_{16}$NO ([M+H]$^+$) 166.1226, found 166.1227.

**Compound 4m**

Synthesis of dihydropyrrole at 40 °C for 20 h; oxidation at 40 °C for 46 h; flash column chromatography (Hexane/EtOAc = 8:1); colorless solid. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.49-7.46 (m, 3H), 7.35-7.32 (m, 2H), 6.45 (brq, $J = 0.8$ Hz, 1H), 3.32 (s, 3H), 2.32 (d, $J = 0.8$ Hz, 3H), 1.86 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 195.7, 138.7, 133.1, 130.7, 128.8, 128.6, 122.9, 121.3, 121.0, 34.3, 30.3, 12.7. ESI-HRMS: calcd for C$_{14}$H$_{16}$NO ([M+H]$^+$) 214.1232, found 214.1236.

**Compound 4n**

Synthesis of dihydropyrrole at rt for 49 h; oxidation at 40 °C for 25 h; flash column chromatography (Hexane/Acetone = 1:1); pale yellow solid; mp 106-108. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.64 (m, 2H), 7.29-7.26 (m, 3H), 7.17 (m, 2H), 6.90-6.88 (m, 2H), 6.56 (m, 1H), 4.81 (s, 2H), 2.32 (d, $J = 0.4$ Hz, 3H), 2.01 (s, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 195.2, 149.9, 141.2, 136.9, 135.1, 128.8, 127.9, 126.5, 125.5, 123.9, 122.0, 121.4, 50.8, 30.7, 12.6. ESI-HRMS: calcd for C$_{19}$H$_{18}$N$_2$O ([M+H]$^+$) 291.1492, found 291.1496.
**Compound 4o**

\[
\text{\includegraphics{compound_4o.png}}
\]

Synthesis of dihydropyrrrole at rt for 24 h; oxidation at 50 °C for 38 h; flash column chromatography (Hexane/EtOAc = 2:1); colorless solid. \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.34-7.25 (m, 3H), 6.92-6.90 (m, 2H), 5.01 (s, 2H), 2.50 (s, 2H), 2.32 (s, 2H), 2.28 (s, 3H), 1.73 (s, 3H), 1.07 (s, 6H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 194.3, 141.6, 137.1, 128.9, 127.5, 126.4, 125.6, 117.4, 114.4, 52.7, 47.0, 36.1, 35.1, 10.4, 9.1. ESI-HRMS: calcd for C\(_{19}\)H\(_{24}\)NO ([M+H]\(^+\)) 282.1858, found 282.1853.

5. **Synthesis of 2,5-Dihydrofuran and 3-Acylfuran**

**Synthesis of 5 (Scheme 1)**

\[
\text{\includegraphics{synthesis_5.png}}
\]

A mixture of Cu(OTf)\(_2\) (3.6 mg, 0.01 mmol) and PPh\(_3\) (10.5 mg, 0.04 mmol) in PhCF\(_3\) (0.2 mL) was stirred at room temperature (25 °C) for 5 min under Ar. To the mixture, enone 1a (19.4 µL, 0.2 mmol), propargyl alcohol (23.6 µL, 0.4 mmol), and pyrrolidine (3.4 µL, 0.04 mmol) were added. The resulting mixture was stirred at the same room temperature under Ar for 24 h until 1a was consumed (monitored by TLC). The mixture was directly purified by flash column chromatography on silica gel (Hexane/EtOAc = 4:1) to give 5 as a colorless solid (26.0 mg, 85%). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 4.91-4.84 (m, 1H), 4.67-4.61 (m, 1H), 4.57-4.50 (m, 1H), 2.51-2.45 (m, 1H), 2.32-2.20 (m, 2H), 2.03 (m, 3H), 2.03-1.98 (m, 1H), 1.77-1.65 (m, 1H), 1.63-1.53 (m, 1H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 198.7, 146.1, 132.8, 86.0, 78.1, 40.5, 32.2, 19.7, 11.6. ESI-HRMS: calcd for C\(_9\)H\(_{13}\)O\(_2\) ([M+H]\(^+\)) 153.0910, found 153.0911.

