Efficient [5+1] Synthesis of 4-Quinolones by Domino Amination and Conjugate Addition Reactions of 1-(2-Fluorophenyl)prop-2-yn-1-ones with Amines

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Abstract: A catalyst-free synthetic approach is described for the synthesis of 4-quinolone derivatives through a tandem amination/conjugated Michael addition sequence of 1-(2-fluorophenyl)prop-2-yn-1-one derivatives. The [5+1]-cyclization proceeds efficiently at a high temperature under an inert atmosphere with lithium carbonate as a base, and it provides a practical route to a diverse range of 4-quinolones. The mechanism was studied in details and several of the intermediates were isolated.

Key words: quinones, ketones, domino reactions, aminations, Michael additions, heterocycles

Functionalized quinolines are attractive compounds for use in drug discovery because many of them exhibit excellent biological activities.[1] It is well known that the quinoline core exists in many natural products.[2,3] Seven of the 200 best-selling drugs in the world contain a quinoline or quinolone framework in the form of the parent heterocycle or a reduced derivative thereof. For example, oxoindeno[1,2-*b*]quinoline derivatives show strong binding to DNA and efficient inhibition of DNA topoisomerase I. These properties are associated with their pronounced anticancer activities.[4] The drug irinotecan is a well-known representative of this family of compounds that prevents DNA from unwinding. In chemical terms, it is a semisynthetic analogue of the natural alkaloid camptothecin.[3]

Other quinoline-containing drugs[5] include mefloquine,[5a–c] montelukast,[5d,e] and aripiprazole.[5f–j] Mefloquine is a leukotriene receptor antagonist that is used for maintenance treatment of asthma and to relieve symptoms of seasonal allergies. Aripiprazole represents a class of antidepressant agents used in the treatment of schizophrenia, bipolar disorder, and clinical depression. Additionally, it shows antipsychotic action. Fluoroquinolones occupy a special position among drugs containing a quinoline core. The four representatives shown in Figure 1 are among the 200 best-selling drugs in the world. Quinoline derivatives have also found applications as chiral ligands for organocatalysis.[6] In view of the importance of quinolines, continual efforts have been made to develop new methods for the synthesis of these heterocyclic scaffolds.[7,8]

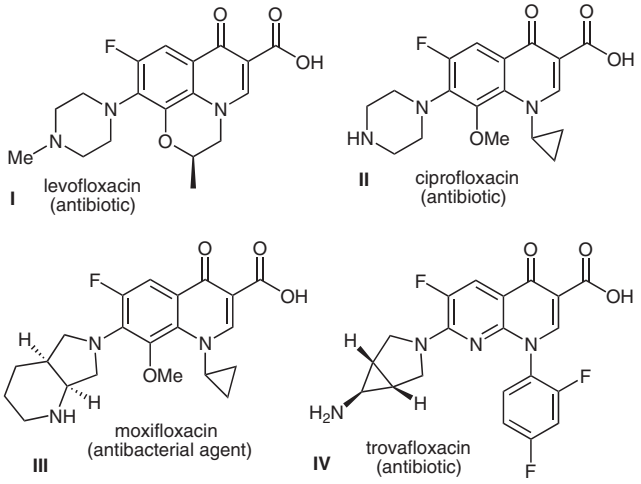

Figure 1 Marketed drugs containing a quinolone framework

As a continuation of our ongoing research program on the design and synthesis of drug-like scaffolds containing a pyridine core,[9] we have attempted to develop a new and efficient strategy for the assembly of functionalized quinolin-4-ones. Recent advances in the synthesis of pyridines, quinolines, and fused pyridines by [5 + 1]-cyclization strategies include several efficient methods for the construction of such heterocyclic scaffolds.[10]

On the basis of our previous experience,[10m] we hypothesized that the quinolin-4-one framework might be assembled in a catalyst-free manner from phenylpropyn-1-ones containing a good leaving group in the *ortho*-position of the aryl part of the molecule. It is known[9c,11] that fluoro or nitro groups[12] located in the position *ortho* or *para* to an electron-withdrawing substituent can be easily substituted by a range of soft or strong nucleophiles. Many nucleophilic substitution reactions of aromatic and heteroaromatic cores in which fluorine serves as the leaving group are known.

Here, we describe the development of a strategy for the synthesis of functionalized quinolin-4-ones by a two-component reaction of 1-(2-fluorophenyl)prop-2-yn-1-ones with amines. We examined this reaction for a series of 1-(2-fluorophenyl)prop-2-yn-1-one derivatives **3**, obtained in good to excellent yields from commercially available alkynes and fluorinated benzoyl chlorides **1** by a Sonogashira reaction (Scheme 1).

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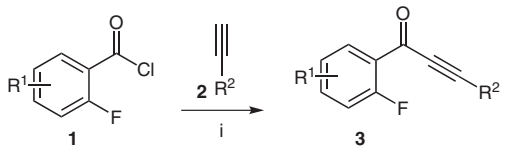


3a R^1 = H, R^2 = Ph (88%)
3b R^1 = H, R^2 = 4-*t*-BuC_6H_4 (78%)
3c R^1 = 5-F, R^2 = 4-*t*-BuC_6H_4 (84%)
3d R^1 = 5-F, R^2 = 4-MeC_6H_4 (91%)
3e R^1 = 4-F, R^2 = 4-MeC_6H_4 (97%)
3f R^1 = 6-F, R^2 = Ph (70%)
3g R^1 = 6-F, R^2 = 4-MeC_6H_4 (73%)
3h R^1 = 6-F, R^2 = 4-*t*-BuC_6H_4 (80%)
3i R^1 = 6-F, R^2 = $(CH_2)_4$Me (70%)
3j R^1 = 3,4,5,6-F, R^2 = 4-*t*-BuC_6H_4 (75%)

Scheme 1 *Reagents and conditions:* (i): $PdCl_2(PPh_3)_2$ (2 mol%), CuI (4 mol%), THF, dry argon.

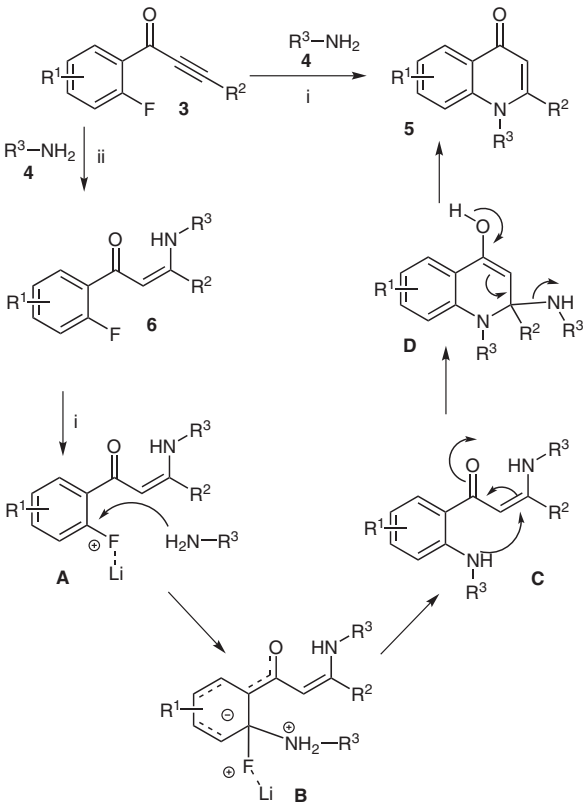
As a first step, we treated the model compound **3a** with two equivalents of (2-phenylethyl)amine in *N*, *N*-dimethylformamide at 140 °C in the presence of potassium carbonate as a base. The first trial gave an 18% yield of the desired 1-substituted quinolin-4-one **5a** after 10 hours of heating (Table 1, entry 1). The crucial conditions for this cyclization appeared to be the temperature, the solvent, and the base–reaction time combination. The best yields were obtained by conducting the reaction for 24 hours in *N*,*N*-dimethylacetamide at 160 °C with lithium carbonate as the base. When the lithium salt was used, the yield of **5a** increased from 51% to 89% (entries 6 and 7). We believe that the lithium(1+) ion coordinates with the fluorine atom, facilitating the nucleophilic substitution (Scheme 2). Furthermore, when we used 1.2 equivalents of the amine, the yield of **5a** decreased to 71%.

Table 1 Optimization of the Synthesis of **5a**

	Conditions	Temp (°C)	Time (h)	Yield (%) of **5a**[a]
1	**4** (2 equiv), DMF, K_2CO_3	140	10 h	18
2	**4** (2 equiv), DMF, Li_2CO_3	140	10 h	25
3	**4** (2 equiv), DMA, K_2CO_3	160	12 h	35
4	**4** (2 equiv), DMA, Li_2CO_3	160	12 h	58
5	**4** (2 equiv), DMA, Li_2CO_3	160	18 h	73
6	**4** (2 equiv), DMA, K_2CO_3	160	24 h	51
7	**4** (2 equiv), DMA, Li_2CO_3	160	24 h	89
8	**4** (1.2 equiv), DMA, Li_2CO_3	160	24 h	75

[a] Yield of pure compound.

Having identified the optimal conditions, we investigated the scope of the reaction with respect to the amine **4** and the fluorine-containing substrate **3**. By using the optimized conditions, we conducted a series of tandem [5+1]-cyclizations of various amines **4** with fluoro ynones **3a** and **3b** to give the corresponding quinolin-4-ones **5a**–**h** (Table 2). Generally, aliphatic amines gave good to excellent yields of the corresponding products, whereas anilines gave good yields. However, the reaction failed in the case of electron-deficient heteroaromatic amines such as benzo[*d*]thiazol-2-amine, pyrimidin-2-amine, or pyridin-2-amine. In general, we observed a slight deviation from the optimal reaction time of 24 hours for some amines. The reaction was therefore conducted for 30 hours and monitored by thin-layer chromatography. This allowed us to achieve complete conversion of the starting 1-(2-fluorophenyl)prop-2-yn-1-ones **3a** and **3b**.



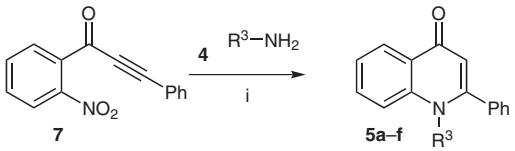
Scheme 2 *Reagents and conditions:* (i) Li_2CO_3, DMA, 160 °C, 24–30 h; (ii) DMF, 100 °C, 10 h.

These results gave us an incentive to test another good leaving group that is often used in aromatic nucleophilic substitution reactions, namely the nitro group. Bearing in mind that the nitro group is often considered to be a better leaving group than the fluoro group, we studied the reaction of the nitro ynone **7** with aliphatic and aromatic amines **4** (Scheme 3). Nitro compound **7** was synthesized by same protocol as that which we developed for the synthesis of compounds **3** through a Sonogashira coupling reaction of commercially available 2-nitrobenzoyl chloride. The cyclization reactions could be performed under milder conditions (*N*,*N*-dimethylformamide, potassium carbonate, 130 °C). The presence of the nitro group did not increase the yields in comparison with those of **5a**–**f**, but nevertheless the 4-quinolones were obtained in good yields (Table 3). However, this variant lacks diversity with regard to the availability of substrates bearing a nitro group at the 2-position of the aryl moiety.

Table 2 Synthesis of Quinolones **5**

Product	Fluoro compound	R^1	R^2	R^3	Yield (%)[a]
5a	**3a**	H	Ph	$(CH_2)_2Ph$	89 (79)[b]
5b	**3a**	H	Ph	$(CH_2)_3Ph$	86 (80)[b]
5c	**3a**	H	Ph	CH_2-4-$MeOC_6H_4$	87 (77)[b]
5d	**3a**	H	Ph	$(CH_2)_4Me$	84 (79)[b]
5e	**3a**	H	Ph	$(CH_2)_5Me$	89 (78)[b]
5f	**3a**	H	Ph	3,5-$(MeO)_2C_6H_3$	74 (70)[b]
5g	**3b**	H	4-*t*-BuC_6H_4	4-ClC_6H_4	75 (70)[c]
5h	**3b**	H	4-*t*-BuC_6H_4	4-BrC_6H_4	73 (64)[c]
5i	**3c**	6-F	4-*t*-BuC_6H_4	3,5-$(MeO)_2C_6H_3$	77 (60)[d]
5j	**3c**	6-F	4-*t*-BuC_6H_4	4-$MeOC_6H_4$	78 (64)[d]
5k	**3d**	6-F	4-Tol	$(CH_2)_5Me$	85
5l	**3d**	6-F	4-Tol	$(CH_2)_2Ph$	88
5m	**3d**	6-F	4-Tol	$(CH_2)_3Ph$	83
5n	**3e**	7-F	4-Tol	4-*t*-BuC_6H_4	75
5o	**3e**	7-F	4-Tol	3,5-$Me_2C_6H_3$	79
5p	**3f**	5-F	Ph	3,5-$Me_2C_6H_3$	77
5q	**3h**	5-F	4-*t*-BuC_6H_4	3,5-$(MeO)_2C_6H_3$	73
5r	**3g**	5-F	4-Tol	3,5-$Me_2C_6H_3$	71
5s	**3g**	5-F	4-Tol	4-EtC_6H_4	70
5t	**3i**	5-F	$(CH_2)_4Me$	4-$MeOC_6H_4$	72

[a] Yield of pure compound is shown in parentheses.
[b] This compound was obtained starting from **7**.
[c] This compound was obtained starting from **6b**.
[d] This compound was obtained starting from **6a**.



