Unexpected Synthesis of N-Acyl Indolines via A Consecutive Cyclization of iminophosphorane

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General Methods:
Reactions were generally carried out in an appropriate round bottom flask with magnetic stirring. Thin layer chromatography (TLC) was performed on a silica gel. All melting points were taken on a Digital Melting Point without correction. $^1$H, and $^{13}$C spectra were recorded on a 400 MHz or 600 MHz spectrometer. Chemical shifts for $^1$H NMR spectra are reported in ppm downfield from TMS, chemical shifts for $^{13}$C NMR spectra are reported in ppm relative to internal chloroform ($\delta$ 77.0 ppm for $^{13}$C), and chemical shifts. The terms m, s, d, t, q refer to multiplet, singlet, doublet, triplet, quartlet; br refers to a broad signal.

General Procedure for the Synthesis of Iminophosphorane 2:
To a stirred solution of 2-(2-azidophenyl)ethanol (0.33 g, 2.0 mmol) and Et$_3$N (0.60 g, 6.0 mmol) in CH$_2$Cl$_2$ (15 mL) was added a solution of acyl chloride (2.0 mmol) in CH$_2$Cl$_2$ (10 mL) at r.t. The reaction mixture was stirred for 30 min. It was then pour into water to remove the Et$_3$NHCl, and extracted with CH$_2$Cl$_2$ three times. The organic phase was combined and dried with anhydrous Na$_2$SO$_4$. The crude product was purified by flash chromatography (15:1, PE–Et$_2$O) to yield azide 1. To a stirred solution of azide 1 (2 mmol) in CH$_2$Cl$_2$ (15 mL) was added a solution of Ph$_3$P (0.52 g, 2 mmol) in dry CH$_2$Cl$_2$ (10 mL). After the reaction mixture was stirred for 1 h, the solvent was removed under reduced pressure, and the residue was recrystallized from Et$_2$O and CH$_2$Cl$_2$ (2:1; v/v) to give the iminophosphorane 2.

2-(Triphenylphosphoranylideneamino)phenethyl benzoate (2a):
yield 93%, white solid, mp: 140-141 °C. $^1$H NMR (600 MHz, CDCl$_3$): $\delta$ = 8.07 (d, 2H, $J$ = 7.8 Hz, Ar-H), 7.78-6.46 (m, 22H, Ar-H), 4.68 (t, 2H, $J$ = 6.6 Hz, OCH$_2$), 3.39 (t, 2H, $J$ = 6.6 Hz, CH$_2$). MS: $m/z$ (%) = 501 (8) [M$^+$], 396 (38), 380 (29), 262 (42), 183 (100), 108 (36), 105 (45), 77 (48). Anal. Calcd for C$_{33}$H$_{28}$NO$_2$P: C, 79.02; H, 5.63; N, 2.79. Found: C, 79.24; H, 5.74; N, 2.61.

2-(Triphenylphosphoranylideneamino)phenethyl 4-methylbenzoate (2b):
yield 81%, white solid, mp: 118-119 °C. $^1$H NMR (600 MHz, CDCl$_3$): $\delta$ = 7.96-6.47 (m, 23H, Ar-H), 4.66 (m, 2H, OCH$_2$), 3.38 (m, 2H, CH$_2$), 2.41 (s, 3H, CH$_3$). MS: $m/z$ (%) = 515 (8) [M$^+$], 396 (44), 380 (37), 262 (59), 183 (100), 119 (50), 108 (40), 91 (60). Anal. Calcd for C$_{34}$H$_{30}$NO$_2$P: C, 79.20; H, 5.86; N, 2.72. Found: C, 79.02; H, 5.68; N, 2.78.

