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A simple and efficient protocol for the synthesis of quinolines catalyzed by chloramine-T

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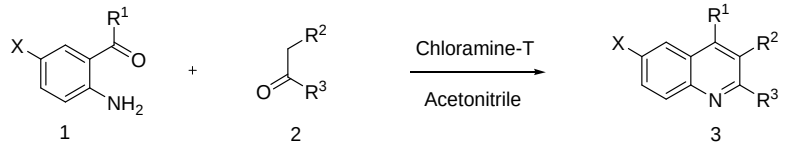
Abstract: Chloramine-T has been proved as an efficient catalyst for the synthesis of substituted quinolines. In this method, 2-amino aryl ketones were smoothly reacted with ketones to afford the corresponding quinoline derivatives in very good yields. All the reactions were carried out at acetonitrile reflux.



***Keywords*:** 2-Amino aryl ketones; ketones; chloramine-T; quinolines.

1. Introduction

Quinoline scaffold are found in many natural products and they exhibit remarkable biological activities like Antimalerial, antibacterial, antiasthmatic, antihypertensive, anti-inflammatory agents and antiobesity.[1-8] Aryl-substituted quinolines act as ligands for 5-lipoxygenase [9], tyrosine kinase [10], leukotriene [11] and other receptors. Furthermore, polyquinolines were shown to undergo hierarchical self-assembly into nanostructures with promising electronic and photonic properties.[12,13] A variety of methods such as Doebner-von Miller, Skraup, Combes, Friedlander and Knorr synthesis have been used for preparation of quinolines and their derivatives.[14-16]

Therefore, the synthesis of quinoline derivatives attracted many researchers and various methods have been developed using a variety of catalysts and conditions.[17-26] Among them, Friedlander annulations are one of the simplest and most straightforward protocols. This method involves a condensation and cyclization between a ketone possessing a methylene group and an aromatic 2-aminoaldehyde or ketone. However, many of these methods have some drawbacks such as high reaction temperature (150-200^{0}C), use of expensive catalysts and extended reaction times. As part of our research program in developing synthetic methodologies [27-29], herein we report, the synthesis of

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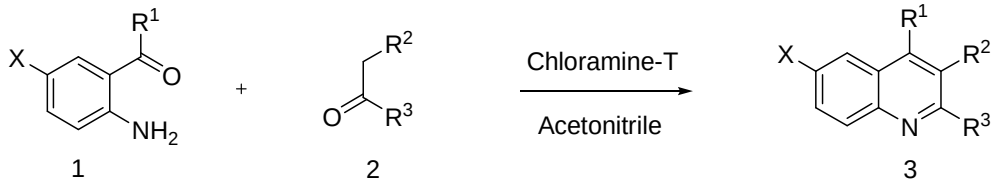
quinolines using chloramines-T as a catalyst. The catalyst chloramines-T is known in the literature for various organic transformations.[30]

2. Results and Discussion

In a typical experiment, 2-amino acetophenone and ethyl acetoacetate were reacted in presence of chloramines-T at acetonitrile reflux to afford the corresponding product, ethyl-2, 4-dimethyl quinoline-3-carboxylate **(3a)** in excellent yield. The reaction was completed within 4 hours.



X= H,Cl

R^1=Me,Ph

R^2=CO_2Et,COMe,CO cycloalkyl CONHarylalkyl

R^3=Me

Scheme 1.synthesis of quinolines

We have examined the effect of temperature on reaction rate and the amount of catalyst used in the reaction and the results were summarized in the table-1. There was no product formation in acetonitrile at room temperature and at reflux conditions even after 24 hours. The product formation was observed in presence of catalyst at room temperature after 24 hours. It was found that the ideal reaction conditions were at acetonitrile reflux and using the catalyst in 10% mole.

