A Facile Synthesis of Some New 3*H*-Pyrrolo[2,3-*c*]quinoline Derivatives from 4-Formylquinolines

Pedro Molina,* Mateo Alajarín, Pilar Sánchez-Andrada

Departamento de Química Orgánica, Facultad de Química, Universidad de Murcia, Campus de Espinardo, E-30071, Murcia, Spain

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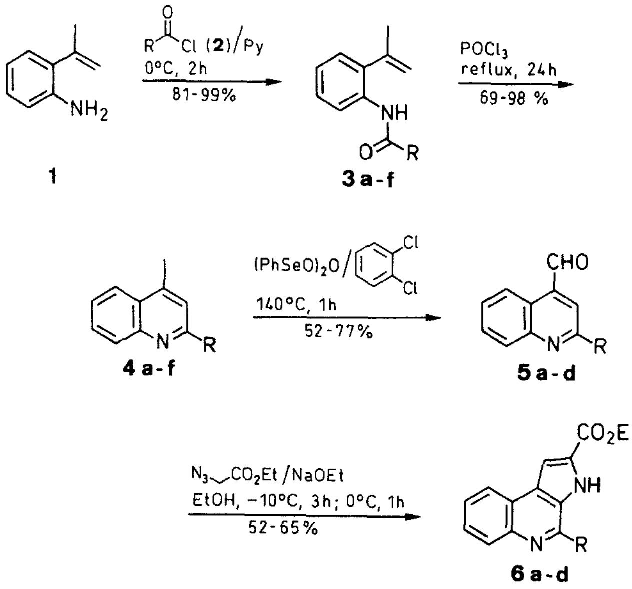
A number of ethyl 3*H*-pyrrolo[2,3-*c*]quinoline-2-carboxylates have been prepared directly by condensation of ethyl azidoacetate with 4-formylquinolines, available from *o*-(1-methylethenyl)aniline by sequential treatment with acid chlorides, phosphorus oxychloride and benzeneseleninic anhydride. This methodology has also been used to synthesize 2,2′-bis(ethoxycarbonyl)-4,4′-bi-3*H*-pyrrolo[2,3-*c*]quinoline and 1,4-bis(2-ethoxycarbonyl)-3*H*-pyrrolo[2,3-*c*]quinolin-4-yl benzene.

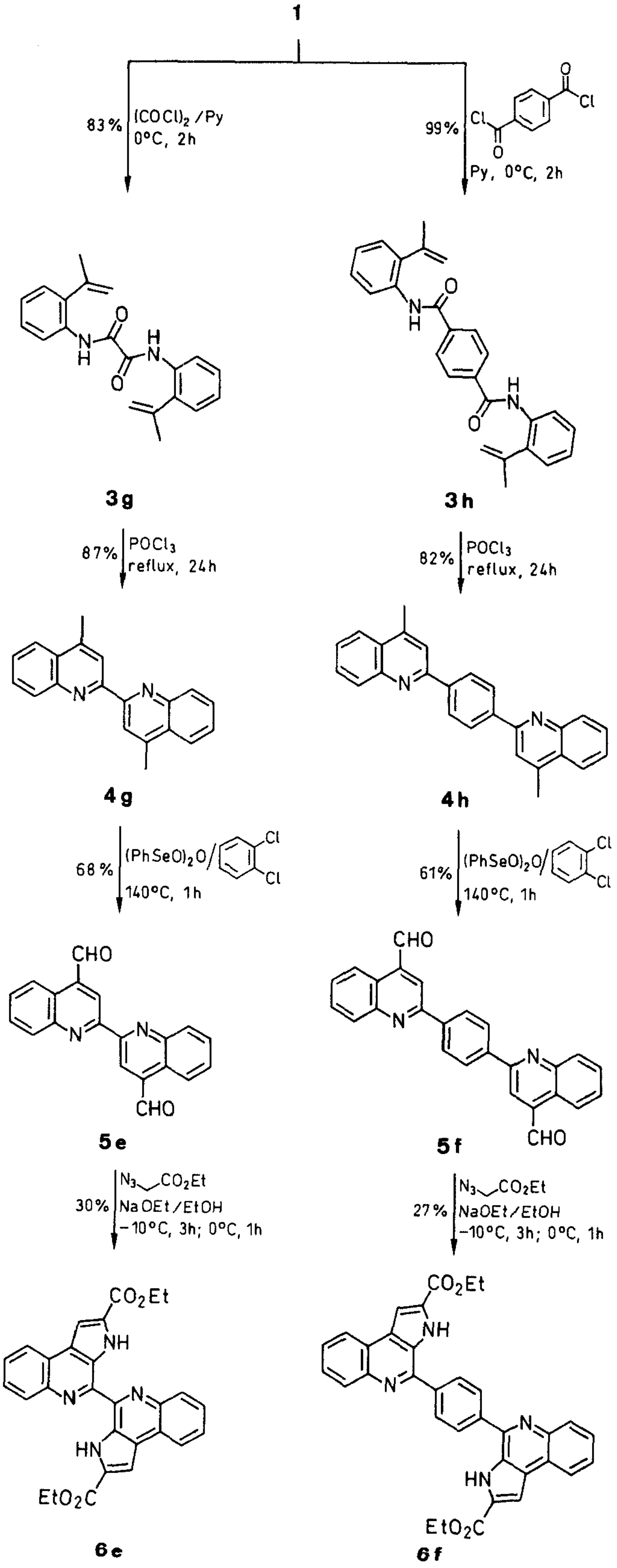
In spite of the fact that the 3*H*-pyrrolo[2,3-*c*]quinoline ring is found in naturally occurring alkaloids such as Calycanthine[1] and some derivatives display a potent activity as CNS depressants,[2] only a few methods have been described for the synthesis of this heterocyclic ring system. The first one involves Fischer indolization of 3-quinolylhydrazines under drastic reaction conditions using either zinc chloride in *p*-cymene at reflux temperature[3] or diethylene glycol as solvent for thermocyclization.[4] In the second method, pyrrole-2-carbaldehydes containing an *ortho*-nitroaryl substituent at 3 position are used as starting materials; however, the utility of this procedure is limited by the availability of not so simple starting materials.[5]