2-(Triphenylphosphoranylideneamino)phenethyl 4-chlorobenzoate (2c):
yield 85%, yellow solid, mp: 127-128 °C. $^1$H NMR (600 MHz, CDCl$_3$): $\delta$ = 7.98 (d, 2H, $J$ = 7.8 Hz, Ar-H), 7.77-6.46 (m, 21H, Ar-H), 4.67 (t, 2H, $J$ = 6.6 Hz, OCH$_2$), 3.37 (t, 2H, $J$ = 6.6 Hz, CH$_2$). MS: $m/z$ (%) = 535 (5) [M$^+$], 396 (36), 380 (32), 262 (44), 184 (17), 183 (100). Anal. Calcd for C$_{33}$H$_{27}$ClNO$_2$P: C, 73.95; H, 5.08; N, 2.61. Found: C, 73.84; H, 5.29; N, 2.35.
2-(Triphenylphosphoranylideneamino)phenethyl 2-chlorobenzoate (2d):
yield 83%, white solid, mp: 121-122 °C. ¹H NMR (600 MHz, CDCl₃): δ =
7.81-6.46 (m, 23H, Ar-H), 4.70 (t, 2H, J = 6.6 Hz, OCH₂), 3.39 (t, 2H, J = 6.6
Hz, CH₂). MS: m/z (%) = 535 (4) [M⁺], 396 (38), 380 (28), 262 (36), 184 (16),
183 (100). Anal. Calcd for C₃₃H₂₇ClNO₂P: C, 73.95; H, 5.08; N, 2.61. Found:
C, 73.67; H, 5.26; N, 2.52.

2-(Triphenylphosphoranylideneamino)phenethyl 3-chlorobenzoate (2e):
yield 87%, white solid, mp: 125-126 °C. ¹H NMR (600 MHz, CDCl₃):
δ = 8.04 (s, 1H, Ar-H), 7.93 (d, 1H, J = 7.8 Hz, Ar-H), 7.77-6.47 (m, 21H,
Ar-H), 4.68 (t, 2H, J = 7.2 Hz, OCH₂), 3.38 (t, 2H, J = 7.2 Hz, CH₂). MS:
m/z (%) = 535 (8) [M⁺], 396 (27), 380 (27), 277 (30), 262 (42), 184 (19),
183 (100). Anal. Calcd for C₃₃H₂₇ClNO₂P: C, 73.95; H, 5.08; N, 2.61. Found:
C, 74.17; H, 5.22; N, 2.35.

2-(Triphenylphosphoranylideneamino)phenethyl 4-nitrobenzoate (2f):
yield 85%, orange solid, mp: 146-147 °C. ¹H NMR (600 MHz, CDCl₃):
δ = 8.23 (d, 2H, J = 9.0 Hz, Ar-H), 8.18 (d, 2H, J = 9.0 Hz, Ar-H),
7.76-6.47 (m, 19H, J = 7.8 Hz, Ar-H), 4.74 (t, 2H, J = 6.6 Hz, OCH₂),
3.40 (t, 2H, J = 6.6 Hz, CH₂). MS: m/z (%) = 546 (13) [M⁺], 277 (26),
183 (25), 119 (58), 118 (100), 117 (30). Anal. Calcd for C₃₃H₂₇N₂O₄P:
C, 72.52; H, 4.98; N, 5.13. Found: C, 72.23; H, 4.74; N, 5.38.

2-(Triphenylphosphoranylideneamino)phenethyl 4-fluorobenzoate (2g):
yield 91%, white solid, mp: 150-151 °C. ¹H NMR (600 MHz, CDCl₃):
δ = 8.07 (t, 2H, J = 7.2 Hz, Ar-H), 7.77-6.46 (m, 21H, Ar-H), 4.67 (t, 2H,
J = 6.6 Hz, OCH₂), 3.37 (t, 2H, J = 6.6 Hz, CH₂). MS: m/z (%) = 519 (8)
[M⁺], 396 (36), 380 (34), 262 (48), 184 (18), 183 (100). Anal. Calcd for C₃₃H₂₇FNO₂P:
C, 76.29; H, 5.24; N, 2.70. Found: C, 76.46; H, 5.05; N,
2.85.