**Synthesis of 6 (Scheme 1)**

\[
\text{\includegraphics{synthesis_6.png}}
\]
To a mixture of 5 (60.8 mg, 0.4 mmol) in dioxane (2.0 mL, anhydrous) was added a solution of DDQ (136.2 mg, 0.6 mmol) in dioxane. The mixture was stirred at 40 °C for 46 h under Ar. The mixture was diluted with CH₂Cl₂, washed with 1 M NaOH, water and brine. The organic layer was dried over Na₂SO₄, filtered, concentrated, and purified by flash column chromatography on silica gel (Hexane/EtOAc = 4:1) to give 6 as a colorless solid (27.3 mg, 46%). ¹H NMR (400 MHz, CDCl₃): δ 7.07 (m, 1H), 2.84 (t, J = 6.4 Hz, 2H), 2.49-2.46 (m, 2H), 2.20 (d, J = 1.6 Hz, 3H), 2.19-2.12 (m, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 195.7, 167.4, 138.9, 120.4, 119.1, 38.3, 23.6, 22.7, 9.1. ESI-HRMS: calcd for C₉H₁₁O₂ ([M+H]+) 151.0759, found 151.0752.

6. Transformations of 3-Acylpyrroles

According to the reported indole C-H functionalization procedure, ⁸ 3-acylpyrroles 4d and 4h were transformed to 7 and 8, respectively.

Synthesis of 7 (Scheme 2)

A mixture of 3-acylpyrrole 4d (20.0 mg, 0.084 mmol, 1 equiv), methyl acrylate (22.8 μL, 0.25 mmol, 3 equiv to 4d), Cu(OAc)₂ (30.5 mg, 0.17 mmol, 2 equiv), and Pd(OAc)₂ (1.9 mg, 0.008 mmol, 0.1 equiv) in DMF/DMSO (9:1, concentration of 4d: 0.4 M) was stirred at 40 °C for 42 h. The mixture was cooled to rt, diluted with AcOEt, added to water, and extracted with EtOAc. Organic layers were combined, washed with brine, dried over Na₂SO₄, filtered, concentrated, and purified by flash column chromatography on silica gel (Acetone/Hexane = 1/2) to gave 7 as a pale yellow solid (21.1 mg, 78%); mp: 114-116. ¹H NMR (400 MHz, CDCl₃): δ 7.59 (d, J = 16.0 Hz, 1H), 7.37-7.29 (m, 3H), 6.97-6.96 (m, 2H), 6.03 (d, J = 16.0 Hz, 1H), 5.20 (s, 2H), 3.73 (s, 3H), 2.70 (t, J = 6.4 Hz, 2H), 2.57 (s, 3H), 2.49 (t, J = 6.4 Hz, 2H), 2.11 (pentet, J = 6.4 Hz, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 194.1, 166.9, 145.4, 134.9, 130.6, 128.1, 126.9, 125.8, 124.1, 116.9, 113.8, 50.5, 46.7, 37.8, 22.0, 21.3, 11.2. ESI-HRMS: calcd for C₂₀H₂₂NO₃ ([M+H]+) 324.1594, found 324.1594.
Synthesis of 8 (Scheme 2)