Scheme 3 *Reagents and conditions:* (i) K_2CO_3, DMF, 130 °C, 6 h.

When alkynes **3g–i**, which contain a second fluorine atom, were investigated, we observed an interesting phenomenon. When the second fluorine was located in a position *ortho* or *para* to the carbonyl group, it was substituted by an amine to give the amino-substituted quinolones **8a–i** and **9a** (Table 3, entries 1–9 and 12). Substrates with the second fluorine in a *meta*-position did not react with amines and, in this case, the reaction gave the corresponding quinolin-4-ones **5i–m** which contain a fluorine group in the 6-position.

Nevertheless, double substitution occurred only with aliphatic amines. The use of anilines under our standard reaction conditions did not result in substitution of the second fluoro group, and products **5n–t** were obtained. However, this result gave us the opportunity of substituting the second activated fluorine in compounds **5o**, **5r**, and **5s** with aliphatic amines to give the quinolones **8j**, **8k**, and **9b**, respectively.

On analyzing the reaction mixtures from **5s** and **5t**, we detected the disubstituted products **8f** and **8i**, respectively, but their yields never exceeded 3–5%. Next, we were interested in developing the procedure to introduce a second molecule of the aniline. We therefore treated **3g**, **3i**, **5s**, and **5t**, with 4-ethylaniline or 4-methoxyaniline under harsher reaction conditions by using *N*-methyl-2-pyrrolidone as the solvent and conducting the reactions at 185 °C for at least 30 h. This resulted in the synthesis of 4-quinolones **8f** (entry 6) and **8i** (entry 9).

Alkyne derivative **3j** containing a pentafluorophenyl group failed to react under any of the previously mentioned reaction conditions, while its reaction with amines gave complex inseparable mixtures. We failed in our attempts to isolate at least one component in a pure form.

To demonstrate the scope of the reaction we also investigated the reactions of diamines, which gave the corresponding *N*,*N*′-linked 4-quinolones **10** (Figure 2). This result shows that our method might be useful, for instance, in the construction of quinolin-4-one-group-containing dendrimers.

The structures of the quinolin-4-ones **5**, **8**, and **9** was established unambiguously by one- and two-dimensional NMR spectrometric methods and the structures of scaffolds **5** and **8** were corroborated by X-ray diffraction analysis (Figures 1–3 in the Supporting Information).[13] On the basis of the examples of the molecular structures of compounds **5g**, **5q**, and **8b**, the structure of the quinolin-4-one scaffold was established unambiguously.

To obtain an insight into the reaction mechanism, we attempted to detect possible intermediates of the cyclization reaction. When we performed the reaction in *N*,*N*-dimethylformamide at 100 °C for ten hours, a single spot that was different from the product or the starting materials was identified by thin-layer chromatographic analysis. We also observed similar spots after the addition of two equivalents of lithium carbonate. These intermediates were isolated and their structures were examined by one- and two-dimensional NMR methods and shown to be those of compounds **6a** and **6b** (Figure 3). Under the standard reaction conditions with one equivalent of the appropriate amine, the formation of the corresponding quinolone was observed after 24 hours. It is also worthwhile mentioning that, in the case of bulky amines such as 1-adamantylamine, the reaction under standard conditions

Table 3 Synthesis of Quinolones **8** and **9**

Entry	Product	Fluoro compound	R^2	R^3	R^4	Yield (%)[a]
1	**8a**	**3h**	4-*t*-BuC_6H_4	$(CH_2)_3Ph$	$(CH_2)_3Ph$	82
2	**8b**	**3h**	4-*t*-BuC_6H_4	CH_2-4-$MeOC_6H_4$	CH_2-4-$MeOC_6H_4$	85
3	**8c**	**3h**	4-*t*-BuC_6H_4	$(CH_2)_2Ph$	$(CH_2)_2Ph$	93
4	**8d**	**3g**	4-Tol	$(CH_2)_2$-3,4-$(MeO)_2C_6H_3$	$(CH_2)_2$-3,4-$(MeO)_2C_6H_3$	85
5	**8e**	**3g**	4-Tol	(*R*)-CH(Ph)Me	(*R*)-CH(Ph)Me	40[b]
6	**8f**	**3g**	4-Tol	4-EtC_6H_4	4-EtC_6H_4	72[c] (79)[c,d]
7	**8g**	**3i**	$(CH_2)_4Me$	$(CH_2)_2Ph$	$(CH_2)_2Ph$	82
8	**8h**	**3i**	$(CH_2)_4Me$	$(CH_2)_3Ph$	$(CH_2)_3Ph$	75
9	**8i**	**3i**	$(CH_2)_4Me$	4-$MeOC_6H_4$	4-$MeOC_6H_4$	74[c] (80)[c,d]
10	**8j**	**3g**	4-Tol	3,5-$(Me)_2C_6H_3$	$(CH_2)_2Ph$	97
11	**8k**	**3g**	4-Tol	4-EtC_6H_4	$(CH_2)_2Ph$	84
12	**9a**	**3g**	4-Tol	(*R*)-CH(Ph)Me	(*R*)-CH(Ph)Me	33[b]
13	**9b**	**3g**	4-Tol	3,5-$(Me)_2C_6H_3$	$(CH_2)_5Me$	79

[a] Yield of pure compound.
[b] In this case reaction took 60 h.
[c] In NMP at 185 °C for 30 h under argon.
[d] This compound was obtained starting from **5s** or **5t**.

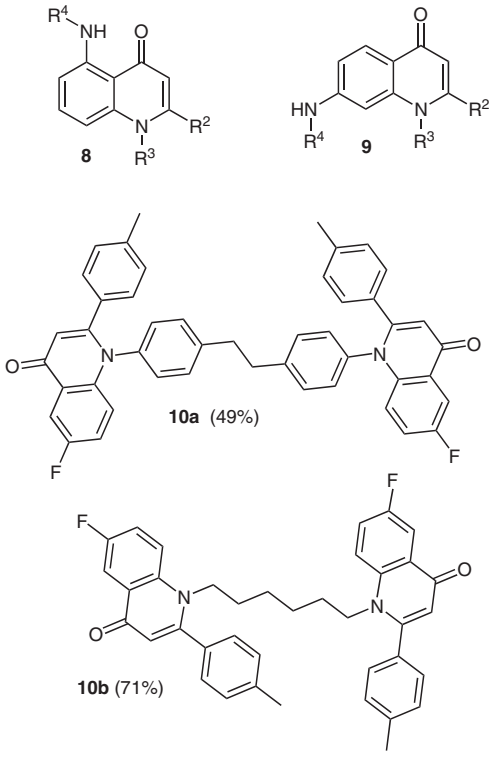


Figure 2 *Reagents and conditions:* For **8** and **9**: Li_2CO_3, DMA, 160 °C, 24–30 h; for **10**: Li_2CO_3, DMA, 160 °C, 60 h.

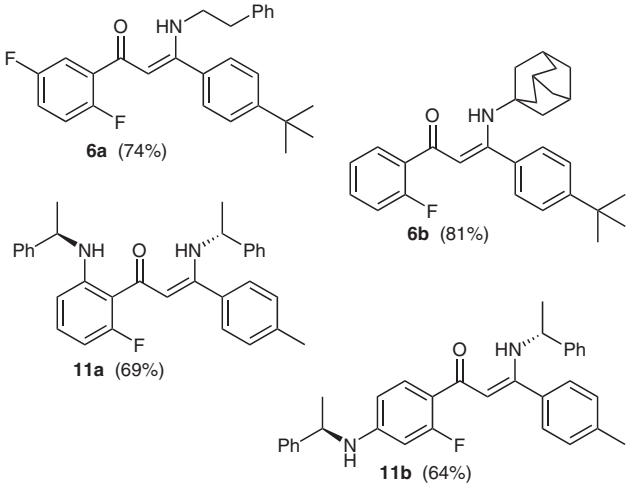


Figure 3 *Reagents and conditions:* (**6**): Li_2CO_3, DMF, 100 °C, 10 h; (**11**): Li_2CO_3, DMF, 130 °C, 15 h.

gave compound **6b** as the single product. The reaction failed when the open-chain product **6b** was subjected to harsh conditions such as treatment with potassium carbonate in *N*-methyl-2-pyrrolidone at 190 °C or in diphenyl ether at 220 °C. In contrast, the reaction of **6b** with two equivalents of 4-chloroaniline or 4-bromoaniline gave compounds **5g** and **5h** in 70% and 64% yield, respectively. The same reactivity was observed for **6a** with 3,5-dimethoxyaniline or 4-methoxyaniline, which gave compounds **5i** and **5j**, respectively. Finally, the structure of compound **6b** was established by X-ray crystal structure analysis (Figure 4 in the Supporting Information).[13]

On the basis of these results, we believe that the one-pot synthesis of 4-quinolones **5** proceeds by reaction of alkynes **3** with amines **4** to give intermediates **6**, which can be isolated and identified (Scheme 2). Subsequent coordination of the lithium cation onto a fluorine atom gives intermediate **A**, which undergoes an aromatic nucleophilic substitution involving Meisenheimer complex **B**. Subsequent elimination of the fluorine anion in the form of lithium fluoride gives intermediate **C**. This undergoes an intermolecular Michael addition via intermediate **D** to give the quinolin-4-one **5**.

To obtain additional support for this mechanism, we treated bulky (*R*)-(+)-(1-phenylethyl)amine with alkyne **3e**. We chose the enantiomerically pure *R*-enantiomer to avoid formation of any diastereomeric pairs when two molecules of amine added to the alkyne moiety. Compound **11a** was obtained as a single product. It is necessary to admit that sterically less-hindered amines reacted with **3** to give **5** directly, and the isolation of intermediates **C** was not possible, even when the reaction was conducted under milder conditions.

In contrast, when 1-(2,6-difluorophenyl)-3-(4-tolyl)prop-2-yn-1-one (**3g**), which contains a second activated fluorine atom in the *para*-position, was treated with (*R*)-(+)-(1-phenylethyl)amine, formation of the intermediate **11b** (Figure 3) was observed. Furthermore, by using our standard reaction conditions and two equivalents of the corresponding amine, intermediates **11** reacted to form the quinolin-4-ones **8e** and **9a**. As mentioned above, in the case of alkyne **3j**, which contains five fluorine atoms, reaction with any type of amine always resulted in the formation of a complex mixture of inseparable products. The structure of the important intermediate **11a** was established by X-ray crystal structure analysis (Figure 5 in the Supporting Information).[13]

In conclusion, we examined the domino reaction of 1-(2-fluorophenyl)prop-2-yn-1-ones **3** with aliphatic and aromatic amines **4** in detail. The reaction provides a practical synthetic route to a set of functionalized 1-substituted quinolin-4-ones. The mechanism of this transformation was investigated and a number of intermediates were isolated and identified. The scope and limitations of the reaction have been studied.

The dry solvents DMF, DMA, NMP, and THF were purchased directly from Acros Organics as AcroSeal bottles. Other solvents were purified by distillation. All reactions were carried out under an inert atmosphere.

^{1}H and ^{13}C NMR spectroscopy: Bruker AV 300 and Bruker AV 400 spectrometers. References: 0.00 ppm for TMS, 7.26 ppm for $CDCl_3$ (^{1}H NMR) and 0.00 ppm for TMS, 77.00 ppm for $CDCl_3$ (^{13}C NMR). The DEPT method was used for determining the presence of primary, secondary, tertiary and quaternary carbon atoms. The ^{1}H NMR spectra were measured with standard number of scans; ^{13}C NMR spectra were measured with standard number of scans or when necessary, with 4000 scans. In case of unclear assignment all possible hydrogen and carbon atoms were stated. ^{19}F NMR spectra were recorded on a Bruker AV 300 (282 MHz) spectrometer. The spectra were measured with standard number of scans. Mass spectrometry (MS): Finnigan MAT 95 XP (electron ionisation EI, 70 eV). High-resolution MS (HRMS): Finnigan MAT 95 XP. Only the measurements with an average deviation from the theoretical mass of ± 2 mDa were accounted as correct. Infrared spectroscopy (IR): Nicolet 550 FT-IR spectrometer with ATR sampling technique for solids as well as liquids. Signal characterization: w = weak, m = medium, s = strong. X-ray crystallography: STOE imaging plate diffraction systems with monochromatic Mo-Kα radiation. Elemental analysis (EA): Leco 932 C, H, N, S. UV/Vis spectroscopy: Lambda 2 (Perkin-Elmer). Melting point determination (mp): Micro-Hot-Stage Galen^{TM} III Cambridge Instruments. The melting points are not corrected. Thin layer chromatography (TLC): Merck Silica 60 F254 aluminum-backed plates from Macherey-Nagel. Detection with UV light at 254 nm and afterwards development with vanillin–sulfuric acid solution (6 g vanillin, 2.5 mL concd H_2SO_4, 250 mL EtOH).[33] Column chromatography: Separation on Fluka silica gel 60 (0.063–0.200 mm, 70–320 mesh). Eluents were distilled before use. Alkynes **2** and amines **4** are commercially available compounds.