Table 1. Optimization of Reaction Conditions for the synthesis of quinolines using Chloramine-T:

SNo	Solvent	Catalyst	Temperature (^{0}C)	Time (h)	Yield (%)
1	CH_3CN	0	RT	24	0
2	CH_3CN	0	85	24	0
3	CH_3CN	0.5	RT	24	60
4	CH_3CN	0.5	85	3.0	95
5	CH_3CN	1.0	85	3.0	95
6	CH_3CN	0.1	85	4.0	95

Encouraged by the result obtained with 2-amino acetophenone and ethyl acetoacetate at established reaction conditions, we have applied this methodology to various substrates. As shown in the table 2, the 2-aminoacetophenone could be replaced by 2-amino-5-chlorobenzo phenone and *ortho*-methylene ketones could be extended from ethyl acetoacetate to methylaceto acetate, cyclic-1,3-diketones, such as 1,3-cyclohexanedione and 5,5-dimethyl-1,3-cyclo hexane dione and simple cyclic ketones such as cyclohexanone 3-*tert*-cyclohexanone and cyclo pentanone. In the optimized reaction conditions, the synthesis of quinoline **1a-o** was successfully obtained in very good yields by Friedlander condensation between 2-aminoacetophenone as well as 2-aminobezophenone with a variety of carbonyl compounds in the presence of catalyst chloramine-T.

3. Conclusion

In conclusion, the application of various catalysts for the preparation of quinolines via Friedlander annulations such as been studied. chloramines-T been demonstrated here as the most

effective catalyst for this synthesis. The simple experimental procedure and impressive yields by applying this inexpensive catalyst have made this protocol practically useful for the synthesis of quinolines.

4. Experimental:

All commercial reagents were used without purification and all solvents were reagent grade. All the reaction mixtures were stirred magnetically and were monitored by TLC using 0.25 mm E-Merck silica gel $60F_{254}$ precoated glass plates, which were visualized with UV light. Melting points were recorded on Buchi R-535 apparatus. IR spectra were recorded on a Perkin-Elmer FT/IR-240 C spectrophotometer with KBr optics. ^{1}H NMR spectra were recorded on Varian Gemini 200 MHz spectrometer recorded in $CDCl_3$ using TMS as an internal standard. ^{13}C NMR spectra (75.5 MHz) Mass spectra were recorded on a Bruker Avance-300 finnigan spectrometer with complete proton decoupling, chemical shifts are reported in ppm relative to the solvent resonance as the internal standard ($CDCl_3$, δ=77.16). MAT 1020 Mass spectrum operating at 70 eV.Mass spectra were recorded on a VG 7070 H Micromass spectrometer. CHN analyses were recorded on a Vario EL Analyser.

4.1. General procedure for the synthesis of quinoilne compounds (4a-o):

A mixture of 2-aminoaryl ketone (1 mmol), ethyl acetoacetate (1.2 mmol), and catalyst chloramines-T (1 mmol) in acetonitrile (5 mL), at reflux for a specified time in Table 1. The progress of the reaction was monitored by thinlayer chromatography (TLC). After completion of the reaction, the organic solvent was removed under reduced pressure.The obtained crude product was purified by column chromatography on silica gel by hexane: ethyl acetate as an eluent.

4.2. Spectral data for all the compounds:

Ethyl-2, 4-dimethylquinoline-3-carboxylate (3a) : Yellow solid. Melting range. 271-272 ^{0}C. IR (KBr): 3070, 2930, 2873, 1725, 1614, 1589, 1214, 1082, 578 cm-^{1}. ^{1}H NMR (300 MHz $CDCl_3$) (δ/ppm): 1.45 (t, 3H *J* = 7.0 Hz), 2.63 (s, 3H), 2.70 (s, 3H), 4.50 (q, 2H, *J* = 7.0 Hz), 7.50 (t, 1H, *J* = 7.0 Hz), 7.70 (t, 1H, *J* = 7.0 Hz), 7.95 (d, 1H, *J* = 8.3 Hz), 8.0 (d, 1H, *J* = 8.4 Hz). ^{13}C NMR (75 MHz, $CDCl_3$**)** (δ/ppm): 14.10, 15.45, 23.62, 61.43, 123.82, 125.73, 126.11, 127.95, 129.22, 129.86, 141.27, 147.0, 154.24, 168.93. EIMS *m/z* (%): 229 (91), 214 (8), 200 (10), 183 (100), 156 (50), 128 (20), 115 (37), 89 (18), 77 (10); Anal.Calcd for $C_{14}H_{15}NO_2$ (230): C, 73.34 %; H, 6.59 %; N, 6.11 %. Found: C, 73.12 %; H, 6.48 %; N, 6.05 %.