2-(Triphenylphosphoranylideneamino)phenethyl 2-fluorobenzoate (2h):
yield 90%, white solid, mp: 131-132 °C. ¹H NMR (600 MHz, CDCl₃):
δ = 7.95 (t, 1H, J = 7.2 Hz, Ar-H), 7.78-6.46 (m, 22H, Ar-H), 4.69 (t, 2H, J = 6.6
Hz, OCH₂), 3.39 (t, 2H, J = 6.6 Hz, CH₂). MS: m/z (%) = 519 (7) [M⁺], 396
(35), 380 (33), 262 (41), 184 (18), 183 (100). Anal. Calcd for C₃₃H₂₇FNO₂P:
C, 76.29; H, 5.24; N, 2.70. Found: C, 76.46; H, 5.05; N,
2.56.

5-Bromo-2-(triphenylphosphoranylideneamino)phenethyl 4-chlorobenzoate (2i):
yield 84%, white solid, mp: 158-159 °C. ¹H NMR (400 MHz,
CDCl₃): δ =
7.97 (d, 2H, J = 8.4 Hz, Ar-H), 7.74-6.28 (m, 20H,
Ar-H), 4.63 (t, 2H, J = 6.8 Hz, OCH₂), 3.31 (t, 2H, J = 6.8 Hz, CH₂). MS: m/z (%) = 613 (10) [M⁺], 476 (21), 277 (21), 262 (51),
189 (18), 183 (100). Anal. Calcd for C₃₃H₂₉BrClNO₂P: C, 64.46;
H, 4.26; N, 2.28. Found: C, 64.19; H, 4.47; N, 2.15.
5-Bromo-2-(triphenylphosphoranylideneamino)phenethyl 2-fluorobenzoate (2j): yield 81%, white solid, mp: 166-167 °C. ¹H NMR (600 MHz, CDCl₃): δ = 7.94-7.13 (m, 20H, Ar-H), 6.86 (d, 1H, J = 8.0 Hz, Ar-H), 6.28 (d, 1H, J = 8.4 Hz, Ar-H), 4.65 (t, 2H, J = 7.2 Hz, OCH₂), 3.32 (t, 2H, J = 7.2 Hz, CH₂). MS: m/z (%) = 597 (10) [M⁺], 476 (22), 458 (15), 262 (49), 183 (100), 123 (51). Anal. Calcd for C₃₃H₂₆BrFNO₂P: C, 66.23; H, 4.38; N, 2.34. Found: C, 66.12; H, 4.58; N, 2.12.

5-Bromo-2-(triphenylphosphoranylideneamino)phenethyl 4-nitrobenzoate (2k): yield 87%, red solid, mp: 174-175 °C. ¹H NMR (400 MHz, CDCl₃): δ = 8.25-7.27 (m, 20H, Ar-H), 6.86 (d, 1H, J = 8.0 Hz, Ar-H), 6.29 (d, 1H, J = 8.4 Hz, Ar-H), 4.70 (t, 2H, J = 6.8 Hz, OCH₂), 3.34 (t, 2H, J = 6.8 Hz, CH₂). MS: m/z (%) = 624 (9) [M⁺], 474 (18), 277 (43), 262 (57), 199 (20), 183 (100). Anal. Calcd for C₃₃H₂₆BrN₂O₄P: C, 63.37; H, 4.19; N, 4.48. Found: C, 63.15; H, 4.31; N, 4.64.