The quinolin-4-one formation reaction is extremely sensitive to the quality of the reagents and to the presence of moisture in solvents, on glassware, and in the Li_2CO_3. The amines should also be dry. Dried solvents and anhyd Li_2CO_3 should be used because the presence of H_2O markedly decreases the overall yields.

1-(2-Fluorophenyl)prop-2-yn-1-ones 3 and 1-(2-Nitrophenyl)-3-phenylprop-2-yn-1-ones 7: General Procedure

A Schlenk flask was charged with $PdCl_2(PPh_3)_2$ (0.02 equiv) and CuI (0.04 equiv) then degassed and backfilled with argon. THF (20 mL/g) and the appropriate 2-fluorobenzoyl chloride derivative **1** (1 equiv) or 2-nitrobenzoyl chloride derivative were added. When this had dissolved, Et_3N (1.5 equiv, previously purged with argon) was added, and the flask was degassed and refilled with argon. The degassing/refilling procedure was repeated three times to ensure that the reaction was not affected by O_2 from the air. The appropriate alkyne **2** was then added (1.3 equiv) and the mixture was stirred for 15 h at r.t. When the reaction was complete (TLC), distilled H_2O was added and the mixture was extracted with CH_2Cl_2. The organic layers were collected, dried (Na_2SO_4), and concentrated to give a residue that was purified by column chromatography [silica gel, heptane–EtOAc (30:1)].

1-(2-Fluorophenyl)-3-phenylprop-2-yn-1-one (3a)

Yellow oil; yield: 3.94 g (88%).

IR (ATR): 3063 (w), 2195 (s), 1627 (s), 1606 (s), 1482 (s), 1453 (s), 1306 (s), 1228 (m), 1203 (s), 1154 (m), 1101 (m), 1026 (m), 1010 (s), 994 (s), 839 (m), 778 (m), 747 (s), 686 (s), 617 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 6.97–7.03 (m, 1 H, CH_{Ar}), 7.08–7.14 (m, 1 H, CH_{Ar}), 7.20–7.32 (m, 3 H, CH_{Ar}), 7.37–7.50 (m, 3 H, CH_{Ar}), 7.95 (dt, ^3J = 7.6 Hz, ^4J = 1.7 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 88.1 (C), 92.5 (t, ^4J = 3.1 Hz, C), 116.7 (d, ^3J = 22.2 Hz, CHAr), 119.5 (C), 123.8 (d, ^4J = 4.0 Hz, CH), 125.1 (d, ^4J = 7.5 Hz, C), 128.3, 130.6, 131.4, 132.7 (CH), 135.3 (d, ^3J = 8.8 Hz, CH), 159.9, 163.3, 173.5 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.3.

MS (GC, 70 eV): *m/z* (%) = 224 (58) [M$^+$], 196 (100), 129 (72).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{15}H_9FO$: 224.06319; found: 224.063269.

3-(4-*tert*-Butylphenyl)-1-(2-fluorophenyl)prop-2-yn-1-one (3b)

Yellow oil; yield: 4.37 g (78%).

IR (ATR): 2162 (w), 2193 (s), 1629 (s), 1606 (s), 1504 (w), 1481 (m), 1453 (s), 1364 (w), 1305 (s), 1267 (m), 1207 (s), 1187 (m), 1154 (m), 1100 (m), 1006 (s), 834 (s), 776 (m), 749 (s), 679 (m), 637 (s), 564 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.33 (s, 9 H, *t*-Bu), 7.14–7.21 (m, 1 H, CH_{Ar}), 7.24–7.29 (m, 1 H, CH_{Ar}), 7.43 (dt, ^3J = 8.6 Hz, ^4J = 1.9 Hz, 2 H, CH_{Ar}), 7.53–7.58 (m, 1 H, CH_{Ar}), 7.60 (dt, ^3J = 8.6 Hz, ^4J = 1.9 Hz, 2 H, CH_{Ar}), 8.10 (dt, ^3J = 7.6 Hz, ^4J = 1.9 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.0 (*t*-Bu), 35.1 (C), 88.4 (C), 99.8 (t, ^4J = 3.2 Hz, C), 117.0 (d, ^4J = 6.7 Hz, CHAr), 117.3 (C), 124.1 (d, ^4J = 3.8 Hz, CH), 125.7, 131.8, 133.1 (CH), 135.4 (d, ^3J = 8.7 Hz, CH), 154.7, 160.0, 164.2, 174.3 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.0.

MS (GC, 70 eV): *m/z* (%) = 280 (30) [M^+], 265 (100), 123 (17).

HRMS (EI): *m/z* [M^+] calcd for $C_{19}H_{17}FO$: 280.12579; found: 280.126387.

3-(4-*tert*-Butylphenyl)-1-(2,5-difluorophenyl)prop-2-yn-1-one (3c)
Yellow oil; yield: 5.00 g (84%).

IR (ATR): 2962 (w), 2186 (s), 1634 (m), 1589 (m), 1487 (s), 1419 (s), 1364 (s), 1312 (m), 1291 (m), 1252 (s), 1190 (m), 1154 (s), 1101 (m), 1037 (m), 1010 (m), 914 (m), 884 (w), 823 (s), 778 (m), 753 (s), 702 (m), 654 (m), 564 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.22 (s, 9 H, *t*-Bu), 7.01–7.08 (m, 1 H, CH_{Ar}), 7.11–7.19 (m, 1 H, CH_{Ar}), 7.33 (d, ^3J = 8.7 Hz, 2 H, CH_{Ar}), 7.50 (d, ^3J = 8.7 Hz, 2 H, CH_{Ar}), 7.62–7.68 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 30.9 (Me), 35.1, 88.1, 94.6, 116.7 (C), 117.4 (dd, ^3J = 24.9 Hz, ^4J = 1.2 Hz, CH), 120.1 (dd, ^1J = 221.8 Hz, ^2J = 9.5 Hz, CH), 120.5 (dd, ^1J = 221.8 Hz, ^2J = 9.5 Hz, CH), 125.7 (CH), 126.5 (dd, ^3J = 221.8 Hz, ^4J = 8.2 Hz, CH), 126.5 (C), 133.2 (CH), 155.0, 156.1 (C), 160.1 (d, ^4J = 4.6 Hz, C), 172.7 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.3 (d, ^3J = 18.2 Hz), –117.0 (d, ^3J = 18.2 Hz).

MS (GC, 70 eV): *m/z* (%) = 298 (26) [M^+], 283 (100), 141 (19).

HRMS (EI): *m/z* [M^+] calcd for $C_{19}H_{16}F_2O$: 298.11637; found: 298.116143.

1-(2,5-Difluorophenyl)-3-(4-tolyl)prop-2-yn-1-one (3d)
Yellow oil; yield: 4.66 g (91%); mp 69 °C.

IR (ATR): 2922 (w), 2187 (s), 1615 (m), 1582 (m), 1483 (m), 1420 (s), 1316 (m), 1925 (m), 1246 (s), 1191 (m), 1150 (s), 1108 (m), 1039 (m), 911 (m), 895 (m), 812 (s), 768 (m), 737 (s), 658 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.39 (s, 3 H, Me), 7.11–7.29 (m, 4 H, CH_{Ar}), 7.54–7.57 (m, 2 H, CH_{Ar}), 7.72–7.78 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.8 (Me), 88.2, 94.7, 116.7 (C), 117.2, 117.6 (CH), 120.1 (dd, ^1J = 223.6 Hz, ^2J = 6.9 Hz, CH), 120.5 (dd, ^1J = 223.6 Hz, ^2J = 6.9 Hz, CH), 126.5–126.7 (C), 129.5, 133.4 (CH), 142.0, 156.1–156.3, 160.2, 172.8 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.3 (d, ^3J = 18.3 Hz), –117.1 (d, ^3J = 18.3 Hz).

MS (GC, 70 eV): *m/z* (%) = 256 (67) [M^+], 228 (48), 207 (13), 143 (100), 63 (22).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{16}H_{11}F_2O$: 257.07725; found: 257.07736.

1-(2,4-Difluorophenyl)-3-(4-tolyl)prop-2-yn-1-one (3e)
Yellow oil; yield: 4.97 g (97%).

IR (ATR): 2198 (s), 1629 (m), 1601 (s), 1495 (m), 1426 (m), 1307 (s), 1267 (s), 1231 (m), 1198 (m), 1179 (m), 1104 (s), 1028 (m), 967 (m), 852 (s), 811 (s), 746 (s), 666 (m), 594 (s).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.39 (s, 3 H, Me), 7.11–7.29 (m, 4 H, CH_{Ar}), 7.54–7.57 (m, 2 H, CH_{Ar}), 7.72–7.78 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.7 (Me), 88.2, 94.0 (C), 105.2 (t, *J* = 22.6 Hz, CH), 111.86 (dd, *J* = 22.0 Hz, *J* = 3.9 Hz, CH), 116.8, 122.4–122.6 (C), 129.5, 133.2 (CH), 133.7 (dd, *J* = 11.2 Hz, *J* = 1.8 Hz, CH), 141.8 (C), 160.9 (d, *J* = 12.4 Hz, C), 164.2 (d, *J* = 12.0 Hz, C), 165.1 (d, *J* = 12.8 Hz, C), 168.3 (d, *J* = 12.5 Hz, CH), 172.7 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –106.0 (d, ^3J = 13.1 Hz), –99.7 (d, ^3J = 13.1 Hz).

MS (GC, 70 eV): *m/z* (%) = 256 (93) [M^+], 228 (95), 207 (16), 143 (100), 113 (23), 63 (28).

HRMS (EI): *m/z* [M + H]$^+$ calcd for $C_{16}H_{11}F_2O$: 257.07725; found: 257.07696.

1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-one (3f)
Yellow oil; yield: 3.39 g (70%).

IR (ATR): 3060 (w), 2193 (s), 1641 (s), 1619 (s), 1489 (w), 1464 (s), 1302 (m), 1288 (m), 1236 (m), 1202 (m), 1068 (w), 1031 (m), 1002 (s), 990 (s), 818 (w), 793 (s), 754 (s), 685 (s), 591 (w), 571 (s), 535 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 6.79–6.84 (m, 2 H, CH_{Ar}), 7.18–7.33 (m, 4 H, CH_{Ar}), 7.41–7.44 (m, 2 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 89.0 (C), 93.2 (t, ^4J = 2.0 Hz, C), 112.0 (d, ^4J = 3.1 Hz, CH), 112.3 (d, ^4J = 3.1 Hz, CH), 117.2 (t, ^3J = 15.0 Hz, C), 119.4 (C), 128.5, 131.0, 133.0 (C), 133.7 (t, ^3J = 10.3 Hz, CH), 158.5 (d, ^4J = 5.6 Hz, C), 162.6 (d, ^4J = 5.6 Hz, C), 171.1 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.0.

MS (GC, 70 eV): *m/z* (%) = 242 (44) [M^+], 214 (100), 129 (59).

HRMS (EI): *m/z* [M^+] calcd for $C_{15}H_8F_2O$: 242.05377; found: 242.053779.

1-(2,6-Difluorophenyl)-3-(4-tolyl)prop-2-yn-1-one (3g)
Yellow oil; yield: 3.74 g (73%).

IR (ATR): 3032 (w), 2189 (s), 1643 (s), 1619 (s), 1508 (m), 1302 (s), 1236 (s), 1202 (m), 1177 (m), 1067 (w), 1027 (m), 994 (s), 815 (s), 793 (s), 755 (w), 725 (m), 687 (w), 572 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.18 (s, 3 H, Me), 6.75–6.80 (m, 2 H, CH_{Ar}), 6.97–7.05 (m, 2 H, CH_{Ar}), 7.20–7.32 (m, 3 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.8 (Me), 89.2, 94.2 (C), 112.0 (d, *J* = 3.1 Hz, CH), 112.4 (d, *J* = 3.1 Hz, CH), 116.7 (C), 117.7 (t, *J* = 15.0 Hz, C), 129.4 (C), 132.0 (d, *J* = 3.1 Hz, C), 133.4 (CH), 142.0 (C), 158.8 (d, *J* = 5.7 Hz, C), 162.9 (d, *J* = 5.7 Hz, C), 171.3 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.0.

MS (GC, 70 eV): *m/z* (%) = 256 (81) [M^+], 228 (88), 143 (100).

HRMS (EI): *m/z* [M + H]$^+$ calcd for $C_{16}H_{11}F_2O$: 257.07725; found: 257.07721.