9-Methyl-3, 4-dihydroacridine-1(2H)-one (3b) : White solid. Melting range. 78-79 ^{0}C. IR (KBr): 3068, 2935, 1478, 1614, 1581, 1350, 755 706, 539 cm^{-1}. ^{1}H NMR (500 MHz $CDCl_3$) (δ/ppm): 2.15-2.30 (m, 2H), 2.75 (t, 2H, *J* = 6.0 Hz), 3.05 (s, 3H), 3.40 (d, 2H), 7.55 (t, 1H, *J* = 7.0 Hz), 7.75 (t, 1H, *J* = 7.5 Hz), 8.00 (d, 1H, *J* =7.5 Hz), 8.20 (d, 1H, *J* =7.5 Hz). ^{13}C NMR ($CDCl_3$, 75 MHz) (δ/ppm): 12.89, 24.57, 32.40, 41.28, 122.79, 124.68, 126.45 (2C), 127.16, 128.45, 140.71, 145.41, 157.92, 198.23, Anal Calcd (%) for $C_{14}H_{13}NO$: C, 79.59 %; H, 6.20 %; N, 6.63 %; O, 7.57 %. Found**:** C, 79.34 %; H, 6.19 %; N, 6.78 %.

9-Methyl-1, 2, 3, 4-tetrahydroacridine (3c): Solid. Melting range. 75-77 ^{0}C. IR (KBr): 2928, 1569, 1478, 1348, 1164, 1076, 939, 839, 819, 775, 752, 708, cm^{-1}. ^{1}H NMR (300 MHz.$CDCl_3$) (δ/ppm): 1.55-1.65 (m, 4H), 2.55 (s, 3H), 2.90 (t, 2H, *J* = 7.6 Hz), 3.10 (t, 2H, *J* = 7.6 Hz), 7.40-7.95 (m, 4H). ^{13}C NMR (75 MHz, $CDCl_3$) (δ/ppm): 12.91, 22.36, 22.74, 26.53, 33.92, 122.75, 124.54, 126.61 (2C), 127.65, 128.43, 140.77, 145.44, 161.95. EIMS *m/z* (%): 198 (M^+, 87), 125 (100). Anal. Calcd for $C_{14}H_{15}N$ (197): C, 85.24 %; H, 7.66 %; N, 7.10 %. Found: C, 85.12 %; H, 6.58 %; N, 7.05 %.

7-Methyl-5, 6-dihydrobenzo[c]acridine (3d) : Solid. Melting range. 112 ^{0}C. IR (KBr): 3070, 3018, 2946, 2842, 1680, 1582, 1499, 1215, 758 cm^{-1}. ^{1}H NMR (300 MHz. $CDCl_3$) (δ/ppm): 2.65 (s, 3H), 3.00 (t, 2H, *J*=7.0 Hz), 3.15 (t, 2H, *J*=6.8 Hz), 7.15-8.55 (m, 8H). ^{13}C NMR (75 MHz, $CDCl_3$) (δ/ppm): 13.60, 25.03, 27.81, 123.35, 125.27, 126.14, 126.95, 127.43, 128.06, 128.90, 129.17, 129.92, 133.17, 134.92, 138.81 139.49, 146.61, 152.35. MS *m*/*z* (%): 246 (M^+, 100), 212 (30) 125 (31). Anal. Calcd for $C_{18}H_{15}N$ (246): C, 88.13 %; H, 6.16 %; N, 5.71 %. Found; C, 88.12; % H, 6.09 %; N, 5.63 %.