2-(triphenylphosphoranylideneamino)phenethyl acetate (2l): yield 86%, yellow solid, mp: 76-78 °C. ¹H NMR (600 MHz, CDCl₃): δ = 7.76-6.44 (m, 19H, Ar-H), 4.42 (t, 2H, J = 6.6 Hz, OCH₂), 3.24 (t, 2H, J = 6.6 Hz, CH₂), 2.04 (s, 3H, CH₃). MS: m/z (%) = 439 (10) [M⁺], 396 (25), 380 (39), 262 (34), 183 (100), 152 (15), 108 (34). Anal. Calcd for C₂₈H₂₆NO₂P: C, 76.52; H, 5.96; N, 3.19. Found: C, 76.27; H, 5.74; N, 3.38.

2-(triphenylphosphoranylideneamino)phenethyl propionate (2m): yield 87%, white solid, mp: 101-102 °C. ¹H NMR (600 MHz, CDCl₃): δ = 7.77-6.44 (m, 19H, Ar-H), 4.43 (t, 2H, J = 6.6 Hz, OCH₂), 3.24 (t, 2H, J = 7.2 Hz, CH₂), 2.33 (q, 2H, J = 7.2 Hz, CH₂), 1.14 (t, 3H, J = 7.2 Hz, CH₃). MS: m/z (%) = 453 (8) [M⁺], 396 (31), 380 (40), 262 (34), 184 (17), 183 (100), 152 (13). Anal. Calcd for C₂₉H₂₈NO₂P: C, 76.80; H, 6.22; N, 3.09. Found: C, 76.94; H, 6.01; N, 3.23.

2-(triphenylphosphoranylideneamino)phenethyl 2-chloropropanoate (2n): yield 88%, yellow solid, mp: 121-124 °C. ¹H NMR (600 MHz, CDCl₃): δ = 7.76-6.45 (m, 19H, Ar-H), 4.54 (t, 2H, J = 7.2 Hz, OCH₂), 4.40 (q, 1H, J = 4.8 Hz, CHCl), 3.30-3.24 (m, 2H, CH₂), 1.67 (d, 3H, J = 7.2 Hz, CH₃). MS: m/z (%) = 487 (6) [M⁺], 397 (7), 380 (42), 277 (35), 183.1 (100). Anal. Calcd for C₂₉H₂₇ClNO₂P: C, 71.38; H, 5.58; N, 2.87. Found: C, 71.15; H, 5.65; N, 2.99.

General Procedure for the Synthesis of N-Acyldi indolines 4 and 5: The solution of iminophosphorane 2 (2 mmol) in xylene or 1,2-dichlorobenzene was heated to reflux for 1-24 h. The crude product was purified by flash chromatography to yield N-acyl indolines 4 and 5.

1-Benzoylindoline (4a): white solid, mp: 121-123 °C. ¹H NMR (600 MHz, CDCl₃): δ = 8.31-7.03 (m, 9H), 4.06 (br, 2H), 3.12 (t, J = 8.4 Hz, 2H). ¹³C NMR (150 MHz, CDCl₃): δ = 168.8, 142.4, 136.8, 132.1, 130.1, 128.4, 126.9, 124.7, 123.9, 123.8, 117.3, 50.7, 28.1. MS: m/z (%) = 223 (66) [M⁺], 105 (100), 77 (33). Anal. Calcd for C₁₂H₁₁NO: C, 80.69; H, 5.87; N, 6.27. Found: C, 80.53; H, 5.85; N, 6.42.
1-(4-Methylbenzoyl)indoline (4b):

white solid, mp: 102-104 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): \( \delta = 7.45-6.99 \) (m, 8H), 4.06 (br, 2H), 3.08 (t, \( J = 7.2 \) Hz, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 169.0, 142.6, 140.4, 133.9, 132.4, 132.2, 129.0, 127.1, 124.7, 123.6, 117.4, 50.7, 28.1, 21.5. MS: \( m/z \) (%) = 237 (14) \([M^+]\), 119.1 (100), 91.1 (38), 65.1(16). Anal. Calcd for C\(_{16}\)H\(_{15}\)NO: C, 80.98; H, 6.37; N, 5.90. Found: C, 80.81; H, 6.48; N, 5.72.