3-(4-*tert*-Butylphenyl)-1-(2,6-difluorophenyl)prop-2-yn-1-one (3h)
Yellow oil; yield: 4.77 g (80%).

IR (ATR): 2962 (w), 2191 (s), 1644 (s), 1619 (s), 1504 (w), 1465 (s), 1364 (w), 1302 (s), 1237 (s), 1205 (m), 1109 (w), 1067 (w), 1026 (s), 994 (s), 835 (s), 793 (s), 688 (m), 564 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.31 (s, 9 H, *t*-Bu), 6.95–7.01 (m, 2 H, CH_{Ar}), 7.39–7.48 (m, 3 H, CH_{Ar}), 7.54–7.58 (m, 2 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.0 (*t*-Bu), 35.1, 89.2, 94.2 (C), 112.1–112.5 (m, CH), 116.7 (C), 125.7, 133.2 (CH), 133.5 (t, *J* = 12.6 Hz, CH), 155.0 (C), 158.8 (d, *J* = 5.6 Hz, C), 162.9 (d, *J* = 5.7 Hz, C), 171.4 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.0.

MS (GC, 70 eV): *m/z* (%) = 298 (30) [M$^+$], 283 (100), 227(12), 141 (23).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{19}H_{16}FO$: 298.11637; found: 298.116627.

1-(2,6-Difluorophenyl)oct-2-yn-1-one (3i)
Yellow oil; yield: 3.30 g (70%).

IR (ATR): 2932 (w), 2862 (s), 2206 (m), 1650 (s), 1619 (s), 1466 (s), 1280 (m), 1252 (s), 1233 (s), 1121 (w), 1009 (s), 915 (w), 870 (w), 794 (s), 758 (w), 690 (w), 570 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.90 (t, ^3J = 7.2 Hz, 3 H, CH_3CH_2), 1.28–1.45 (m, 4 H, 2 × CH_2), 1.56–1.66 (m, 2 H, CH_2), 2.42 (t, ^3J = 7.1 Hz, 2 H, CCH_2), 6.94 (t, ^3J = 8.4 Hz, 2 H, CH_{Ar}), 7.37–7.44 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 12.9 (CH_3), 20.9, 27.5, 28.1, 47.1 (CH_2), 89.2, 94.2, 116.7 (C), 117.7 (t, ^3J = 15.0 Hz, C), 132.0 (d, J = 3.1 Hz, C), 133.4 (CH), 142.0 (C), 158.8 (d, J = 5.7 Hz, CH), 162.9 (d, J = 5.7 Hz, CH), 171.3 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.4.

MS (GC, 70 eV): *m/z* (%) = 236 (1) [M$^+$], 180 (17), 151 (21), 141 (100), 113 (17).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{14}H_{14}F_2O$: 236.10127; found: 236.10129.

3-(4-*tert*-Butylphenyl)-1-(pentafluorophenyl)prop-2-yn-1-one (3j)
Yellow oil; yield: 5.28 g (75%); mp 127–129 °C.

IR (ATR): 2961 (w), 1524 (m), 1498 (s), 1392 (w), 1363 (m), 1267 (w), 1116 (m), 1060 (m), 1017 (w), 987 (s), 964 (s), 835 (s), 771 (w), 736 (w), 651 (w), 561 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.33 (s, 9 H, *t*-Bu), 7.33–7.52 (m, 4 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.1 (*t*-Bu), 34.9 (d, ^4J = 2.8 Hz, C), 72.4 (m, C), 73.5, 81.5 (C), 100.6 (m, C), 101.9 (d, ^4J = 3.4 Hz, C), 118.7 (d, ^3J = 20.1 Hz, C), 125.5 (d, ^4J = 5.0 Hz, CH), 129.2 (m, C), 131.7, 132.2 (CHAr), 135.6–135.8 (m, C), 139.0–139.7 (m, C), 143.4 (C), 144.9–145.2 (m, C), 152.9 (d, ^3J = 36.6 Hz, C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –162.1, –153.3 (t, ^3J = 19.5 Hz), –136.3 to –136.2.

MS (GC, 70 eV): *m/z* (%) = 352 (100) [M$^+$].

HRMS (EI): *m/z* [M$^+$] calcd for $C_{19}H_{13}F_5O$: 352.08866; found: 352.08870.

4-Quinolones 5, 6, 8, 9, 10, 11: General Procedure
The 1-(2-fluorophenyl)prop-2-yn-1-one derivative **3** (1 mmol), amine **4** (2 mmol), and Li_2CO_3 (2 mmol, 0.148 g) were and dissolved in dry DMA (7 mL) in a pressure tube or a long Schlenk flask under a flow of dry argon. The mixture was heated at 160 °C for 24–30 h until the reaction was complete (TLC). The soln was evaporated under reduced pressure and the residue was purified by column chromatography [silica gel, heptane–EtOAc (3:1)]. Synthesis of compounds **10** generally took about 60 h. 4-Quinolones **5o**, **5r**, and **5s** were subsequently used as the starting materials for the synthesis of compounds **8h**, **8i**, and **9b**, respectively. Compounds **6** were synthesized analogously, but the reaction was conducted at 100 °C in DMF. For further modifications, see Tables 1 and 2.

2-Phenyl-1-(2-phenylethyl)quinolin-4(1*H*)-one (5a)
White solid, yield: 0.289 g (89%); mp 145–146 °C.

IR (ATR): 1616 (m), 1589 (s), 1553 (s), 1483 (m), 1416 (m), 1368 (w), 1311 (m), 1268 (m), 1174 (m), 1143 (m), 1074 (w), 1003 (w), 862 (w), 776 (m), 755 (s), 704 (s), 669 (m), 557 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.92 [t, ^3J = 7.6 Hz, 2 H, $(CH_2)_2$], 4.28 [t, ^3J = 7.6 Hz, 2 H, $(CH_2)_2$], 6.25 (s, 1 H, CH_{Ar}), 6.72–6.76 (m, 2 H, CH_{Ar}), 7.15–7.20 (m, 5 H, CH_{Ar}), 7.41–7.51 (m, 4 H, CH_{Ar}), 7.66–7.79 (m, 2 H, CH_{Ar}), 8.55 (dd, ^3J = 8.0 Hz, ^4J = 1.2 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 34.8, 49.4 (CH_2), 112.8, 116.2, 123.8, 127.0, 128.3, 128.5, 128.7, 128.8, 129.4, 132.5 (CH_{Ar}), 135.7, 136.8, 140.4, 154.9, 177.1 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 325 (31) [M$^+$], 234 (100), 132 (18).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{23}H_{19}NO$: 325.14612; found: 325.14617.

2-Phenyl-1-(3-phenylpropyl)quinolin-4(1*H*)-one (5b)
Yellow viscous oil; yield: 0.291 g (86%).

IR (ATR): 2937 (w), 1625 (s), 1594 (s), 1484 (m), 1463 (m), 1417 (s), 1299 (m), 1265 (m), 1212 (w), 1172 (m), 1078 (w), 1029 (w), 912 (w), 835 (s), 778 (m), 759 (s), 697 (s), 672 (s), 623 (m), 547 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.93–2.03 [m, 2 H, $(CH_2)_3$], 2.46 [t, ^3J = 7.6 Hz, 2 H, $(CH_2)_3$], 3.96–4.01 [m, 2 H, $(CH_2)_3$], 6.23 (s, 1 H, CH_{Ar}), 6.97–7.00 (m, 2 H, CH_{Ar}), 7.14–7.48 (m, 10 H, CH_{Ar}), 7.56–7.62 (m, 1 H, CH_{Ar}), 8.49 (dd, ^3J = 8.0 Hz, ^4J = 1.5 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 29.8, 32.6, 47.5 (CH_2), 112.8, 116.1, 123.7, 126.3, 127.0, 128.1, 128.2, 128.5, 128.8, 129.5, 132.3 (CH_{Ar}), 135.8, 139.8, 140.5, 154.6, 177.0 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 339 (35) [M$^+$], 375 (41), 361 (100), 243 (42), 91 (41).

HRMS (ESI): *m/z* [M$^+$] calcd for $C_{24}H_{21}NO$: 339.16177; found: 339.16188.

1-(4-Methoxybenzyl)-2-phenylquinolin-4(1*H*)-one (5c)
Yellow solid, yield: 0.297 g (87%); mp 209–210 °C.

IR (ATR): 1623 (m), 1598 (s), 1514 (s), 1487 (s), 1429 (m), 1361 (w), 1313 (m), 1251 (s), 1176 (s), 1143 (m), 1034 (m), 960 (m), 833 (s), 806 (m), 760 (s), 703 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 3.74 (s, 3 H, OMe), 5.20 (s, 2 H, CH_2), 6.33 (s, 1 H, CH_{Ar}), 6.78–6.81 (m, 2 H, CH_{Ar}), 6.87–6.90 (m, 2 H, CH_{Ar}), 7.30–7.42 (m, 7 H, CH_{Ar}), 7.48–7.54 (m, 1 H, CH_{Ar}), 8.50 (dd, ^3J = 8.7 Hz, ^4J = 1.5 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 51.7 (OMe), 55.2 (CH_2), 113.0, 114.4, 117.4, 123.7, 126.6, 126.7 (CH_{Ar}), 127.2 (C_{Ar}), 128.1, 128.6, 129.6, 132.3 (CH_{Ar}), 135.6, 141.1, 155.1, 159.0, 177.5 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 341 (7) [M$^+$], 121 (100).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{23}H_{19}NO_2$: 341.14103; found: 341.14099.

1-Pentyl-2-phenylquinolin-4(1*H*)-one (5d)
Yellow oil; yield: 0.244 g (84%).

IR (ATR): 2927 (m), 2863 (m), 1618 (s), 1595 (s), 1480 (s), 1422 (m), 1308 (m), 1267 (m), 1177 (m), 1080 (m), 963 (w), 835 (s), 756 (s), 703 (s), 668 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.73 [t, ^3J = 7.0 Hz, 3 H, $CH_3(CH_2)_3CH_2$], 1.03–1.13 [m, 4 H, $CH_3(CH_2)_3CH_2$], 1.57–1.67 [m, 2 H, $CH_3(CH_2)_3CH_2$], 3.95 [t, ^3J = 8.0 Hz, 2 H, $CH_3(CH_2)_3CH_2$], 6.19 (s, 1 H, CH_{Ar}), 7.31–7.36 (m, 3 H, CH_{Ar}), 7.43–7.51 (m, 4 H, CH_{Ar}), 7.61–7.67 (m, 1 H, CH_{Ar}), 8.46 (dd, ^3J = 8.0 Hz, ^4J = 1.6 Hz, 1 H,CH_{Ar}).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 12.9 (CH_3), 20.9, 27.5, 28.1, 47.1 (CH_2), 111.7, 115.3, 122.5, 125.9 (CH_{Ar}), 126.3 (C_{Ar}), 127.2, 127.7 (CH_{Ar}), 128.1 (C_{Ar}), 128.4, 131.2 (CH_{Ar}), 135.0, 139.6, 153.5, 176.3 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 291 (50) [M$^+$], 234 (100), 132 (17).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{20}H_{21}NO$: 291.16177; found: 291.16171.

1-Hexyl-2-phenylquinolin-4(1*H*)-one (5e)
Yellow oil; yield: 0.271 g (89%).

IR (ATR): 3044 (w), 2927 (m), 1617 (m), 1594 (s), 1570 (m), 1479 (s), 1421 (m), 1306 (m), 1266 (m), 1177 (m), 1138 (m), 1035 (w), 923 (w), 835 (s), 758 (s), 703 (s), 668 (m), 550 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 0.79 [t, ^3J = 7.2 Hz, $CH_3(CH_2)_4CH_2$, 3 H], 1.06–1.20 [m, 6 H, $CH_3(CH_2)_4CH_2$], 1.60–1.68 [m, 2 H, $CH_3(CH_2)_4CH_2$], 4.00 [t, ^3J = 8.0 Hz, 2 H, $CH_3(CH_2)_4CH_2$], 6.27 (s, 1 H, CH_{Ar}), 7.36–7.42 (m, 3 H, CH_{Ar}), 7.46–7.54 (m, 3 H, CH_{Ar}), 7.66–7.71 (m, 1 H, CH_{Ar}), 8.51 (dd, ^3J = 8.0 Hz, ^4J = 1.6 Hz, 1 H, CH_{Ar}).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 13.8 (CH_3), 22.2, 26.0, 28.6, 30.9, 48.2 (CH_2), 112.7, 116.2, 123.6, 127.0 (CH_{Ar}), 127.2 (C_{Ar}), 128.3, 128.7, 129.4, 132.2 (CH_{Ar}), 136.0, 140.5, 154.7, 177.0 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 305 (56) [M^+], 234 (100), 132 (17).

HRMS (EI): *m/z* [M^+] calcd for $C_{21}H_{23}NO$: 305.17742; found: 305.17731.