Compound 8 was synthesized from 4h (19.0 mg, 0.075 mmol) by the procedure used for the synthesis of 7 from 4d but at 60 °C for 19 h. Purification by flash column chromatography on silica gel (EtOAc/Hexane = 1/2) gave 8 as a pale green solid (23.2 mg, 81%). 1H NMR (400 MHz, CDCl3): δ 7.56-7.54 (m, 2H), 7.39-7.31 (m, 5H), 7.01-6.99 (m, 2H), 6.95 (d, J = 16.0 Hz, 1H), 6.62 (d, J = 16.0 Hz, 1H), 5.23 (s, 2H), 2.82-2.79 (m, 2H), 2.73-2.70 (m, 2H), 2.50 (s, 3H), 1.91-1.98 (m, 4H). 13C NMR (100 MHz, CDCl3): δ 199.1, 142.2, 141.8, 136.9, 132.4, 129.2, 128.2, 127.8, 127.6, 126.3, 125.5, 123.4, 122.1, 120.3, 119.1, 110.0, 47.7, 43.1, 25.0, 24.8, 21.9, 12.6. ESI-HRMS: calcd for C26H25N2O ([M+H]+) 381.1961, found 381.1958.

7. References

Current Data Parameters
NRME 01082013-Cui
EXPNO 12
PROCNO 1

F2 - Acquisition Parameters
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SOLVENT CDCl3
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DS 2
SWN 8250.825 Hz
FIDRES 0.125898 Hz
AQ 3.9715922 sec
RG 161.3
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DE 6.00 usec
TE 297.4 K
D1 1.00000000 sec
DECOST 0.00000000 sec
DCHIR 0.01500000 sec

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F2 - Processing parameters
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LB 0.30 Hz
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PC 1.00
Current Data Parameters
NAME 12072013-Cui
EXPNO 11
PROCNO 1

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FUPRGM zgpp350
TD 65536
SOLVENT CDCl3
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DS 2
SW 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.363196 sec
RS 2996.3
DM 20.800 usec
DR 6.60 usec
TE 298.5 K
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d10 0.00000000 sec
DELTA 1.89999999 sec
MCREST 0.00000000 sec
MCRESTK 0.01000000 sec

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F1 10.00 usec
F11 -2.00 dB
SF01 100.6479773 MHz

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HUC2 1H
PCFRO2 8.00 usec
F3 15.70 dB
F312 2.10 dB
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SF02 400.2316009 MHz

F2 - Processing parameters
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LB 0.10 Hz
GB 0
PC 1.40
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PROCNO  1

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Time  15.16
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PULPROG  zg30
TD  65536
SOLVENT  CDCl3
NS  16
DS  2
SWH  8250.825 Hz
FIDRES  0.123898 Hz
AQ  3.9715922 sec
RG  181
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Current Data Parameters
NAME  29072013-Cui
EXPNO  21
PROCNO  1

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d1  0.00000000 sec
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DMRES  0.00000000 sec
DMERK  0.01500000 sec

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P11  -2.00 dB
SP01  100.6479773 MHz

---------- CHANNEL f2 ----------
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HUC2  1H
PCFD02  80.00 usec
PL2  2.70 dB
PL12  17.10 dB
PL13  17.10 dB
SP02  400.2316009 MHz

F2 - Processing parameters
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WUW  0
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Current Data Parameters

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EXPNO  23
PROCNO 1

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SOLVENT CDCl3
RS      3024
DS      4
SNW     24028.461 Hz
FIDRES  0.366798 Hz
AQ      1.3632196 sec
NS      7296.2
DW      20.800 usec
DR      6.00 usec
TB      298.1 K
D1      2.0000000 sec
d11    0.00000000 sec
DELTA   1.00000000 sec
DCREST  0.00000000 sec
DCRERR  0.00000000 sec

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Sp01   100.6479773 MHz

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PCFD2   80.00 usec
FL2     2.70 dB
FL12   17.10 dB
FL13   17.10 dB
Sp02   400.2316009 MHz

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SMMEM  H M
Fsz     0
LF      1.00 Hz
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Current Data Parameters
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EXPNO  10
PROCNO  1

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FIDRES  0.125898 Hz
AQ  3.9715922 sec
RG  203.2
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DE  6.00 usec
TE  297.2 K
P1  1.0000000 sec
DECRES  0.0000000 sec
MSPMR  0.0150000 sec

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F2 - Processing parameters
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MDW  EM
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LB  0.30 Hz
GB  0
PC  1.00
Current Data Parameters
NRMB 14082013-Cui
EXPNO 10
PROCNO 1