1-(4-Chlorobenzoyl)indoline (4c):

white solid, mp: 116-117 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): \( \delta = 8.30-7.03 \) (m, 8H), 4.04 (br, 2H), 3.11 (t, \( J = 8.4 \) Hz, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 167.0, 141.9, 135.6, 134.8, 131.7, 129.3, 128.1, 127.1, 126.6, 124.4, 123.6, 117.0, 50.3, 27.7. MS: \( m/z \) (%) = 257 (18) \([M^+]\), 141 (33), 139 (100), 111 (33), 75 (11). Anal. Calcd for C\(_{15}\)H\(_{12}\)ClNO: C, 69.91; H, 4.69; N, 5.43. Found: C, 69.64; H, 4.85; N, 5.31.

1-(2-Chlorobenzoyl)indoline (4d):

white solid, mp: 93-94 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): major rotamer (75:25) \( \delta = 8.35 \) (d, \( J = 14.4 \) Hz, 0.75H), 7.43-6.81 (m, 7.54H), 5.71 (d, \( J = 8.4 \) Hz, 0.25H), 4.37-4.27 (m, 0.52H), 3.84-3.75 (m, 1.47H), 3.18-3.10 (m, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 169.1, 142.7, 137.1, 132.5, 130.4, 128.7, 127.2, 125.0, 124.1, 117.5, 50.9, 28.3. MS: \( m/z \) (%) = 257 (19) \([M^+]\), 141 (34), 139 (100), 111 (29), 75 (12). Anal. Calcd for C\(_{15}\)H\(_{12}\)ClNO: C, 69.91; H, 4.69; N, 5.43. Found: C, 69.72; H, 4.58; N, 5.67.

1-(3-Chlorobenzoyl)indoline (4e):

white solid, mp: 158-159 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): \( \delta = 8.24-7.06 \) (m, 8H), 4.03 (br, 2H), 3.13 (t, \( J = 8.4 \) Hz, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 167.1, 142.3, 138.5, 134.4, 132.0, 130.2, 129.8, 127.0, 125.0, 117.8, 51.2, 28.2. MS: \( m/z \) (%) = 257 (20) \([M^+]\), 141 (33), 139 (100), 111 (37), 75 (11). Anal. Calcd for C\(_{15}\)H\(_{12}\)ClNO: C, 69.91; H, 4.69; N, 5.43. Found: C, 70.15; H, 4.84; N, 5.27.

1-(4-Nitrobenzoyl)indoline (4f):

yellow solid, mp: 203-204 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): \( \delta = 8.32-5.86 \) (m, 8H), 4.27-3.97 (m, 2H), 3.16 (t, \( J = 7.8 \) Hz, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 166.4, 148.4, 142.2, 131.8, 127.9, 127.5, 124.8, 123.8, 122.9, 117.7, 50.8, 28.4. MS: \( m/z \) (%) = 268 (35) \([M^+]\), 150 (100), 139 (18), 120 (58), 104 (34), 91 (27), 76 (21), 65 (22). Anal. Calcd for C\(_{15}\)H\(_{12}\)N\(_2\)O\(_3\): C, 67.16; H, 4.51; N, 10.44. Found: C, 67.37; H, 4.75; N, 10.27.

1-(4-Fluorobenzoyl)indoline (4g):