Allyl 2, 4-dimethylquinoline-3-carboxylate (3e) : Viscose oil. Melting range 265-267 IR (KBr); 3032, 2988, 2961, 1624, 1577, 1498, 1267, 1221, 755 cm^{-1}. ^{1}H NMR (300 MHz $CDCl_3$) (δ/ppm): 2.65 (s, 3H), 2.70 (s, 3H), 4.82 (dt, 2H, *J* =2.40 & 5.25 Hz), 5.50 (dd, 2H, *J*= 1.56 & *J* = 15.0 Hz), 5.95-6.20 (m, 1H), 7.45-8.05 (m, 4H). MS *m*/*z* (%); 241 (M^{+1}). Anal. Calcd for $C_{15}H_{15}NO_2$ *(*241): C, 74.67 %; H, 7.6.27 %; N, 5.80 %. Found: C, 7.66 %; H, 6.38 %; N, 5.82 %.

Ethyl 2-methyl-4-phenylquinoline-3-carboxylate (3f) : Solid**.** Melting range 98-99 °C. IR (KBr): 3030, 2960, 1700, 1605, 1568, 1482, 905 cm^{-1}. ^{1}H NMR (300 MHz $CDCl_3$) (δ/ppm): 1.30 (t, 3H, *J* =7.0 Hz), 2.80 (s, 3H), 4.20 (q, 2H, *J*= 7.0 Hz), 7.30-7.60 (m, 6H) 7.75 (d, 1H, *J*=8.1 Hz), 7.80 (t, 1H, *J*=7.9 Hz), 8.10 (d, 1H, *J*= 8.1 Hz). ^{13}C NMR (75 MHz) (δ/ppm): 13.65, 23.32, 68.81, 96.14, 125.1, 126.1, 126.4, 127.8, 128.2, 129.1, 129.5, 135.7 (2C), 135.7, 145.7, 147.8, 153.6, 167.7. MS *m*/*z* (%): 291 (M^{+1}) (70), 281 (20), 264 (30), 246 (20), 221 (20), 207 (20), 191 (15), 147 (40), 133 (15), 73 (100) Anal. Calcd for $C_{19}H_{17}NO_2$ (291): C, 78.33 %; H, 5.88 %; N, 4.81 %. Found: C, 78.42 %; H, 5.91 %; N, 4.88 %.

1-(6-Chloro-2-methyl-4-phenylquinolin-3-yl) ethanone (3g) : Solid. Melting range. 149-150°C. IR (KBr): 3029, 2960, 1701, 1606, 1567, 1481, 909, 602 cm^{-1}. ^{1}H NMR (300 MHz $CDCl_3$) (δ/ppm): 1.98 (s, 3H), 2.66 (s, 3H), 7.30-7.20 (m, 7H), 8.00 (d, 1H, *J* =8.9 Hz). ^{13}C NMR (δ/ppm): 23.58, 31.60, 124.71, 125.82, 128.83, 129.11, 129.84, 130.85, 132.27, 134.49, 135.46, 142.95, 145.86, 153.87 (2C), 204.91; MS *m*/*z* (%): 295 (M^{+1} 100), 280 (25), 254 (10), 154 (15), 136 (20), 91 (35), 81 (60), 69 (40), 55 (50). Anal. Calcd for $C_{18}H_{14}NO_2Cl$ (295): C, 73.10 %; H, 4.77 %; N, 4.74 %. Found: C, 73.00 %; H, 4.60 %, N, 4.66 %.