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PULLPROG zg30
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SOLVENT CDCl3
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DS 2
SWH 8250.825 Hz
FIDRES 0.125898 Hz
AQ 3.9715922 sec
RG 322.5
DM 60.600 usec
DE 6.00 usec
TE 297.4 K
DP 1.00000000 sec
HOFR 0.00000000 sec
DMCR 0.01500000 sec

--------- CHANNEL F1 ---------
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PL1 2.70 dB
SF01 400.2324716 MHz

F2 - Processing parameters
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LS 0.30 Hz
GB 0
PC 1.00
Current Data Parameters
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EXFO   21
PROCMD  1

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NS   1024
DS   4
SNR  24038.46 Hz
FIDRES  0.366798 Hz
AQ  1.3632196 sec
NS   5160.6
DM  20.800 usec
DR   6.00 usec
TB   298.1 K
D1   2.00000000 sec
d11  0.00000000 sec
DELTAB  1.00000000 sec
MCRES  0.00000000 sec
MCWB  0.00000000 sec

--- CHANNEL f1 ---
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PL1  -2.00 db
ZF01  100.6479773 MHz

--- CHANNEL f2 ---
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HUC2  1H
PCFD2  80.00 usec
PL2   2.70 db
PL12  17.10 db
PL13  17.10 db
ZF02  400.2316009 MHz

F2 - Processing parameters
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SF  100.6479140 MHz
WDB  1M
ZMS   0
LB   1.00 Hz
GB   0
PC   1.40
Current Data Parameters
NRME 19072013-Cui
EXPNO 40
PROCNO 1

F2 - Acquisition Parameters
Date_ 20130719
Time 18.17
INSTRM avance400
PROBND 5 mm QNP 18/13
FULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 8250.825 Hz
FIDRES 0.125898 Hz
AQ 3.9715922 sec
DG 143.7
DM 60.600 usec
DE 6.00 usec
TE 297.0 sec
D1 1.00000000 sec
MCREST 0.00000000 sec
MXMP 0.01500000 sec

------- CHANNEL F1 -------
HOC1 1H
F1 15.00 usec
FL1 2.70 db
SF01 400.2324716 MHz

F2 - Processing parameters
SI 32768
SF 400.2300015 MHz
MDW BM
SSB 0
LS 0.30 Hz
GE 0
PC 1.00
**Current Data Parameters**

**NAME**: 23082013-Cui

**EXPRO**: 11

**PROCNO**: 1

**F2 - Acquisition Parameters**

**Data**: 20130823

**Time**: 13:38

**INSTRUM**: avance400

**POBD**: 5 mm QNP 1H/13C

**F2FROG**: zgpa30

**TD**: 65536

**SOLVENT**: CDCl3

**DS**: 1024

**DS**: 4

**SW**: 240.39.461 Hz

**FIDRES**: 0.366798 Hz

**AQ**: 1.3632196 sec

**BG**: 4562

**DM**: 20.800 usec

**DR**: 6.00 usec

**TB**: 298.4 K

**D1**: 2.00000000 sec

**d1**: 0.00000000 sec

**DELT1**: 1.00000000 sec

**DECR1**: 0.00000000 sec

**DECR2**: 0.00000000 sec

------- CHANNEL f1 -------

**HzC**: 15.0g

**HzC**: 10.00 usec

**PL1**: -2.00 dB

**SF1**: 100.6717773 MHz

------- CHANNEL f2 -------

**CPD**: waltz16

**HzC**: 1.0H

**PCFD2**: 80.00 usec

**PL2**: 2.70 dB

**PL12**: 17.10 dB

**PL13**: 17.10 dB

**SF2**: 400.234009 MHz

**F2 - Processing parameters**

**SI**: 32768

**SF**: 100.6717940 MHz

**NR**: 16

**NB**: 0

**LB**: 1.00 Hz

**GB**: 0

**PC**: 1.40