We report now a simple and apparently general method for the preparation of 3*H*-pyrrolo[2,3-*c*]quinolines under mild reaction conditions. Our approach is based on the known thermal decomposition of α-azido acrylates bearing a β-aryl or heteroaryl substituent to give fused



3–6	R	3–6	R
a	4-MeOC$_6$H$_4$	d	Ph
b	4-ClC$_6$H$_4$	e	4-MeC$_6$H$_4$
c	4-pyridyl	f	4-O$_2$NC$_6$H$_4$

Scheme 1



Scheme 2

pyrroles. However, although this method has been applied for the annulation of a pyrrole ring into a preformed benzene,[6] thiophene,[7] furan,[8] and indole ring,[9] no examples dealing with annulation into a quinoline ring have been reported, to the best of our knowledge.

The key intermediates 4-formylquinolines **5** have been prepared from *o*-(1-methylethenyl)aniline[10] (**1**) by sequential treatment with acid chlorides and phosphorus oxychloride[11] followed by oxidation with benzeneseleninic anhydride[12] of the resulting 4-methylquinolines **4**. Thus, aniline **1** reacts with acid chlorides **2** in pyridine at 0 °C leading to the corresponding amides **3** in excellent yields (81–99%) (Table 1). When compounds **3** are treated with neat freshly distilled phosphorus oxychloride at reflux temperature, the corresponding 2-substituted 4-methylquinolines **4** are obtained as crystalline solids and in good yields (69–98%). The oxidation of compounds **4** into 4-formylquinolines **5** is achieved by treatment with benzeneseleninic anhydride in 1,2-dichlorobenzene at 140 °C. In general, the yields of this oxidation reaction are good (52–77%) (Table 1), except for compounds **4e** and **4f**. The former gives a complex mixture and the latter gives the oxidized product in yield lower than 10%. Treatment of compounds **5** with ethyl azidoacetate in ethanol in presence of sodium ethoxide at −10 °C under nitrogen for 3 hours leads directly to 3*H*-pyrrolo[2,3-*c*]quinoline derivatives **6** in moderate yields (52–65%) and no trace of the ethyl α-azido-β-(4-quinolyl)acrylates are detected in the crude products (Scheme 1) (Tables 1 and 2). The method is also applicable when dicarboxylic acid chlorides are used. In this case 4,4′-bi-3*H*-pyrrolo[2,3-*c*]quinoline **6e** and 1,4-bis(3*H*-pyrrolo[2,3-*c*]quinolin-4-yl)benzene **6f** are obtained, albeit the yields in the last step (pyrrolo annulation) are low (27–30%) (Scheme 2) (Tables 1 and 2).

According to the previously reported results on the thermal stability of ethyl α-azido-β-aryl(heteroaryl)acrylates, the direct conversion **5** → **6** came as a surprise. It is significant that aldehydes related to **5** such as 1-formylnaphthalene of 4-formylpyridine[13] react with ethyl azidoacetate at low temperatures in completely normal fashion to give the expected ethyl β-substituted α-azidoacrylate with no evidence of pyrrole formation. Thus it is clear that the quinoline ring plays a key role in the decomposition at low temperatures of the azido group.