7-Chloro-9-phenyl-2, 3-dihydro-1H-cyclopenta[b] quinoline (3h) : Solid.Melting range. 104-106 ^{0}C**.** IR (KBr): 3437, 3042, 2950, 1972, 1920, 1751, 1600, 1584, 1482, 1440, 1381, 1339, 1305, 1201, 1160, 1124, 1073, 1027, 949, 878, 828, 755, 705, 658 cm^{-1}. ^{1}H NMR (δ/ppm): 2.10-2.20 (m, 2H), 2.90 (t, 2H, *J* =7.2 Hz), 3.20 (t, 2H, *J* =7.0 Hz), 7.30-7.55 (m, 7H), 7.95 (d, 1H, *J* = 8.5 Hz). ^{13}C NMR (δ/ppm): 23.28, 30.99, 35.01, 124.42, 125.22, 126.91, (2C), 128.25, 129.01 (3C), 129.84, 130.35, 131.20, 138.11, 141.82, 144.90, 162.77. MS *m*/*z* (%): 279 (M^+), 280 (100), 276, 246, 230, 203, 190, 179, 158, 150, 128. Anal Calcd for $C_{18}H_{14}ClN$ (279): C, 73.10 %; H, 4.775; N, 4.74 %. Found: C, 73.0 %; H, 4.60 %; N, 4.66 %.

Isopropyl-6-chlro-2-methyl-4-phenylquinoline-3-carboxylate (3i) : Solid Melting range. 124-125°C. IR (KBr): 3426, 3055, 2982, 2928, 1900, 1722, 1606, 1579, 1560, 1477, 1448, 1390, 1309, 1278, 1225, 1187, 1107, 1085, 954, 908, 878, 829, 804, 760, 703 cm^{-1}. ^{1}H NMR (300 MHz $CDCl_3$) (δ/ppm): 0.90 (d, 6H, *J*=6.1 Hz), 2.70 (s, 3H), 4.80 (heptet, 1H, *J*=6.1 Hz), 7.30 (d, 2H, *J*=7.65 Hz) 7.40 (t, 4H, *J*=7.65 Hz), 7.55 (dd, 1H, *J*=9.0 & 2.2 Hz), 7.90 (d, 1H, *J*=8.4 Hz). MS *m*/*z* (%): 340 (M^+, 40), 292 (100), 264 (16). Anal. Calcd for $C_{20}H_{18}ClNO_2$ (340): C, 70.69 %; H, 5.34 %; N, 4.12 %; O, 9.42 %; Cl, 10.43 %. Found: C, 70.60 %; H, 5.30 %; N, 4.02 %: O, 9.32 %; Cl, 10.33 %.

2-Tert-butyl-7-chloro-9-phenyl-1, 2, 3, 4-tetrahydroacridine (3j) : Solid Melting range. 154-155 ^{0}C. IR (KBr): 3040, 2980, 2890, 1600, 1560, 1475, 1370, 1360, 1160, 1070, 950, 825, 760, 700 cm^{-1}. ^{1}H

NMR (300 MHz $CDCl_3$) (δ/ppm): 0.87 (s, 9H), 1.41-1.62 (m, 2H), 2.20-2.35 (m, 2H), 2.60-2.70 (m, 1H), 3.00-3.15 (m, 1H), 3.22-3.33 (m, 1H), 7.18-7.23 (m, 3H), 7.50-7.60 (m, 4H), 7.90 (d, 1H, *J*= 8.87 Hz). ^{13}C NMR (125 MHz, $CDCl_3$) (δ/ppm): 23.99, 27.1 (3C), 29.34, 32.49, 34.75, 44.56, 124.50, 127.4 (2C), 128.75, 129.02 (3C), 129.61, 129.85, 130.04, 131.11, 136.32, 144.63, 145.90, 159.72. MS *m*/*z* (%): 350 (M^{+1} 31.4), 349 (85), 293 (48), 292 (100), 57 (60). Anal. Calcd for $C_{23}H_{24}Cl$ N (350.167); C, 78.965 %; H, 6.91 %; N, 4.00 %, Cl, 10.13 %. Found: C, 78.79 %; H, 6.84 %; N, 3.78 %.Cl, 9.98 %.