1-(3,5-Dimethoxyphenyl)-2-phenylquinolin-4(1*H*)-one (5f)
Light-yellow solid; yield: 0.264 g (74%); mp 216–218 °C.

IR (ATR): 3035 (w), 2197 (w), 1628 (m), 1590 (s), 1462 (s), 1417 (s), 1359 (m), 1314 (m), 1264 (m), 1205 (s), 1150 (s), 1053 (s), 927 (m), 891 (w), 830 (m), 773 (m), 754 (s), 712 (s), 639 (w) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 3.66 (s, 6 H, 2 × OMe), 6.10 (s, 1 H, CH_{Ar}), 6.47 (t, ^4J = 2.1 Hz, 1 H, CH_{Ar}), 6.64 (d, ^4J = 2.4 Hz, 2 H, CH_{Ar}), 6.99 (d, ^3J = 8.6 Hz, 1 H, CH_{Ar}), 7.25–7.29 (m, 3 H, CH_{Ar}), 7.38–7.43 (m, 3 H, CH_{Ar}), 7.58–7.64 (m, 1 H, CH_{Ar}), 8.25 (dd, ^3J = 7.8 Hz, ^4J = 1.4 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, DMSO): δ = 55.5 (OMe), 100.8, 108.6, 111.2, 118.3, 123.6, 125.1 (CH), 125.4 (C), 127.6, 128.6, 129.0, 132.2 (CH), 133.0, 135.5, 140.3, 142.1, 153.8, 160.7, 176.0 (C).

MS (GC, 70 eV): *m/z* (%) = 357 (100) [M^+], 329 (42).

HRMS (EI): *m/z* [M^+] calcd for $C_{23}H_{19}NO_3$: 357.13594; found: 357.136003.

2-(4-*tert*-Butylphenyl)-1-(4-chlorophenyl)quinolin-4(1*H*)-one (5g)
Yellow oil; yield: 0.290 g (75%).

IR (ATR): 2962 (w), 1631 (s), 1603 (s), 1557 (w), 1505 (m), 1489 (s), 1408 (m), 1318 (m), 1269 (m), 1137 (w), 1081 (m), 1023 (m), 970 (w), 833 (s), 742 (s), 666 (m), 638 (m), 548 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.25 (s, 9 H, *t*-Bu), 6.42 (s, 1 H, CH_{Ar}), 6.87 (d, ^3J = 8.6 Hz, 1 H, CH_{Ar}), 7.04–7.11 (m, 4 H, CH_{Ar}), 7.20–7.22 (m, 2 H, CH_{Ar}), 7.32–7.50 (m, 4 H, CH_{Ar}), 8.50 (dd, ^3J = 8.1 Hz, ^4J = 1.3 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.1 (*t*-Bu), 34.6 (C), 112.8, 117.7, 123.9, 125.0, 126.4, 128.9, 129.8, 131.3, 131.9 (CH), 132.4, 134.8, 137.8, 142.5, 152.1, 153.9, 178.1 (C).

MS (GC, 70 eV): *m/z* (%) = 387 (100) [M^+], 372 (46), 344 (20).

HRMS (EI): *m/z* [M^+] calcd for $C_{25}H_{22}ClNO$: 387.13844; found: 387.138553.

2-(4-*tert*-Butylphenyl)-1-(4-bromophenyl)quinolin-4(1*H*)-one (5h)
Beige solid; yield: 0.315 g (73%); mp 245–245 °C.

IR (ATR): 2962 (w), 1630 (s), 1602 (s), 1505 (w), 1486 (s), 1469 (m), 1408 (m), 1363 (w), 1318 (m), 1269 (m), 1137 (w), 1068 (w), 1020 (m), 670 (w), 876 (w), 832 (s), 744 (s), 730 (m), 666 (m), 637 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.25 (s, 9 H, *t*-Bu), 6.49 (s, 1 H, CH_{Ar}), 6.88 (d, ^3J = 8.9 Hz, 1 H, CH_{Ar}), 7.02–7.07 (m, 4 H, CH_{Ar}), 7.20–7.23 (m, 2 H, CH_{Ar}), 7.35–7.51 (m, 4 H, CH_{Ar}), 8.50 (dd, ^3J = 7.9 Hz, ^4J = 1.2 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.1 (*t*-Bu), 34.6 (C), 112.7, 117.7 (CH), 122.9 (C), 124.1, 125.0, 126.4, 128.9, 131.6, 132.1, 132.8 (CH), 138.3, 152.2, 154.2, 172.7, 177.6, 186.6 (C).

MS (GC, 70 eV): *m/z* (%) = 433 (100) [M^+], 431 (99), 416 (36), 388 (17), 309 (11), 207 (15).

HRMS (EI): *m/z* [M^+] calcd for $C_{25}H_{22}BrNO$: 431.08793; found: 431.087506.

2-(4-*tert*-Butylphenyl)-1-(3,5-dimethoxyphenyl)-6-fluoroquinolin-4(1*H*)-one (5i)
Yellow solid; yield: 0.332 g (77%); mp 121 °C.

IR (ATR): 2961 (w), 1611 (s), 1579 (s), 1506 (w), 1456 (s), 1427 (m), 1386 (m), 1290 (m), 1252 (m), 1193 (m), 1152 (s), 1057 (m), 1012 (w), 930 (m), 834 (s), 700 (m), 603 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.24 (s, 9 H, *t*-Bu), 3.67 (s, 6 H, 2 × OMe), 6.29 (q, ^4J = 2.3 Hz, 2 H, CH_{Ar}), 6.38–6.40 (m, 2 H, CH_{Ar}), 7.04–7.24 (m, 6 H, CH_{Ar}), 8.10 (dd, ^3J = 8.9 Hz, ^4J = 3.0 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.1 (*t*-Bu), 34.6 (C), 55.6 (2 × OMe), 101.1, 108.3 (CH), 110.3 (d, ^2J = 22.4 Hz, CHAr), 111.8 (CHAr), 120.1–120.6 (m, CHAr), 124.8 (CHAr), 127.4 (d, ^4J = 7.0 Hz, C), 128.6 (CHAr), 132.5, 138.8, 140.5, 152.0, 154.0, 157.2, 161.3, 177.0 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.8.

MS (GC, 70 eV): *m/z* (%) = 431 (100) [M^+], 416 (42).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{27}H_{27}FNO_3$: 432.19695; found: 432.19788.

2-(4-*tert*-Butylphenyl)-6-fluoro-1-(4-methoxyphenyl)quinolin-4(1*H*)-one (5j)
White solid; yield: 0.313 g (78%); mp 185 °C.

IR (ATR): 2958 (w), 1609 (s), 1580 (m), 1505 (s), 1480 (s), 1391 (m), 1361 (m), 1294 (m), 1243 (s), 1173 (s), 1135 (m), 1084 (w), 1032 (m), 927 (m), 884 (m), 860 (w), 832 (s), 795 (s), 713 (w), 631 (m), 540 (s) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.23 (s, 9 H, *t*-Bu), 3.78 (s, 3 H, OMe), 6.42 (s, 1 H, CH_{Ar}), 6.83–6.86 (m, 2 H, CH_{Ar}), 6.90–6.95 (m, 2 H, CH_{Ar}), 7.01–7.08 (m, 4 H, CH_{Ar}), 7.14–7.21 (m, 2 H, CH_{Ar}), 8.10 (dd, ^3J = 8.9 Hz, ^4J = 2.9 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.1 (*t*-Bu), 34.6 (C), 55.5 (OMe), 110.6 (d, *J* = 19.8 Hz, CH), 114.7, 120.1 (CH), 120.5 (d, *J* = 7.4 Hz, CH), 124.8, 128.9, 130.8 (CH), 131.7, 132.5, 139.5, 151.8, 154.7, 157.2, 159.5, 161.2 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.8.

MS (GC, 70 eV): *m/z* (%) = 401 (100) [M^+], 386 (29), 358 (13).

HRMS (EI): *m/z* [M^+] calcd for $C_{26}H_{24}FNO_2$: 401.17856; found: 401.179009.

6-Fluoro-1-hexyl-2-(4-tolyl)quinolin-4(1*H*)-one (5k)
White solid; yield: 0.286 g (85%); mp 181–182 °C.

IR (ATR): 3470 (m), 2928 (m), 1597 (s), 1564 (s), 1510 (m), 1471 (s), 1397 (m), 1299 (m), 1255 (w), 1205 (w), 1160 (m), 1115 (w), 1007 (w), 936 (m), 892 (m), 846 (s), 821 (s), 710 (m), 617 (m).

^1H NMR (300 MHz, $CDCl_3$): δ = 0.77 [t, ^3J = 7.3 Hz, 3 H, $CH_3(CH_2)_4CH_2$], 1.07–1.18 [m, 6 H, $CH_3(CH_2)_4CH_2$], 1.59–1.64 [m, 2 H, $CH_3(CH_2)_4$ CH_2], 2.42 (s, 3 H, Me), 3.99 [t, ^3J = 8.2 Hz, 2 H, $CH_3(CH_2)_4CH_2$], 6.16 (s, 1 H, CH_{Ar}), 7.22–7.29 (m, 4 H, CH_{Ar}), 7.74–7.41 (m, 1 H, CH_{Ar}), 7.49–7.53 (m, 1 H, CH_{Ar}), 8.10 (dd, ^3J = 9.0 Hz, ^4J = 3.0 Hz, 1 H,CH_{Ar}).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 13.8, 21.3 (Me), 22.3, 26.9, 28.6, 29.6, 48.4 (CH_2), 111.4 (d, *J* = 20 Hz, CHAr), 112.2 (CHAr), 118.6 (d, *J* = 8 Hz, CHAr), 120.5 (d, *J* = 27 Hz, CHAr), 128.1 (CHAr),

128.8 (d, J = 35 Hz, CAr), 129.4 (CHAr), 132.9, 137.1, 139.6, 154.8, 157.0, 160.9, 176.3 (CAr).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –118.8.

MS (GC, 70 eV): m/z (%) = 337 (52) [M^+], 266 (100), 150 (18).

HRMS (EI): m/z [M^+] calcd for $C_{22}H_{24}FNO$: 337.18419; found: 337.18421.

6-Fluoro-1-(2-phenylethyl)-2-(4-tolyl)quinolin-4(1*H*)-one (5l)
Yellow oil; yield: 0.314 g (88%).

IR (ATR): 1633 (m), 1613 (s), 1510 (m), 1479 (s), 1396 (m), 1350 (w), 1295 (m), 1203 (w), 1155 (m), 1063 (w), 1002 (w), 930 (m), 898 (m), 832 (s), 806 (m), 779 (m), 746 (m), 729 (m), 698 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.43 (s, 3 H, Me), 2.90 [t, ^3J = 7.5 Hz, 2 H, (CH_2)$_2$], 4.28 [t, ^3J = 7.5 Hz, 2 H, (CH_2)$_2$], 6.16 (s, 1 H, CH_{Ar}), 6.73–6.76 (m, 2 H, CH_{Ar}), 7.03–7.06 (m, 2 H, CH_{Ar}), 7.15–7.22 (m, 5 H, CH_{Ar}), 7.43–7.49 (m, 1 H, CH_{Ar}), 7.62–7.67 (m, 1 H, CH_{Ar}), 8.18 (dd, ^3J = 8.9 Hz, ^4J = 3.1 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.4 (Me), 34.5, 49.5 (CH_2), 111.8 (d, J = 21.4 Hz, CHAr), 112.3 (CHAr), 118.5 (d, J = 7.6 Hz, CHAr), 120.8 (d, J = 25.5 Hz, CHAr), 127.0, 128.1, 128.5, 128.8 (CHAr), 129.0 (d, J = 40 Hz, CAr), 132.7, 136.7, 137.0, 139.6, 155.0, 157.4, 160.7, 176.3 (CAr).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.8.

MS (GC, 70 eV): m/z (%) = 357 (1) [M^+], 234 (100).

HRMS (EI): m/z [M^+] calcd for $C_{24}H_{20}FNO$: 357.15289; found: 357.15290.

6-Fluoro-1-(3-phenylpropyl)-2-(4-tolyl)quinolin-4(1*H*)-one (5m)
White solid; yield: 0.308 g (83%); mp 163–165 °C.

IR (ATR): 2919 (w), 1634 (s), 1604 (s), 1576 (m), 1510 (m), 1470 (s), 1394 (m), 1295 (m), 1244 (w), 1201 (m), 1145 (s), 1055 (w), 975 (w), 930 (m), 888 (s), 833 (s), 822 (s), 746 (s), 700 (s), 561 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.84–1.92 [m, 2 H, (CH_2)$_3$], 2.35–2.41 [m, 5 H, Me, (CH_2)$_3$], 3.88–3.94 [m, 2 H, (CH_2)$_3$], 6.08 (s, 1 H, CH_{Ar}), 6.89–6.92 (m, 2 H, CH_{Ar}), 7.07–7.21 (m, 8 H, CH_{Ar}), 7.56–7.62 (m, 1 H, CH_{Ar}), 8.02 (dd, ^3J = 9.0 Hz, ^4J = 2.6 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 20.4 (Me), 29.9, 31.5, 46.6 (CH_2), 110.4 (d, J = 23 Hz, CHAr), 111.2 (CHAr), 117.4 (d, J = 7 Hz, CHAr), 119.1 (d, J = 25 Hz, CHAr), 125.3, 127.0, 127.2, 127.5 (CHAr), 127.8 (d, J = 27 Hz, CAr), 128.4 (CHAr), 131.7, 136.0 (CAr), 138.7 (d, J = 13 Hz, CHAr), 153.7, 156.0, 159.9, 175.3 (CAr).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –118.1.