Melting points are uncorrected. IR spectra were recorded on a Nicolet FT 5DX spectrophotometer. ^1H and ^{13}C NMR spectra were obtained using a Varian 300 spectrometer. Mass spectra were recorded on a Hewlett-Packard 5993C instrument.

2′-(1-Methylethenyl)anilides 3; General Procedure:

To a solution of *o*-(1-methylethenyl)aniline (**1**, 1 g, 7.5 mmol) in dry pyridine (15 mL) at 0 °C, the appropriate acid chloride was added. The resultant mixture was stirred at 0 °C for 2 h and then poured into ice-water (40 mL). The precipitated solid was separated by filtration, washed with H_2O (3 × 5 mL), air-dried and recrystallized from $CHCl_3$/hexane to give **3** as crystalline solids (Tables 1 and 2).

2-Substituted 4-Methylquinolines 4; General Procedure:

A mixture of the appropriate amide **3** (0.5 g) and freshly distilled $POCl_3$ (10 mL) was heated at reflux temperature for 24 h. The

Table 1. Compounds **3, 4, 5** and **6** Prepared

Product	Yield[a] (%)	mp (°C) (solvent)	Molecular Formula[b] or Lit. mp (°C)	MS (70 eV) *m*/*z* (%)
3a	97	115–117 ($CHCl_3$/hexane)	$C_{17}H_{17}NO_2$ (267.3)	267 (M^+, 1), 135 (100), 132 (66), 77 (23)
3b	96	119–120 ($CHCl_3$/hexane)	$C_{16}H_{14}ClNO$ (271.7)	271 (M^+, 2), 141 (25), 139 (82), 132 (100)
3c	81	125–127 ($CHCl_3$/hexane)	$C_{15}H_{14}N_2O$ (238.3)	238 (M^+, 1), 132 (100), 106 (19), 78 (31)
3d	90	81–83 ($CHCl_3$/hexane)	$C_{16}H_{15}NO$ (237.3)	237 (M^+, 2), 133 (58), 132 (100), 105 (83)
3e	70	79–81 ($CHCl_3$/hexane)	$C_{17}H_{17}NO$ (251.3)	252 ($M^+ + 1$, 100), 251 (M^+, 20), 237 (50)
3f	99	135–137 ($CHCl_3$/hexane)	$C_{16}H_{14}N_2O_3$ (282.3)	282 (M^+, 1), 150 (11), 132 (100), 104 (16)
3g	83	165–167 ($CHCl_3$)	$C_{20}H_{20}N_2O_2$ (320.4)	320 (M^+, 3), 132 (100), 131 (51), 130 (23)
3h	99	183–185 (CH_2Cl_2)	$C_{26}H_{24}N_2O_2$ (396.5)	396 (M^+, 1), 133 (10), 132 (100), 104 (15)
4a	83	190–192 ($CHCl_3$)	$C_{17}H_{15}NO$ (249.3)	249 (M^+, 100), 206 (49), 204 (53), 191 (60)
4b	98	167–169 (dec) (EtOH/hexane)	$C_{16}H_{12}ClN$ (253.7)	255 ($M^+ + 2$, 31), 253 (M^+, 100), 218 (67)
4c	70	107–109 ($CHCl_3$)	$C_{15}H_{12}N_2$ (220.3)	220 (M^+, 100), 219 (45), 205 (22), 115 (33)
4d	89	108–110 ($CHCl_3$/hexane)	$C_{16}H_{13}N$ (219.3)	219 (M^+, 100), 204 (73), 115 (42), 108 (45)
4e	69	51–53 (Et_2O/hexane)	$C_{17}H_{15}N$ (233.3)	233 (M^+, 100), 218 (67), 217 (29), 115 (37)
4f	89	127–129 (dec) (EtOH)	125–126[14]	264 (M^+, 31), 218 (100), 115 (66), 109 (55)
4g	87	285–287 (benzene)	278–280[15]	284 (M^+, 1), 142 (3), 81 (28), 69 (100)
4h	82	247–249 (EtOH)	$C_{26}H_{20}N_2$ (360.5)	360 (M^+, 100), 345 (19), 180 (52), 115 (35)
5a	73	65–67 ($CHCl_3$/hexane)	$C_{17}H_{13}NO_2$ (263.3)	263 (M^+, 100), 220 (45), 192 (26), 191 (76)
5b	69	139–141 ($CHCl_3$)	$C_{16}H_{10}ClNO$ (267.7)	269 ($M^+ + 2$, 8), 267 (M^+, 30), 102 (74), 75 (100)
5c	52	135–137 ($CHCl_3$)	$C_{15}H_{10}N_2O$ (234.3)	234 (M^+, 28), 206 (72), 205 (100), 101 (47)
5d	77	72–74 ($CHCl_3$/hexane)	74[16]	233 (M^+, 58), 205 (35), 204 (100), 102 (22)
5e	68	292–294 (dec) (DMF)	$C_{20}H_{12}N_2O_2$ (312.3)	312 (M^+, 52), 128 (100), 127 (47), 101 (93)
5f	62	302–304 (DMF)	$C_{26}H_{16}N_2O_2$ (388.4)	388 (M^+, 100), 359 (20), 204 (26), 101 (27)
6a	59	81–83 ($CHCl_3$/hexane)	$C_{21}H_{18}N_2O_3$ (346.4)	346 (M^+, 1), 307 (39), 235 (74), 191 (100)
6b	52	70–72 ($CHCl_3$)	$C_{20}H_{15}ClN_2O_2$ (350.8)	350 (M^+, 2), 311 (43), 241 (33), 239 (100)
6c	65	113–115 (DMSO)	$C_{19}H_{15}N_3O_2$ (317.3)	317 (M^+, 3), 278 (88), 206 (100), 205 (41)
6d	54	120–122 ($CHCl_3$/hexane)	$C_{20}H_{16}N_2O_2$ (316.4)	316 (M^+, 2), 277 (49), 216 (16), 205 (100)
6e	30	165–167 ($CHCl_3$)	$C_{28}H_{22}N_4O_4$ (478.5)	478 (M^+, 1), 400 (15), 329 (27), 328 (100)
6f	27	135–137 (dec) ($CHCl_3$)	$C_{34}H_{26}N_4O_4$ (554.6)	554 (M^+, 1), 476 (2), 115 (16), 69 (100)