white solid, mp: 104-105 °C. \( ^1H \) NMR (600 MHz, CDCl\(_3\)): \( \delta = 8.24-7.03 \) (m, 8H), 4.08 (br, 2H), 3.13 (t, \( J = 8.4 \) Hz, 2H). \( ^{13}C \) NMR (150 MHz, CDCl\(_3\)): \( \delta = 167.3, 164.0, 162.4, 142.1, 132.6, 132.0, 129.1, 126.7, 124.5, 123.6, 117.0, 116.2, 115.1, 114.1, 50.4, 28.0. MS: \( m/z \) (%) = 241 (17) \([M^+]\), 123 (100), 95 (35). Anal. Calcd for C\(_{15}\)H\(_{12}\)FNO: C, 74.67; H, 5.01; N, 5.81. Found: C, 74.58;
**1-(2-Fluorobenzoyl)indoline (4h):**
- White solid, mp: 96-97 ºC.
- $^1$H NMR (600 MHz, CDCl$_3$): major rotamer (79:21) δ = 8.31 (d, J = 7.8 Hz, 0.79H), 7.48-6.83 (m, 7.34H), 5.92 (d, J = 6.6 Hz, 0.21H), 4.38-4.28 (m, 0.42H), 3.92 (t, J = 7.8 Hz, 1.57H), 3.12 (t, J = 7.8 Hz, 2H).
- 13C NMR (150 MHz, CDCl$_3$): δ = 163.7, 162.7, 158.8, 158.3, 157.2, 156.6, 141.8, 140.6, 132.9, 131.7, 130.1, 128.5, 128.1, 126.8, 126.4, 125.0, 124.3, 123.9, 116.8, 115.5, 112.6, 48.7, 47.9, 27.4, 26.2. MS: m/z (%) = 241 (17) [M+], 123 (100), 95 (35).
- Anal. Calcd for C$_{15}$H$_{12}$FNO: C, 74.67; H, 5.01; N, 5.81. Found: C, 74.42; H, 4.87; N, 5.97.

**5-Bromo-1-(4-chlorobenzoyl)indoline (4i):**
- White solid, mp: 142-143 ºC.
- $^1$H NMR (400 MHz, CDCl$_3$): δ = 7.51-7.26 (m, 7H, Ar-H), 4.07 (br, 2H, OCH$_2$), 3.12 (t, J = 8.0 Hz, 2H, CH$_2$). MS: m/z (%) = 335 (11) [M+], 139 (100), 111 (27).
- Anal. Calcd for C$_{15}$H$_{11}$BrClNO: C, 53.52; H, 3.29; N, 4.16. Found: C, 53.74; H, 3.43; N, 4.04.

**5-Bromo-1-(2-fluorobenzoyl)indoline (4j):**
- White solid, mp: 149-150 ºC.
- $^1$H NMR (400 MHz, CDCl$_3$): major rotamer (75:25) δ = 8.19 (d, J = 8.4 Hz, 0.72H, Ar-H), 7.49-6.95 (m, 6.42H, Ar-H), 5.77 (br, 0.25H, Ar-H), 4.39-4.22 (m, 0.47H, OCH$_2$), 3.95 (t, J = 8.4 Hz, 1.49H, OCH$_2$), 3.12 (t, J = 8.0 Hz, 2H, CH$_2$). 13C NMR (100 MHz, CDCl$_3$): δ = 164.4, 159.2, 156.8, 141.5, 134.3, 131.8, 131.7, 128.7, 127.7, 124.8, 118.8, 116.9, 116.1, 115.9, 49.2, 27.8. MS: m/z (%) = 319 (12) [M+], 123 (100), 95 (20).

**5-Bromo-1-(4-nitrobenzoyl)indoline (4k):**
- Yellow solid, mp: 215-216 ºC.
- $^1$H NMR (400 MHz, CDCl$_3$): δ = 8.35-7.29 (m, 7H, Ar-H), 4.00 (br, 2H, OCH$_2$), 3.16 (t, J = 8.0 Hz, 2H, CH$_2$). MS: m/z (%) = 346 (17) [M+], 150 (100), 117 (24), 104 (32).