MS (GC, 70 eV): m/z (%) = 371 (77) [M^+], 266 (100), 253 (19), 150 (20), 91 (27).

HRMS (EI): m/z [M^+] calcd for $C_{25}H_{22}FNO$: 371.16854; found: 371.16856.

1-(4-*tert*-Butylphenyl)-7-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one (5n)
Yellow solid; yield: 0.289 g (75%); mp 218–220 °C.

IR (ATR): 2963 (w), 1639 (s), 1601 (s), 1510 (s), 1449 (s), 1392 (s), 1306 (s), 1263 (m), 1175 (m), 1124 (w), 1083 (w), 1027 (w), 986 (w), 841 (s), 814 (s), 754 (w), 660 (w), 634 (w), 571 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.28 (s, 9 H, *t*-Bu), 2.24 (s, 3 H, Me), 6.43 (s, 1 H, CH_{Ar}), 6.59 (dd, ^3J = 11.2 Hz, ^4J = 2.2 Hz, 1 H, CH_{Ar}), 6.94–7.10 (m, 7 H, CH_{Ar}), 7.32–7.37 (m, 2 H, CH_{Ar}), 8.46–8.52 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.1 (Me), 31.2 (*t*-Bu), 34.8 (C), 104.2 (d, J = 27.6 Hz, CH), 112.5 (d, J = 22.3 Hz, CH), 112.7 (CH), 122.7 (C), 126.6, 128.5, 129.0, 129.1, 129.2 (CH), 132.5, 136.1, 138.7 (C), 144.2 (d, J = 11.5 Hz, C), 152.5, 154.9 (C), 164.7 (d, J = 249.5 Hz, C), 177.1 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –105.5.

MS (GC, 70 eV): m/z (%) = 385 (100) [M^+], 370 (59).

HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{26}H_{25}FNO$: 386.19147; found: 386.1918.

1-(3,5-Dimethylphenyl)-7-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one (5o)
Yellow solid; yield: 0.282 g (79%); mp 271–273 °C.

IR (ATR): 2917 (w), 1633 (s), 1601 (s), 1511 (w), 1441 (s), 1386 (s), 1313 (m), 1261 (m), 1166 (m), 1125 (m), 1080 (w), 1021 (w), 951 (w), 848 (s), 819 (s), 763 (m), 709 (m), 640 (w), 596 (w) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.24 (s, 6 H, 2 × Me), 2.25 (s, 3 H, Me), 6.37 (s, 1 H, CH_{Ar}), 6.57 (dd, ^3J = 11.3 Hz, ^4J = 2.4 Hz, 1 H, CH_{Ar}), 6.73 (s, 2 H, CH_{Ar}), 6.94–7.08 (m, 6 H, CH_{Ar}), 8.44–8.50 (m, 1 H, CH_{Ar}).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 21.0, 21.2 (Me), 104.2 (d, J = 27.1 Hz, CH), 112.4 (d, J = 23 Hz, CH), 112.6 (CH), 122.7 (C), 127.2, 128.5, 128.9 (CH), 129.1 (d, J = 10.6 Hz, CH), 130.7 (CH), 132.6 (C), 138.6 (d, J = 2.6 Hz, C), 139.5 (C), 144.1 (d, J = 11.3 Hz, C), 154.7, 163.0, 166.3, 177.1 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –105.7.

MS (GC, 70 eV): m/z (%) = 357 (100) [M^+], 329 (91), 150 (13).

HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{24}H_{21}FNO$: 358.16017; found: 358.16006.

1-(3,5-Dimethylphenyl)-5-fluoro-2-phenylquinolin-4(1*H*)-one (5p)
Light-yellow solid; yield: 0.264 g (77%); mp 132 °C.

IR (ATR): 3047 (w), 1614 (s), 1471 (s), 1403 (s), 1307 (m), 1198 (w), 1120 (w), 1056 (m), 932 (w), 846 (M), 799 (m), 753 (s), 728 (m), 702 (s), 648 (m), 536 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.21 (s, 6 H, 2 × Me), 6.36 (s, 1 H, CH_{Ar}), 6.69–6.72 (m, 3 H, CH_{Ar}), 6.91–6.98 (m, 2 H, CH_{Ar}), 7.12–7.20 (m, 5 H, CH_{Ar}), 7.30–7.37 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, DMSO-d_6): δ = 21.0 (Me), 110.1 (d, J = 17.4 Hz, CH), 114.1 (CH), 114.2 (d, J = 4.6 Hz, CH), 116.2 (d, J = 8.6 Hz, C), 127.3, 127.7, 128.6, 129.0, 130.5 (CH), 131.7 (d, J = 10.3 Hz, C), 135.2, 139.5 (C), 144.8 (d, J = 3.8 Hz, C), 153.4, 160.0, 163.5, 176.8 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –112.1.

MS (GC, 70 eV): m/z (%) = 343 (97) [M^+], 315 (100), 299 (14).

HRMS (EI): m/z [M^+] calcd for $C_{23}H_{18}FNO$: 343.13669; found: 343.137067.

2-(4-*tert*-Butylphenyl)-5-fluoro-1-(3,5-dimethoxyphenyl)quinolin-4(1*H*)-one (5q)
Yellow solid; yield: 0.315 g (73%); mp 263–265 °C.

IR (ATR): 3003 (w), 1621 (s), 1558 (m), 1517 (m), 1504 (m), 1447 (s), 1365 (m), 1291 (m), 1257 (m), 1171 (m), 1122 (w), 1023 (w), 1000 (w), 842 (s), 742 (s), 660 (m), 565 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.21 (s, 9 H, *t*-Bu), 3.65 (s, 6 H, 2 × OMe), 6.01 (s, 1 H, CH_{Ar}), 6.47–6.48 (m, 1 H, CH_{Ar}), 6.62–6.63 (m, 2 H, CH_{Ar}), 6.78 (d, ^3J = 9.1 Hz, 1 H, CH_{Ar}), 7.06–7.12 (m, 1 H, CH_{Ar}), 7.28 (br s, 4 H, CH_{Ar}), 7.50–7.57 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 28.9 (*t*-Bu), 32.3 (C), 52.9, 53.6 (OMe), 99.0, 106.5 (CH), 107.7 (d, J = 21.4 Hz, CH), 111.1, 112.4 (CH), 113.4 (C), 122.4, 126–9, 130.3 (CH), 138.6 (C), 142.3 (d, J = 4.4 Hz, C), 149.1, 151.0, 157.0, 158.0, 160.5, 173.0 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –113.4.

MS (GC, 70 eV): m/z (%) = 431 (100) [M^+], 416 (20), 388 (19).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{27}H_{27}FNO_3$: 432.19695; found: 432.19743.

1-(3,5-Dimethylphenyl)-5-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one (5r)
Yellow oil; yield: 0.253 g (71%); mp 133–134 °C.

IR (ATR): 2917 (w), 1633 (s), 1614 (s), 1510 (w), 1471 (s), 1398 (s), 1305 (m), 1195 (w), 1116 (w), 1089 (w), 1056 (m), 933 (w), 830 (s), 795 (m), 752 (s), 726 (m), 666 (w), 602 (w) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.22 (s, 6 H, 2 × Me), 2.24 (s, 3 H, Me), 6.32 (s, 1 H, CH_{Ar}), 6.67–6.72 (m, 3 H, CH_{Ar}), 6.89–7.03 (m, 6 H, CH_{Ar}), 7.27–7.35 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.0, 21.1 (Me), 109.9 (d, *J* = 21.5 Hz, CH), 114.2 (CH), 116.1 (d, *J* = 7.2 Hz, CH), 127.3, 128.4, 128.9, 130.5 (CH), 131.5 (d, *J* = 10.8 Hz, CH), 132.4, 138.5, 139.1, 139.4 (C), 144.8 (d, *J* = 3.8 Hz, C), 153.5, 160.0, 163.5, 176.8 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –112.3.

MS (GC, 70 eV): *m/z* (%) = 357 (79) [M$^+$], 329 (100).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{24}H_{21}FNO$: 358.16017; found: 358.16034.

1-(4-Ethylphenyl)-5-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one (5s)
Yellow solid; yield: 0.250 g (70%); mp 250–251 °C.

IR (ATR): 3057 (w), 2970 (w), 1633 (s), 1614 (s), 1511 (s), 1475 (s), 1407 (s), 1306 (m), 1253 (m), 1190 (w), 1122 (w), 1104 (w), 1037 (m), 920 (w), 857 (m), 831 (s), 789 (m), 747 (s), 650 (m), 598 (w) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.20 (t, ^3J = 7.7 Hz, 3 H, CH_3CH_2), 2.24 (s, 3 H, Me), 2.62 (q, ^3J = 7.7 Hz, 2 H, CH_3CH_2), 6.33 (s, 1 H, CH_{Ar}), 6.66 (d, ^3J = 8.8 Hz, 1 H, CH_{Ar}), 6.90–7.02 (m, 7 H, CH_{Ar}), 7.14–7.17 (m, 2 H, CH_{Ar}), 7.27–7.35 (m, 1 H, CH_{Ar}).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 15.1 (CH_3CH_2), 21.1 (Me), 28.4 (CH_3CH_2), 110.0 (d, *J* = 21.4 Hz, CH), 114.1 (d, *J* = 4.4 Hz, CH), 114.3, 128.5, 129.0, 129.6 (CH), 131.6 (d, *J* = 11.8 Hz, CH), 132.4, 136.9, 138.5 (C), 145.0 (d, *J* = 3.8 Hz, C), 145.3, 153.6, 160.0, 163.5 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –111.5.

MS (GC, 70 eV): *m/z* (%) = 357 (94) [M$^+$], 329 (100), 314 (18).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{24}H_{21}FNO$: 358.16017; found: 358.16061.

5-Fluoro-1-(4-methoxyphenyl)-2-pentylquinolin-4(1*H*)-one (5t)
Yellow oil; yield: 0.244 g (72%).

IR (ATR): 2923 (m), 1613 (s), 1507 (s), 1469 (s), 1408 (s), 1296 (m), 1235 (s), 1170 (m), 1107 (m), 1038 (s), 826 (m), 798 (m), 551 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.80 (t, ^3J = 6.7 Hz, 3 H, CH_3CH_2), 1.15–1.20 (m, 4 H, CH_2), 1.47–1.53 (m, 2 H, CH_2), 2.24 (t, ^3J = 7.2 Hz, 2 H, CCH_2), 3.91 (s, 3 H, OMe), 6.33 (s, 1 H, CH_{Ar}), 6.46 (d, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 6.87–6.93 (m, 1 H, CH_{Ar}), 7.07–7.18 (m, 4 H, CH_{Ar}), 7.23–7.31 (m, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 13.8 (CH_3CH_2), 22.3, 27.9, 31.2, 33.5 (CH_2), 55.7 (OMe), 109.9 (d, *J* = 23 Hz, CHAr), 111.7 (CHAr), 113.8 (d, *J* = 5 Hz, CHAr), 115.5, 130.1 (CHAr), 131.2–131.5 (m, CHAr), 145.5, 154.9, 159.7, 160.3, 162.9, 163.7, 176.9 (CAr).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –112.2.

MS (GC, 70 eV): *m/z* (%) = 339 (22) [M$^+$], 296 (17), 283 (100), 268 (13), 121 (29).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{22}H_{22}FNO_2$: 339.16291; found: 339.162750.

(2*Z*)-3-(4-*tert*-Butylphenyl)-1-(2,5-difluorophenyl)-3-[(2-phenylethyl)amino]prop-2-en-1-one (6a)
Yellow oil; yield: 0.31 g (74%).