[a] Yield of isolated pure product.

[b] Satisfactory microanalyses obtained: C ±0.30, H ±0.28, N ±0.29.

Table 2. Spectral Data of Compounds **3**, **4**, **5** and **6**

Product	IR (Nujol) ν (cm^{-1})	^{1}H NMR (300 MHz) (solvent/TMS)[a] δ, J (Hz)	^{13}C NMR (75 MHz) (solvent/TMS)[a] δ
3a	3280, 1631	2.12–2.11 (m, 3H), 3.87 (s, 3H), 5.11–5.12 (m, 1H), 5.47–5.48 (m, 1H), 6.98 (d, 2H, J = 8.8), 7.10 (td, 1H, J = 7.2, 1.2), 7.18 (dd, 1H, J = 7.7, 1.8), 7.31 (td, 1H, J = 7.7, 1.7 Hz), 7.79 (dd, 2H, J = 8.8), 8.39 (s, 1H), 8.47 (dd, 1H, J = 8.2, 0.7)	24.72, 55.52, 114.11, 116.81, 120.72, 123.72, 127.39 (q), 127.65, 128.09, 128.83, 133.42 (q), 134.26 (q), 143.48 (q), 162.49 (q), 164.66 (q)
3b	3263, 1647	2.09–2.10 (m, 3H), 5.09–5.10 (m, 1H), 5.45–5.46 (m, 1H), 7.34–7.08 (m, 3H), 7.42 (d, 2H, J = 8.5), 7.74 (d, 2H, J = 8.5), 8.40 (d, 1H, J = 8.5), 8.44 (s, 1H)	24.57, 116.78, 120.96, 124.17, 127.70, 128.01, 128.33, 129.05, 133.43 (q), 133.75 (q), 136.01 (q), 143.27 (q), 163.96 (q)[c]
3c	3296, 1654	2.10–2.11 (m, 3H), 5.09–5.10 (m, 1H), 5.48–5.49 (m, 1H), 7.12–7.36 (m, 3H), 7.65 (dd, 2H, J = 4.5, 1.5), 8.39 (d, 1H, J = 8.1), 8.63 (s, 1H), 8.76 (dd, 2H, J = 4.5, 1.4)	24.43, 116.78, 120.19, 121.02, 124.59, 127.67, 127.96, 133.13 (q), 133.90 (q), 141.92 (q), 142.99 (q), 150.61, 162.89 (q)
3d	3200, 1637	2.09–2.20 (m, 3H), 5.10–5.11 (m, 1H), 5.46–5.47 (m, 1H), 7.06–7.21 (m, 2H), 7.31 (td, 1H, J = 7.6, 2.0), 7.42–7.56 (m, 3H), 7.82 (dd, 2H, J = 8.0), 8.47 (d, 2H, J = 8.0)	24.57, 116.79, 120.87, 123.95, 126.90, 127.67, 128.01, 128.83, 131.75, 133.66 (q), 134.03 (q), 135.09 (q), 143.28 (q), 165.03 (q)
3e	3273, 1641	2.09–2.10 (m, 3H), 2.40 (s, 3H), 5.09–5.10 (m, 1H), 5.44–5.45 (m, 1H), 7.05–7.34 (m, 3H), 7.26 (d, 2H, J = 8.2), 7.72 (d, 2H, J = 8.2), 8.45 (s, 1H), 8.47 (d, 1H, J = 8.4)	21.46, 24.60, 116.76, 120.77, 123.79, 126.92, 127.64, 128.01, 129.48, 132.28 (q), 133.51 (q), 134.15 (q), 142.28 (q), 143.34 (q), 165.02 (q)
3f	3292, 1643	2.12–2.13 (m, 3H), 5.12–5.13 (m, 1H), 5.49–5.50 (m, 1H), 7.12–7.27 (m, 2H), 7.33 (td, 1H, J = 7.5, 2.3), 7.97 (d, 2H, J = 8.8), 8.31 (d, 2H, J = 8.8), 8.41 (d, 1H, J = 8.2), 8.54 (s, 1H)	24.65, 116.97, 121.02, 124.09, 124.75, 127.84, 128.16, 128.55 (q), 131.10 (q), 133.95 (q), 140.59 (q), 143.25, 149.72 (q), 163.02 (q)