7-Chloro-3, 3-dimethyl-9-phenyl-3, 4-dihydroacridine-1(2H)-one (3k) : Yellow solid. Melting range. 219-220 ^{0}C. IR (KBr): 3074, 2952, 2866, 1696, 1554, 1477, 1384, 1297, 1198, 1079, 837, 699 cm^{-1}. ^{1}H NMR ($CDCl_3$, 300 MHz) (δ/ppm): 1.15 (s, 6H), 2.52 (s, 2H), 3.23 (s, 2H), 7.15 (t, 2H), 7.36-7.37 (s, 1H), 7.48-7.53 (t, 3H) 7.64-7.69 (dd, 1H, J_1= 9.06, J_2= 2.26 Hz), 7.95-7.99 (d, 1H, *J*= 9.06 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) (δ/ppm): 24.14, 27.14 (2C), 45.23, 55.10, 127.23, 127.92 (2C), 128.20, 129.10 (3C), 129.95, 131.15, 132.62, 133.55, 139.26, 146.24, 148.36, 158.77, 197.64; MS *m*/*z* (%): 336 (500), 280 (60), 250 (40), 245 (140), 217 (80), 249 (100), 131 (120), 113 (60).Anal. Calcd for $C_{21}H_{18}ClNO$: C, 75.10 %; H, 5.40 %; N, 4.17 %. Found: C, 75.07 %; H, 5.42 %; N, 4.18 %.

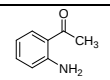
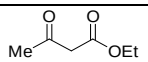
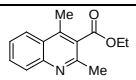
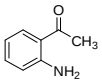
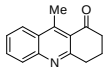
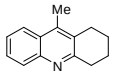
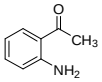
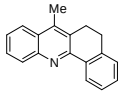
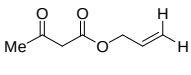
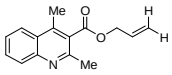
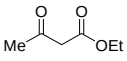
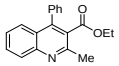
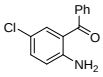
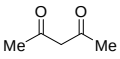
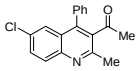
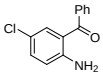
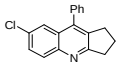
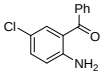
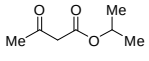
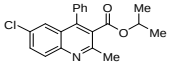
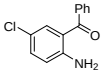
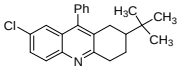
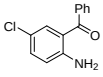
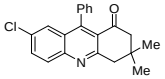
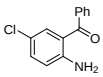
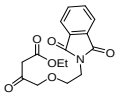
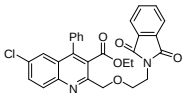
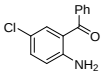
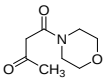
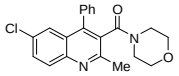
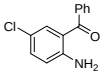
Ethyl-6-chloro-2-(2-pthalimidoethoxy methyl)-4-phenyl quinoline-3-carboxylate (3l) : Yellow solid: Melting range.165-166 ^{0}C. ^{1}H NMR ($CDCl_3$, 300 MHz) (δ/ppm): 0.95 (t, 3H *J* = 7.5 Hz), 3.70 (t, 2H, *J* =6.0 Hz), 3.81-3.87 (t, 2H, *J* = 6.0 Hz), 4.05 (q, 2H *J* = 7.5 Hz), 4.90 (s, 2H), 7.29-7.34 (m, 3H) 7.45-7.51 (m, 4H) 7.61-7.73 (m, 2H) 7.77-7.83 (m, 2H), 7.80-8.02 (d, 1H, *J* = 9.0 Hz): ^{13}C NMR (75 MHz, $CDCl_3$) (δ/ppm): 13.50, 37.34, 60.37, 67.55, 73.48, 123.32 (2C), 126.93 (2C), 127.10, 127.50 (2C), 129.22 (3C), 130.06, 131.75, 132.01 (2C), 132.04, 132.20 (2C), 138.15, 148.44, 149.20, 159.55, 167.25 (2C), 168.10; MS *m*/*z* (%): 515 (1050), 370 (200), 342 (100), 245 (250), 108 (100), 217 (100), 149 (100), 131 (150). Anal. Calcd for $C_{29}H_{23}ClN_2O_5$: 515.1373, Found; 515.1359.