IR (ATR): 2948 (w), 1568 (m), 1538 (m), 1484 (m), 1456 (m), 1412 (m), 1364 (w), 1327 (m), 1288 (m), 1267 (m), 1246 (m), 1161 (m), 1143 (m), 1099 (m), 1065 (w), 1019 (w), 990 (w), 908 (w), 844 (m), 814 (s), 794 (m), 776 (m), 743 (s), 697 (s), 632 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.32 (s, 9 H, *t*-Bu), 2.85 (t, ^3J = 6.9 Hz, 2 H, CH_2), 3.48 (q, ^3J = 6.9 Hz, 2 H, CH_2), 5.64 (s, 1 H, CHC), 6.95–7.01 (m, 2 H, CH_{Ar}), 7.07–7.09 (m, 2 H, CH_{Ar}), 7.16–7.25 (m, 5 H, CH_{Ar}), 7.37–7.40 (m, 2 H, CH_{Ar}), 7.49–7.54 (m, 1 H, CH_{Ar}), 11.47 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.2 (Me), 34.7 (C), 37.3, 46.5 (CH_2), 97.5 (d, ^4J = 9.9 Hz, CHAr), 116.4 (dd, ^3J = 24.8 Hz, ^4J = 3.5 Hz, CH), 117.0–118.2 (m, 2 × C–F), 125.4, 126.6, 127.4, 128.5, 128.8 (CHAr), 130.3 (dd, ^3J = 16.0 Hz, ^4J = 6.5 Hz, CH), 132.0, 138.1, 152.9, 154.2, 156.7, 158.1, 160.5, 167.6 (C), 182.8 (d, ^5J = 3.0 Hz, C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –118.8 (d, ^3J = 18.6 Hz), –118.1 (d, ^3J = 18.6 Hz).

MS (GC, 70 eV): *m/z* (%) = 419 (19) [M$^+$], 328 (100), 272 (10), 141 (51).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{27}H_{27}F_2NO$: 419.20552; found: 419.205681.

(2*Z*)-3-(1-Adamantylamino)-3-(4-*tert*-butylphenyl)-1-(2-fluorophenyl)prop-2-en-1-one (6b)
Yellow solid; yield: 0.349 g (81%); mp 116–118 °C.

IR (ATR): 2904 (m), 1610 (m), 1583 (s), 1493 (m), 1477 (m), 1448 (m), 1398 (w), 1338 (s), 1299 (s), 1208 (m), 1150 (m), 1098 (m), 1086 (m), 1028 (m), 880 (w), 839 (m), 760 (s), 676 (w), 628 (w), 582 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.29 (s, 9 H, *t*-Bu), 1.40–1.53 (m, 6 H, adamantyl), 1.73–1.74 (m, 6 H, adamantyl), 1.20 (br s, 3 H, adamantyl), 6.92–6.99 (m, 1 H, CH_{Ar}), 7.09 (dt, ^3J = 7.6 Hz, ^4J = 1.1 Hz, 1 H, CH_{Ar}), 7.20–7.32 (m, 6 H, CH_{Ar}), 7.76 (dt, ^3J = 7.7 Hz, ^4J = 1.9 Hz, 1 H, CH_{Ar}), 11.68 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 29.5 (CH), 31.3 (*t*-Bu), 34.7 (C), 35.9, 44.4 (CH_2), 55.2 (CH), 99.5 (C), 116.0 (d, *J* = 24.6 Hz, CH), 123.9 (d, *J* = 3.5 Hz, CH), 124.5, 127.8 (CH), 129.1 (d, *J* = 13.7 Hz, C), 130.4 (d, *J* = 3.0 Hz, CH), 131.4 (d, *J* = 8.8 Hz, CH), 134.8, 152.2, 158.3, 162.3, 167.3 (C), 183.8 (d, *J* = 3.1 Hz, C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –112.3.

MS (GC, 70 eV): *m/z* (%) = 431 (100) [M$^+$], 374 (41), 336 (24), 308 (67), 252 (17), 123 (52).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{29}H_{34}FNO$: 432.26244; found: 432.27007.

2-(4-*tert*-Butylphenyl)-1-(3-phenylpropyl)-5-[(3-phenylpropyl)amino]quinolin-4(1*H*)-one (8a)
Yellow solid; yield: 0.433 g (82%); mp 215–216 °C.

IR (ATR): 2951 (w), 1617 (s), 1520 (m), 1450 (s), 1386 (w), 1264 (s), 1167 (s), 1121 (w), 1015 (w), 909 (w), 840 (m), 740 (s), 697 (s), 563 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.39 (s, 9 H, *t*-Bu), 1.97–2.12 (m, 4 H, CH_2), 2.45 (t, ^3J = 7.5 Hz, 2 H, CH_2), 2.81 (t, ^3J = 7.5 Hz, 2 H, CH_2), 3.22 (t, ^3J = 6.4 Hz, 2 H, CH_2), 3.91 (t, ^3J = 8.0 Hz, 2 H, CH_2), 6.07 (s, 1 H, CH_{Ar}), 6.29–6.36 (m, 2 H, CH_{Ar}), 7.00–7.02 (m, 2 H, CH_{Ar}), 7.16–7.31 (m, 11 H, CH_{Ar}), 7.44–7.47 (m, 2 H, CH_{Ar}), 10.47 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 29.3, 30.2 (CH_2), 31.2 (*t*-Bu), 32.6, 33.3 (CH_2), 34.7 (C), 42.0, 48.0 (CH_2), 100.2, 101.9, 112.5 (CH_{Ar}), 113.2 (C), 125.5, 125.7, 126.1, 127.9, 128.1, 128.3, 128.4,

128.5 (CH_{Ar}), 132.9 (C), 133.3 (CH_{Ar}), 140.2, 141.7, 143.2, 152.1, 152.3, 153.0, 180.8 (C).

MS (GC, 70 eV): *m/z* (%) = 528 (33) [M^+], 437 (42), 423 (100), 305 (17), 91 (50).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{37}H_{41}N_2O$: 529.32134; found: 529.32191.

2-(4-*tert*-Butylphenyl)-1-(4-methoxybenzyl)-5-[(4-methoxybenzyl)amino]quinolin-4(1*H*)-one (8b)
Yellow solid; yield: 0.452 g (85%); mp 192–193 °C.

IR (ATR): 2955 (w), 1614 (s), 1504 (s), 1447 (s), 1360 (w), 1244 (s), 1170 (s), 1110 (m), 1030 (m), 925 (w), 814 (m), 740 (m), 676 (m), 561 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.31 (s, 9 H, *t*-Bu), 3.76 (s, 3 H, OMe), 3.78 (s, 3 H, OMe), 4.40 (s, 2 H, CH_2), 5.12 (s, 2 H, CH_2), 6.23–6.38 (m, 3 H, CH_{Ar}), 6.79–6.93 (m, 5 H, CH_{Ar}), 7.15–7.25 (m, 4 H, CH_{Ar}), 7.30–7.37 (m, 4 H, CH_{Ar}), 10.76 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 31.2 (*t*-Bu), 34.8 (C), 46.6, 52.4 (CH_2), 55.2, 55.3 (OMe), 102.4, 103.1 (CH_{Ar}), 112.6 (C), 113.2, 114.0, 114.2 (CH_{Ar}), 125.5, 126.8, 127.9, 128.3 (CH_{Ar}), 128.6, 130.9, 132.6 (C), 133.4 (CH_{Ar}), 143.6, 151.5, 152.7, 154.0, 158.6, 158.8, 180.8 (C).

MS (GC, 70 eV): *m/z* (%) = 532 (8) [M^+], 411 (47), 121 (100).

HRMS (EI): *m/z* [M^+] calcd for $C_{35}H_{36}N_2O_3$: 532.27204; found: 532.272902.

2-(4-*tert*-Butylphenyl)-1-(2-phenylethyl)-5-[(2-phenylethyl)amino]quinolin-4(1*H*)-one (8c)
Yellow solid; yield: 0.465 g (93%); mp 185–187 °C.

IR (ATR): 2962 (w), 1635 (m), 1614 (m), 1585 (m), 1464 (m), 1401 (m), 1328 (w), 1257 (w), 1197 (m), 1153 (s), 1122 (m), 1057 (m), 837 (s), 794 (w), 752 (m), 711 (m), 664 (m), 583 (m) cm^{-1}.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 1.35 (s, 9 H, *t*-Bu), 2.80–2.85 (m, 2 H, CH_2), 2.94 (t, ^3J = 7.0 Hz, 2 H, CH_2), 3.37–3.46 (m, 2 H, CH_2), 4.07 (t, ^3J = 8.1 Hz, 2 H, CH_2), 6.47 (d, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 6.71–6.74 (m, 2 H, CH_{Ar}), 6.90 (d, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 7.14–7.36 (m, 10 H, CH_{Ar}), 7.47–7.54 (m, 4 H, CH_{Ar}), 10.4 (t, ^3J = 5.1 Hz, 1 H, NH).

^{13}C NMR: Not recorded (insufficient solubility).

MS (GC, 70 eV): *m/z* (%) = 500 (3) [M^+], 409 (100), 289 (14), 105 (35).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{35}H_{37}N_2O$: 501.29004; found: 501.29016.

1-[2-(3,4-Dimethoxyphenyl)ethyl]-5-{[2-(3,4-dimethoxyphenyl)ethyl]amino}-2-(4-tolyl)quinolin-4(1*H*)-one (8d)
Yellow solid; yield: 0.491 g (85%); mp 85–87 °C.

IR (ATR): 2932 (w), 1616 (m), 1590 (m), 1505 (s), 1447 (m), 1257 (m), 1234 (s), 1138 (s), 1025 (s), 910 (w), 827 (m), 806 (m), 763 (m), 726 (m), 637 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.37 (s, 3 H, Me), 2.81 (t, ^3J = 7.4 Hz, 2 H, CH_2), 2.95–2.99 (m, 2 H, CH_2), 3.40–3.46 (m, 2 H, CH_2), 3.65 (s, 3 H, OMe), 3.80 (s, 3 H, OMe), 3.83 (s, 3 H, OMe), 3.87 (s, 3 H, OMe), 4.11 (t, ^3J = 7.4 Hz, 2 H, CH_2), 5.95 (s, 1 H, CH_{Ar}), 6.10 (d, ^4J = 2.0 Hz, 1 H, CH_{Ar}), 6.32 (dd, ^3J = 8.2 Hz, ^4J = 1.7 Hz, 1 H, CH_{Ar}), 6.38 (d, ^3J = 8.3 Hz, 1 H, CH_{Ar}), 6.61–6.67 (m, 2 H, CH_{Ar}), 6.79–6.87 (m, 3 H, CH_{Ar}), 6.98 (d, ^3J = 8.3 Hz, 2 H, CH_{Ar}), 7.19 (d, ^3J = 7.4 Hz, 2 H, CH_{Ar}), 7.42 (t, ^3J = 8.3 Hz, 1 H, CH_{Ar}), 10.51 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.1 (Me), 33.6, 34.9, 44.9, 49.7 (CH_2), 55.4, 55.6, 55.7, 55.8 (OMe), 110.3, 101.9, 111.1, 111.2, 111.4, 112.0 (CH), 112.5 (C), 113.0, 120.5, 128.2, 128.9 (CH), 129.4, 132.2, 132.9 (C), 133.3 (CH), 138.8, 143.0, 147.4, 147.7, 148.7, 148.8, 151.9, 152.9, 180.7.

MS (GC, 70 eV): *m/z* (%) = 578 (3) [M^+], 427 (100), 165 (85).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{36}H_{39}N_2O_5$: 579.28535; found: 579.2862.

1-[(1*R*)-1-Phenylethyl]-5-{[(1*R*)-1-phenylethyl]amino}-2-(4-tolyl)quinolin-4(1*H*)-one (8e)
Yellow solid; yield: 0.183 g (40%); mp 123–125 °C.

IR (ATR): 2966 (w), 1616 (s), 1519 (m), 1505 (s), 1445 (s), 1377 (m), 1339 (w), 1267 (m), 1216 (m), 1159 (s), 1019 (w), 827 (m), 744 (m), 697 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.54 (d, ^3J = 6.7 Hz, 3 H, $CHCH_3$), 1.78 (d, ^3J = 6.7 Hz, 3 H, $CHCH_3$), 2.30 (s, 3 H, Me), 4.43 (q, ^3J = 6.7 Hz, 1 H, $CHCH_3$), 5.68 (q, ^3J = 6.7 Hz, 1 H, $CHCH_3$), 5.94 (d, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 6.07 (d, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 6.11 (s, 1 H, CH_{Ar}), 6.80 (t, ^3J = 8.5 Hz, 1 H, CH_{Ar}), 7.07–7.34 (m, 14 H, CH_{Ar}), 10.81 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 17.3, 21.3, 25.0 (Me), 53.1, 58.9 (CH), 103.5, 105.3, 113.5, 125.1, 126.0, 126.7, 127.0, 127.5, 128.5, 128.7, 129.5, 132.0 (CH), 133.6, 139.5, 140.5, 141.8, 145.2, 150.9, 154.2, 181.0 (C).

MS (GC, 70 eV): *m/z* (%) = 458 (19) [M^+], 443 (22), 353 (100), 207 (28), 105 (19).

HRMS (EI): *m/z* [M^+] calcd for $C_{32}H_{30}N_2O$: 458.23527; found: 458.235207.

1-(4-Ethylphenyl)-5-[(4-ethylphenyl)amino]-2-(4-tolyl)quinolin-4(1*H*)-one (8f)
Yellow solid; yield: 0.362 g (79%); mp 174–175 °C.