3g	3347, 1689	2.12–2.13 (m, 3H), 5.12–5.13 (m, 1H), 5.54–5.55 (m, 1H), 7.12–7.36 (m, 3H), 8.43 (d, 1H, J = 8.1), 9.94 (s, 1H)	24.52, 117.84, 120.00, 125.04, 128.04, 128.11, 132.59 (q), 134.32 (q), 141.82 (q), 157.44 (q)
3h	3205, 1638	2.08–2.09 (m, 3H), 5.08–5.09 (m, 1H), 5.45–5.46 (m, 1H), 7.08–7.20 (m, 2H), 7.28 (td, 1H, J = 7.7, 1.8), 7.88 (s, 2H), 8.40 (s, 1H), 8.44 (d, 1H, J = 8.1)	24.72, 117.00, 120.87, 124.36, 127.55, 127.79, 128.16, 133.73 (q), 138.02 (q), 143.30 (q), 164.05 (q), 169.82 (q)
4a	1636, 1599	2.90 (s, 3H), 3.83 (s, 3H), 7.12 (d, 2H, J = 8.4), 7.81 (t, 1H, J = 7.4), 8.02 (t, 1H, J = 8.0), 8.26 (d, 1H, J = 8.4), 8.31 (s, 1H), 8.33 (d, 2H, J = 8.4), 8.91 (d, 1H, J = 8.8)	19.51, 57.76, 114.72, 121.20, 121.32, 122.28 (q), 125.32, 126.30 (q), 128.65, 131.86, 133.68, 137.72 (q), 152.39 (q), 156.66 (q), 163.14 (q)
4b	1647, 1602	2.80 (s, 3H), 7.63 (d, 2H, J = 8.1), 7.71 (d, 1H, J = 7.8), 7.87 (t, 1H, J = 7.6), 8.10–8.30 (m, 3H), 8.28 (d, 2H, J = 8.1)	16.97, 119.69, 124.40, 126.90 (q), 127.09, 127.58, 128.87, 129.48, 130.78, 135.24 (q), 135.47 (q), 144.94 (q), 148.44 (q), 153.69 (q)
4c	1596, 1542	2.74 (s, 3H), 7.57 (td, 1H, J = 8.1, 0.9), 7.67 (s, 1H), 7.73 (td, 1H, J = 7.6, 1.1), 7.97 (d, 1H, J = 8.4), 8.02 (d, 2H, J = 5.1), 8.16 (d, 1H, J = 8.2), 8.75 (d, 2H, J = 5.1)	19.02, 119.11, 121.58, 123.63, 126.91, 127.80 (q), 129.72, 130.48, 145.53 (q), 146.73 (q), 147.98 (q), 150.29, 155.97 (q)
4d	1639, 1548	2.98 (s, 3H), 7.52–7.55 (m, 3H), 7.80 (t, 1H, J = 7.3), 7.91–7.96 (m, 2H), 8.08–8.17 (m, 3H), 8.82 (d, 1H, J = 8.4)	20.45, 121.29, 122.25, 124.82, 127.13 (q), 129.48, 129.62, 129.89, 130.37 (q), 133.12, 134.55, 138.57 (q), 154.09 (q), 157.27 (q)
4e	1600, 1550	2.20 (s, 3H), 2.34 (s, 3H), 7.29 (d, 2H, J = 8.2), 7.47 (t, 1H, J = 8.1), 7.64 (s, 1H), 7.66 (t, 1H, J = 8.1), 7.91 (d, 1H, J = 8.2), 8.03 (d, 2H, J = 8.2), 8.15 (d, 1H, J = 8.2)	18.97, 21.35, 119.55, 123.58, 125.82, 127.17 (q), 127.41, 129.24, 129.50, 130.13, 136.95 (q), 139.22 (q), 144.64 (q), 148.12 (q), 156.96 (q)
4f	1596, 1554	2.76 (s, 3H), 7.65 (t, 1H, J = 7.5), 7.82 (t, 1H, J = 7.6), 8.07–8.12 (m, 3H), 8.33 (d, 2H, J = 7.6), 8.48 (d, 2H, J = 7.6)	18.48, 119.56, 123.89, 124.22, 127.15, 127.29 (q), 128.27, 129.87, 130.05, 144.57 (q), 146.06 (q), 147.30 (q), 147.92 (q), 153.27 (q)