(6-Chloro-2-methyl-4-phenyl quinolin-3-yl)(morpholino) methanone (3m) : Yellow solid; Melting range. 187-189 ^{0}C. ^{1}H NMR ($CDCl_3$, 300 MHz**)** (δ/ppm): 2.68 (s, 3H), 2.75-2.91 (m, 2H,) 2.97-3.22 (m, 2H), 3.27-3.40 (m, 1H), 3.45-3.63 (m, 3H), 7.23-7.33 (m, 1H), 7.46-7.68 (m, 6H), 8.03 (d, 1H, *J*= 9.14 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) (δ/ppm): 14.43, 41.35 (2C), 66.27 (2C), 124.14, 125.67 (2C), 127.01, 129.14 (3C), 129.27, 130.06, 131.00, 132.42, 138.12, 143.3, 146.11, 155.12, 166.85. MS *m*/*z* (%): 367 (M^+100).

(R)-6-Chloro-2-methyl-4-phenyl–N-(1-phenylethyl) quinoline-3-carboxamide (3n) : Yellow solid; Melting range. 225-227 ^{0}C. ^{1}H NMR ($CDCl_3$, 300 MHz) (δ/ppm):1.15 (d, 3H, *J*=6.80 Hz), 2.80 (s, 3H), 5.05 (d, 1H, J_1 = 6.80 Hz, J_2=7.55 Hz), 5.50 (broad doublet, NH, *J*= 7.55 Hz), 6.91-7.00 (m, 2H), 7.19-7.29 (m, 4H), 7.34-7.43 (m, 2H), 7.47-7.56 (m, 3H), 7.61-7.66 (dd, 1H, J_1= 9.06 Hz, J_2= 2.26 Hz), 7.997-8.02 (d, 1H, *J*= 9.06 Hz); ^{13}C NMR(δ/ppm): 14.43, 23.50, 48.63, 125.10, 126.97, 126.10, 127.31, 127.42, 127.53, 128.71, 128.82, 129.32, 129.43, 129.43, 130.51, 130.72, 130.84, 132.21, 134.66, 138.72, 141.84, 144.01, 145.88, 155.80, 166.67. MS (ESI); *m*/*z* (%) 401 (M^+100).

6-Chloro-2-methyl-4-phenyl-N-P-tolylquinoline-3-carboxamide (3o) : Melting range 227-229 ^{0}C. ^{1}H NMR ($CDCl_3$, 300 MHz) (δ/ppm): 2.29 (s, 3H), 2.83 (s, 3H), 6.80 (s, 1H, NH), 6.93-7.01 (m, 4H), 7.40-7.55 (m, 7H), 8.00 (d, 1H, *J*= 9.06, Hz). MS (ESI); *m*/*z* (%) 387.20 (M^+ 100).

Table 2. Chloramine-T catalyzed Friedlander synthesis of quinolines

Entry	2-Amino ketone	Ketone/ diketones	Product	Time (h)	Yield (%)
a				4.0	95
b				3.5	89
c				4.0	87
d				3.5	88
e				3.0	92
f				3.0	93
g				4.0	91
h				4.5	85
i				3.0	91
j				4.0	90
k				3.5	94
l				4.5	89
m				5.0	90
n				4.5	86
o				4.0	87

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