**1-Acetylindoline (4l):**
- White solid, mp: 98-100 ºC.
- $^1$H NMR (600 MHz, CDCl$_3$): δ = 8.20 (d, J = 7.8 Hz, 1H), 7.17 (q, J = 7.8 Hz, 2H), 7.00 (t, J = 7.8 Hz, 1H), 4.12 (t, J = 7.8 Hz, 0.29H), 4.01 (t, J = 8.4 Hz, 1.71H), 3.17 (t, J = 7.8 Hz, 1.72H), 3.05 (t, J = 7.8 Hz, 0.29H), 2.43 (s, 0.43H), 2.20 (s, 2.67H). 13C NMR (150 MHz, CDCl$_3$): δ = 168.2, 142.4, 130.8, 126.8, 125.3, 124.1, 122.9, 122.5, 116.1, 113.5, 48.1, 47.4, 27.3, 26.2, 24.1, 23.6. MS: m/z (%) = 161 (32) [M+], 119 (67), 118 (100), 91 (17).
- Anal. Calcd for C$_{10}$H$_{11}$NO: C, 74.51; H, 6.88; N, 8.69. Found: C, 74.58; H, 6.63; N, 8.94.

**1-Propionylindoline (4m):**
- White solid, mp: 101-102 ºC.
- $^1$H NMR (600 MHz, CDCl$_3$): δ = 8.24 (d, J = 7.8 Hz, 1H), 7.18 (q, J = 7.8 Hz, 2H), 6.99 (t, J = 7.8 Hz, 1H), 4.14 (s, 0.29H), 4.01 (t, J = 8.4 Hz, 1.71H), 3.18 (t, J = 8.4 Hz, 1.71H), 3.05 (s, 0.29H), 2.68 (s, 0.29H), 2.43 (q, J = 7.8 Hz, 2.67H).
$^{13}$C NMR (150 MHz, CDCl$_3$): $\delta$ = 171.4, 142.6, 130.7, 126.8, 124.0, 122.8, 116.1, 47.1, 29.1 28.4, 27.4, 26.2, 9.2, 8.1. MS: $m/z$ (%) = 175 (29) [M$^+$], 119 (100), 91 (18), 65 (9). Anal. Caled for C$_{11}$H$_{13}$NO: C, 75.40; H, 7.48; N, 7.99. Found: C, 75.67; H, 7.45; N, 7.78.

1-(2-Chloropropanoyl)indoline (4n):

yellow solid; m.p.: 110-112 °C; $^1$H NMR (600 MHz, CDCl$_3$): $\delta$ = 8.24 (d, $J$ = 8.4 Hz, 1H), 7.21 (q, $J$ = 7.8 Hz, 2H), 7.06 (t, $J$ = 7.8 Hz, 1H), 4.58 (q, $J$ = 6.6 Hz, 1H), 4.39 (q, $J$ = 9.6 Hz, 1H), 4.09 (q, $J$ = 10. 2 Hz, 1H), 3.27-3.20 (m, 2H), 1.75 (d, $J$ = 6.6 Hz, 3H);

$^{13}$C NMR (150 MHz, CDCl$_3$): $\delta$ = 166.5, 142.5, 131.4, 127.4, 124.5, 124.2, 117.2, 51.9, 47.5 27.9, 20.4; MS: $m/z$ (%) = 209 (31) [M$^+$], 146 (32), 128 (18), 119 (100), 91 (33), 65 (15); Anal. Caled for C$_{11}$H$_{13}$ClNO: C, 63.01; H, 5.77; N, 6.68. Found: C, 63.25; H, 5.58; N, 6.60.
\[ \text{\textbf{2a}} \]

\[ \begin{align*}
N & = \text{PPH}_3 \\
\text{benzyl} & = \text{O} \\
\text{phenyl} & = \text{N} = \text{PPH}_3
\end{align*} \]

\[ \text{\textbf{2b}} \]

\[ \begin{align*}
N & = \text{PPH}_3 \\
\text{benzyl} & = \text{O} \\
\text{phenyl} & = \text{N} = \text{PPH}_3
\end{align*} \]
S10
Br-N=PPh$_3$-O-Cl

2i

Br-N=PPh$_3$-O-F

2j