4g	1600, 1548	2.84 (s, 3H), 7.72 (td, 1H, J = 7.7, 1.2), 7.86 (td, 1H, J = 7.2, 1.3), 8.03 (dd, 1H, J = 8.5, 0.7), 8.31 (s, 1H), 8.36 (d, 1H, J = 8.5)	19.58, 120.12, 126.46, 126.48, 128.70 (q), 129.81, 133.24, 142.53 (q), 147.26 (q), 153.61 (q)
4h	1631, 1597	3.09 (s, 3H), 7.95 (t, 1H, J = 7.6), 8.07–8.14 (m, 2H), 8.30–8.38 (m, 3H), 8.68 (d, 1H, J = 8.4)	20.19, 121.66, 122.14, 123.26 (q), 125.26 (q), 127.87, 130.57, 134.45 (q), 135.74, 138.10 (q), 152.25 (q), 159.86 (q)
5a	1703, 1600	3.87 (s, 3H), 7.03 (d, 2H, J = 8.6), 7.62 (t, 1H, J = 7.5), 7.77 (t, 1H, J = 7.5), 8.13–8.24 (m, 4H), 8.90 (d, 1H, J = 8.3), 10.50 (s, 1H)	55.47, 114.49, 122.60 (q), 123.67, 124.17, 128.48, 128.91, 129.87, 130.36, 130.75 (q), 137.72 (q), 149.19 (q), 156.79 (q), 161.48 (q), 192.97
5b	1704, 1590	7.48 (d, 2H, J = 8.8), 7.67 (td, 1H, J = 6.9, 2.3), 7.78 (td, 1H, J = 7.7, 1.3), 8.13 (d, 2H, J = 8.8), 8.14 (s, 1H), 8.21 (dd, 1H, J = 8.4, 0.6), 8.91 (dd, 1H, J = 8.5, 0.8), 10.52 (s, 1H)	122.94 (q), 123.28, 124.12, 128.62, 129.11, 129.25, 130.18, 130.53, 136.34 (q), 136.66 (q), 137.71 (q), 149.27 (q), 155.88 (q), 192.69
5c	1724, 1596	7.73 (td, 1H, J = 8.4, 1.4), 7.85 (td, 1H, J = 8.4, 1.4), 8.10 (dd, 2H, J = 4.8, 1.3), 8.25 (s, 1H), 8.26 (d, 1H, J = 8.4), 8.81 (dd, 2H, J = 4.8, 1.3), 8.96 (dd, 1H, J = 8.4, 1.4), 10.59 (s, 1H)	121.35, 122.81, 123.61 (q), 124.10, 129.91, 130.56, 130.76, 137.92 (q), 145.53 (q), 149.40 (q), 150.59, 154.45 (q), 192.34
5d	1705, 1595	7.23–8.13 (m, 9H), 8.87 (d, 1H, J = 7.1), 10.45 (s, 1H)	122.69 (q), 123.80, 124.04, 127.26, 128.73, 128.91, 129.89, 130.09, 130.18, 137.49 (q), 138.20 (q), 149.19 (q), 157.06 (q), 192.79
5e	1705, 1590	8.05 (t, 1H, J = 7.6), 8.15 (t, 1H, J = 7.7), 8.52 (d, 1H, J = 8.4), 9.07–9.11 (m, 2H), 10.80 (s, 1H)	122.11, 124.82, 126.08 (q), 126.37, 133.45, 135.02, 142.17 (q), 144.53 (q), 146.99 (q), 190.79
5f	1704, 1597	8.17 (t, 1H, J = 7.9), 8.29 (t, 1H, J = 7.6), 8.39 (s, 2H), 8.54 (d, 1H, J = 8.8), 8.78 (s, 1H), 9.26 (d, 1H, J = 8.6), 10.78 (s, 1H)	121.58, 124.92 (q), 125.34, 125.84, 130.67, 133.32, 134.61 (q), 136.69, 140.22 (q), 144.37 (q), 154.29 (q), 189.73

Table 2. (continued)

Product	IR (Nujol) ν (cm^{-1})	^1H NMR (300 MHz) (solvent/TMS)[a] δ, J (Hz)	^{13}C NMR (75 MHz) (solvent/TMS)[a] δ
6a	3381, 1717	1.49 (t, 3H, J = 7.1), 3.87 (s, 3H), 4.53 (q, 2H, J = 7.1), 7.02–7.08 (m, 2H), 7.58 (td, 1H, J = 7.8, 1.3), 7.73 (td, 1H, J = 7.0, 1.5), 8.15–8.19 (m, 3H), 8.33 (s, 1H), 8.70 (dd, 1H, J = 8.6, 1.3)[b]	14.40, 55.43, 61.90, 114.33, 119.80, 123.72 (q), 125.42, 125.45 (q), 127.33, 128.88, 129.81, 130.12, 130.20 (q), 131.43 (q), 135.97 (q), 149.27 (q), 156.28 (q), 161.14 (q), 166.58 (q)
6b	3375, 1721	1.51 (t, 3H, J = 7.1), 4.55 (q, 2H, J = 7.1), 7.50 (d, 2H, J = 8.5), 7.64 (td, 1H, J = 7.8, 1.2), 7.78 (td, 1H, J = 7.6, 1.3), 8.16 (d, 2H, J = 8.5), 8.25 (d, 1H, J = 8.3), 8.34 (s, 1H), 8.73 (dd, 1H, J = 7.8, 0.9)[b]	14.33, 62.05, 119.79, 124.04 (q), 125.44, 128.03, 128.81, 129.12, 129.15 (q), 129.94, 129.99 (q), 130.22, 136.13 (q), 136.54 (q), 136.78 (q), 148.80 (q), 155.25 (q), 166.18 (q)
6c	3358, 1721	1.41 (t, 3H, J = 7.1), 4.47 (q, 2H, J = 7.1), 7.74 (td, 1H, J = 7.7, 1.1), 7.87 (td, 1H, J = 7.5, 1.3), 8.15 (dd, 1H, J = 9.1, 0.7), 8.19 (dd, 2H, J = 4.6, 1.6), 8.48 (s, 1H), 8.52 (d, 1H, J = 8.4), 8.76 (dd, 2H, J = 4.6, 1.6)[b]	14.04, 62.03, 119.12, 121.23, 123.78 (q), 125.01, 128.77, 130.07, 130.69, 137.03 (q), 144.57 (q), 148.21 (q), 150.52, 153.41 (q), 165.64 (q)[d]
6d	3375, 1725	1.51 (t, 3H, J = 7.1), 4.55 (q, 2H, J = 7.1), 7.52–7.61 (m, 4H), 7.68 (td, 1H, J = 7.7, 1.3), 7.82 (td, 1H, J = 7.7, 1.3), 8.21–8.25 (m, 2H), 8.40 (s, 1H), 8.75 (dd, 1H, J = 8.6, 0.9)[b]	14.28, 61.79, 120.07, 123.98 (q), 125.38, 127.42 (q), 127.44, 127.63, 128.83, 129.64, 129.77, 130.22, 130.25 (q), 135.98 (q), 138.70 (q), 149.14 (q), 156.54 (q), 166.28 (q)
6e	3115, 1724	1.55 (t, 3H, J = 7.1), 4.60 (q, 2H, J = 7.1), 7.70 (td, 1H, J = 7.6, 1.3), 7.83 (td, 1H, J = 7.6, 1.4), 8.34 (d, 1H, J = 7.8), 8.79 (d, 1H, J = 8.4), 9.30 (s, 1H)[b]	14.50, 62.07, 120.50, 125.49 (q), 125.78, 128.77, 128.82 (q), 130.08, 130.61, 130.66 (q), 136.72 (q), 148.87 (q), 155.03 (q), 166.60 (q)
6f	3319, 1720	1.53 (t, 3H, J = 7.2), 4.57 (q, 2H, J = 7.2), 7.65 (t, 1H, J = 7.1), 7.80 (t, 1H, J = 8.4), 8.29 (d, 1H, J = 7.1), 8.41 (s, 1H), 8.47 (s, 2H), 8.75 (d, 1H, J = 8.2)[b]	14.48, 62.11, 120.45, 124.24 (q), 125.56, 127.95, 128.08, 130.05 (q), 130.09, 130.44 (q), 130.49, 136.32 (q), 139.97 (q), 149.41 (q), 156.04 (q), 166.55 (q)

[a] Solvent: $CDCl_3$ for **3a–h**, **4c–e**, **5a**, **5c,d**, **6a,b**, and **6d–f**; DMSO-d_6 for **4a,b**, **4f** and **5b** and $CDCl_3/CF_3CO_2H$ for **4g–h**, **5e–f** and **6c**.
[b] NH not observed.
[c] One quaternary carbon not observed.
[d] Two quaternary carbons not observed.

solvent was removed under reduced pressure and the residual material was slurried with 1 N aq NaOH (25 mL) and the separated solid was collected by filtration, washed with H_2O (3 × 5 mL), air-dried and recrystallized from $CHCl_3$/hexane to give **4** (Tables 1 and 2).

2-Substituted 4-Formylquinolines 5; General Procedure:

To a solution of the appropriate 2-substituted 4-methylquinoline **4** (1.62 mmol) in 1,2-dichlorobenzene (15 mL), $(PhSeO)_2O$ (0.58 g, 1.62 mmol) was added under N_2. The mixture was heated at 140 °C for 1 h. After cooling, the precipitated solid was filtered and the filtrate was diluted with $CHCl_3$ (15 mL) and then a solution of 40 % aq $NaHSO_3$ (25 mL) was added. The resultant solution was stirred at r.t. for 2 h. The separated solid was collected by filtration and treated with hot sat. aq Na_2CO_3 (10 mL). The solid was filtered, washed with H_2O (2 × 5 mL), air-dried and recrystallized from $CHCl_3$ to give **5** as crystalline solids (Tables 1 and 2).

4-Substituted Ethyl 3*H*-Pyrrolo[2,3-*c*]quinoline-2-carboxylates 6; General Procedure:

To a well-stirred solution containing Na (0.06 g, 2.56 mmol) in dry EtOH (10 mL) a solution of ethyl azidoacetate (0.33 g, 2.56 mmol) and the appropriate 2-substituted 4-formylquinoline **5** (0.6 mmol) in the same solvent (15 mL) was added dropwise at – 10 °C, under N_2. The mixture was stirred at this temperature for 3 h and then at 0 °C for 1 h. After this, it was poured into aq 30 % NH_4Cl (15 mL) and was extracted with CH_2Cl_2 (3 × 10 mL). The combined organic layers were washed with H_2O (3 × 15 mL) and dried (Na_2SO_4). The solvent was removed under reduced pressure and the crude product was chromatographed on silica gel column (40 cm × 3.5 cm, 70–230 mesh) using EtOAc/hexane as eluent to give **6** (Tables 1 and 2).

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(1) Späth, E.; Stroh, W.; Lederer, E.; Eiter, K. *Monatsh. Chem.* **1948**, *79*, 11.
(2) Kariyone, K.; Nakamura, Y., Jpn. Patent 7228796; *Chem. Abstr.* **1972**, *77*, 140011.
Kariyone, K.; Nakamura, Y. Jpn. Patent 7228797; *Chem. Abstr.* **1972**, *77*, 140012; Kariyone, K.; Nakamura, Y. Jpn. Patent 7228799; *Chem. Abstr.* **1972**, *77*, 140014.
(3) Govindachari, T.R.; Rajappa, S.; Sudarsanam, V. *Tetrahedron* **1961**, *16*, 1.
(4) Parrick, J.; Wilcox, R. *J. Chem. Soc., Perkin Trans. 1* **1976**, 2121.
(5) Hattori, K.; Hashimoto, M.; Umio, S. Jpn. Patent 6901535; *Chem. Abstr.* **1969**, *70*, 77932.
Umio, S.; Kariyone, K.; Nakamura, H., Jpn. Patent 7111021; *Chem. Abstr.* **1971**, *75*, 49056.
(6) Hemetsberger, H.; Knittel, D. *Monatsh. Chem.* **1972**, *103*, 194.
(7) Farnier, M.; Soth, S.; Fournari, P. *Can. J. Chem.* **1976**, *54*, 1074.
(8) Krutosikova, A.; Kovac, J.; Kristofcak, J. *Collect. Czech. Chem. Commun.* **1979**, *44*, 1799.
(9) Moody, C.J.; Ward, J.G. *J. Chem. Soc., Perkin Trans. 1* **1984**, 2903.
(10) Atkinson, C.M.; Simpson, J.C.E. *J. Chem. Soc.* **1947**, 808.
(11) Hibino, S.; Sugino, E. *Heterocycles* **1987**, *26*, 1883.
(12) Barton, D.H.R.; Hui, R.A.M.F.; Lester, D.J.; Ley, S.V. *Tetrahedron Lett.* **1979**, 3331.
Barton D.H.R.; Hui, R.A.M.F.; Ley, S.V. *J. Chem. Soc., Perkin Trans. 1* **1982**, 2179.
(13) Molina, P.; Aller, E.; Lorenzo, A. *Tetrahedron* **1992**, *48*, 4601.
(14) Quiang, L.G.; Baine, N.H. *J. Org. Chem.* **1988**, *53*, 4218.
(15) Sasse, W.H.F. *J. Chem. Soc.* **1960**, 526.
(16) Schering, E.; Brit. Patent 240051; *Chem. Abstr.* **1926**, *20*, 2167.