IR (ATR): 2960 (w), 1623 (m), 1591 (s), 1564 (m), 1504 (m), 1441 (s), 1376 (w), 1342 (w), 1274 (s), 1176 (m), 1112 (w), 1038 (w), 1018 (w), 844 (s), 819 (s), 751 (m), 721 (m), 636 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.11–1.20 (m, 6 H, 2 × CH_3CH_2), 2.17 (s, 3 H, Me), 2.51–2.61 (m, 4 H, 2 × CH_3CH_2), 5.91 (dd, ^3J = 8.4 Hz, ^4J = 0.8 Hz, 1 H, CH_{Ar}), 6.22 (s, 1 H, CH_{Ar}), 6.84–6.95 (m, 7 H, CH_{Ar}), 7.00–7.12 (m, 5 H, CH_{Ar}), 7.18–7.21 (m, 2 H, CH_{Ar}), 11.99 (s, 1 H, NH).

^{13}C NMR (75.5 MHz, $CDCl_3$): δ = 15.2, 15.7 (2 × CH_3CH_2), 21.2 (Me), 28.3, 28.4 (2 × CH_3CH_2), 104.5, 104.9 (CH_{Ar}), 112.7 (C_{Ar}), 128.5, 128.6, 128.8, 129.0, 129.7, 132.5 (CH_{Ar}), 132.7, 137.4, 138.4, 138.7, 139.5, 144.9, 145.6, 148.9, 153.2, 181.4 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 458 (100) [M^+], 443 (38).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{31}N_2O$: 459.24309; found: 459.24294.

2-Pentyl-1-(2-phenylethyl)-5-[(2-phenylethyl)amino]quinolin-4(1*H*)-one (8g)
Yellow oil; yield: 0.359 g (82%).

IR (ATR): 2943 (w), 2865 (w), 1626 (s), 1596 (s), 1554 (m), 1516 (m), 1453 (w), 1365 (w), 1264 (s), 1208 (w), 1172 (m), 1080 (w), 1029 (w), 854 (w), 828 (m), 750 (m), 738 (m), 696 (s), 628 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.78–0.83 [m, 3 H, $CH_2(CH_2)_3CH_3$], 1.17–1.26 [m, 4 H, $CH_2(CH_2)_3CH_3$], 1.46–1.51 [m, 2 H, $CH_2(CH_2)_3CH_3$], 2.29 [t, ^3J = 6.5 Hz, 2 H, $CH_2(CH_2)_3CH_3$], 2.92–2.97 (m, 4 H, CH_2CH_2), 3.36 [t, ^3J = 7.3 Hz, 2 H, CH_2CH_2], 4.13 (t, ^3J = 7.3 Hz, 2 H, CH_2CH_2), 5.92 (s, 1 H, CH_{Ar}), 6.28 (d, ^3J = 8.7 Hz, 1 H, CH_{Ar}), 6.53 (d, ^3J = 8.7 Hz, 1 H, CH_{Ar}), 7.04–7.34 (m, 11 H, CH_{Ar}), 10.44 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 13.8 (CH_3CH_2), 22.3, 28.2, 31.3, 33.3, 34.4, 35.4, 44.8, 47.5 (CH_2), 99.8, 101.7, 111.4 (CH_{Ar}), 112.2 (C_{Ar}), 126.2, 127.0, 128.4, 128.6, 128.7, 128.9, 133.2 (CH_{Ar}), 137.5, 139.6, 143.4, 151.9, 152.6, 181.2 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 438 (4) [M^+], 347 (100), 105 (42).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{30}H_{35}N_2O$: 439.27439; found: 439.27482.

2-Pentyl-1-(3-phenylpropyl)-5-[(3-phenylpropyl)amino]quinolin-4(1*H*)-one (8h)
Yellow oil; yield: 0.245 g (75%).

IR (ATR): 2927 (w), 2857 (w), 1616 (s), 1594 (s), 1557 (m), 1518 (s), 1451 (s), 1370 (w), 1267 (s), 1170 (s), 1029 (w), 910 (w), 837 (w), 739 (s), 697 (s), 620 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.88–0.93 [m, 3 H, $CH_2(CH_2)_3CH_3$], 1.26–1.29 [m, 4 H, $CH_2(CH_2)_3CH_3$], 1.49–1.59 [m, 2 H, $CH_2(CH_2)_3CH_3$], 2.00–2.09 [m, 4 H, $CH_2(CH_2)_3CH_3$, $(CH_2)_3$], 2.38–2.43 [m, 2 H, $(CH_2)_3$], 2.74–2.83 [m, 4 H, $(CH_2)_3$], 3.19 [t, ^3J = 6.6 Hz, 2 H, $(CH_2)_3$], 3.95 [m, 2 H, $(CH_2)_3$], 6.03 (s, 1 H, CH_{Ar}), 6.25 (d, ^3J = 8.2 Hz, 1 H, CH_{Ar}), 6.33 (d, ^3J = 8.6 Hz, 1 H, CH_{Ar}), 7.16–7.37 (m, 11 H, CH_{Ar}), 10.47 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 13.8 (CH_3CH_2), 22.3, 28.5, 29.4, 30.3, 31.3, 32.7, 33.2, 33.3, 42.0, 45.6 (CH_2), 99.5, 101.5, 111.3 (CH_{Ar}), 112.1 (C_{Ar}), 125.7, 126.5, 128.2, 128.3, 128.5, 128.6, 133.0 (CH_{Ar}), 140.1, 141.7, 143.6, 152.0, 152.5, 181.2 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 466 (35) [M$^+$], 375 (41), 361 (100), 243 (42), 91 (41).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{39}N_2O$: 467.30569; found: 467.30601.

1-(4-Methoxyphenyl)-5-[(4-methoxyphenyl)amino]-2-pentylquinolin-4(1*H*)-one (8i)
Yellow oil; yield: 0.248 g (80%).

IR (ATR): 2928 (w), 1624 (s), 1601 (s), 1452 (s), 1263 (s), 1207 (s), 1123 (m), 1109 (s), 883 (m), 867 (s), 787 (m), 704 (w), 661 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.75 (t, ^3J = 7.0 Hz, 3 H, CH_3CH_2), 1.09–1.18 (m, 4 H, CH_2), 1.40–1.45 (m, 2 H, CH_2), 2.15 (t, ^3J = 7.7 Hz, 2 H, CCH_2), 3.73 (s, 3 H, OMe), 3.83 (s, 3 H, OMe), 5.67 (dd, ^3J = 8.4 Hz, ^4J = 0.8 Hz, 1 H, CH_{Ar}), 6.13 (s, 1 H, CH_{Ar}), 6.60 (dd, ^3J = 8.3 Hz, ^4J = 0.8 Hz, 1 H, CH_{Ar}), 6.81–6.85 (m, 2 H, CH_{Ar}), 6.92–7.01 (m, 3 H, CH_{Ar}), 7.05–7.09 (m, 2 H, CH_{Ar}), 7.15–7.16 (m, 2 H, CH_{Ar}), 11.80 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 13.8 (CH_3CH_2), 22.3, 27.9, 31.2, 33.55 (CH_2), 55.5, 55.6 (2 × OMe), 103.7, 104.3, 110.2 (CH_{Ar}), 111.7 (C_{Ar}), 114.5, 115.3, 125.7, 130.2, 131.9, 132.2 (CH_{Ar}), 134.0 (C_{Ar}), 146.1, 150.0, 154.0, 156.3, 159.9, 181.7 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 442 (100) [M$^+$], 427 (90).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{28}H_{30}N_2O_3$: 443.22564; found: 443.23317.

1-(3,5-Dimethylphenyl)-5-[(2-phenylethyl)amino]quinolin-2-(4-tolyl)-4(1*H*)-one (8j)
Yellow solid; yield: 0.444 g (97%); mp 154 °C.

IR (ATR): 3207 (w), 2831 (w), 1619 (s), 1586 (m), 1519 (m), 1505 (s), 1441 (s), 1382 (m), 1348 (m), 1307 (m), 1251 (s), 1182 (m), 1125 (s), 1024 (w), 839 (s), 746 (s), 697 (s), 658 (m), 586 (m).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 2.21 (s, 6 H, 2 × Me), 2.24 (s, 3 H, Me), 3.05 (t, ^3J = 7.5 Hz, 2 H, CH_2), 3.47 (t, ^3J = 7.5 Hz, 2 H, CH_2), 5.88 (d, ^3J = 8.1 Hz, 1 H, CH_{Ar}), 6.20 (s, 1 H, CH_{Ar}), 6.33 (d, ^3J = 8.1 Hz, 1 H, CH_{Ar}), 6.70 (s, 2 H, CH_{Ar}), 6.88–7.03 (m, 5 H, CH_{Ar}), 7.12–7.23 (m, 2 H, CH_{Ar}), 7.32–7.33 (m, 4 H, CH_{Ar}), 10.38 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.0, 21.2 (Me), 35.4, 44.9 (CH_2), 101.8, 103.0 (CH), 111.7 (C), 112.8, 126.3, 17.6, 128.3, 128.5, 128.8, 129.0, 130.0, 132.8, 132.9 (CH), 138.1, 139.0, 139.7, 145.5, 151.2, 152.5, 181.5 (C).

MS (GC, 70 eV): *m/z* (%) = 458 (3) [M$^+$], 367 (100).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{31}N_2O$: 459.24309; found: 459.24347.

1-(4-Ethylphenyl)-5-[(2-phenylethyl)amino]-2-(4-tolyl)quinolin-4(1*H*)-one (8k)
Yellow oil; yield: 0.385 g (84%).

IR (ATR): 3214 (w), 2962 (w), 2865 (w), 1619 (m), 1504 (s), 1344 (w), 1267 (s), 1183 (m), 1021 (m), 851 (m), 816 (m), 740 (m), 698 (s), 565 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.19 (t, ^3J = 7.6 Hz, 3 H, CH_3CH_2), 2.24 (s, 3 H, Me), 2.61 (q, ^3J = 7.6 Hz, 2 H, CH_3CH_2), 3.05 (t, ^3J = 7.3 Hz, 2 H, CH_2CH_2), 3.47 (t, ^3J = 7.3 Hz, 2 H, CH_2CH_2), 5.87 (d, ^3J = 8.4 Hz, 1 H, CH_{Ar}), 6.23 (s, 1 H, CH_{Ar}), 6.34 (d, ^3J = 8.0 Hz, 1 H, CH_{Ar}), 6.92–7.00 (m, 6 H, CH_{Ar}), 7.11–7.23 (m, 4 H, CH_{Ar}), 7.30–7.33 (m, 4 H, CH_{Ar}), 10.39 (s, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 15.2 (CH_3CH_2), 21.2 (Me), 28.4, 35.4, 44.9 (CH_2), 102.0, 103.0, 111.7 (CH_{Ar}), 112.8 (C_{Ar}), 126.3, 128.4, 128.5, 128.7, 128.8, 129.1, 129.7 (CH_{Ar}), 132.9, 137.5, 138.2, 139.7, 144.7, 145.6, 151.2, 152.7, 181.4 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 458 (3) [M$^+$], 367 (100).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{31}N_2O$: 459.24309; found: 459.24349.

1-[(1*R*)-1-Phenylethyl]-7-{[(1*R*)-1-phenylethyl]amino}-2-(4-tolyl)quinolin-4(1*H*)-one (9a)
Yellow oil; yield: 0.151 g (33%).

IR (ATR): 3312 (w), 2969 (w), 1621 (w), 1575 (s), 1556 (s), 1488 (m), 1447 (m), 1318 (s), 1238 (s), 1205 (m), 1106 (s), 975 (w), 908 (w), 823 (m), 783 (m), 759 (m), 696 (s) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 1.43 (t, ^3J = 6.3 Hz, 6 H, $CHCH_3$), 2.27 (s, 3 H, Me), 4.38–4.55 (m, 2 H, $CHCH_3$), 5.63 (d, ^4J = 1.7 Hz, 1 H, CH_{Ar}), 5.99 (dd, ^3J = 14.2 Hz, ^4J = 2.2 Hz, 1 H, CH_{Ar}), 6.26 (dd, ^3J = 8.7 Hz, ^4J = 2.2 Hz, 1 H, CH_{Ar}), 7.04–7.24 (m, 14 H, CH_{Ar}), 7.64 (t, ^3J = 8.7 Hz, 1 H, CH_{Ar}), 11.58 (d, ^3J = 9.5 Hz, 1 H, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.3, 24.5, 24.9 (Me), 53.2, 54.0 (CH), 98.0 (d, *J* = 10.0 Hz, CH), 99.4 (d, *J* = 30.3 Hz, CH), 109.3 (C), 117.3 (d, *J* = 11.3 Hz, CH), 125.7, 126.7, 127.2, 127.7, 128.5, 128.7, 128.8 (CH), 131.6 (d, *J* = 5.1 Hz, CH), 131.7 (d, *J* = 11.4 Hz, CH), 133.2, 139.2, 144.0, 144.5 (C), 150.9 (d, *J* = 10.7 Hz, C), 160.4, 162.4 (d, *J* = 249.3 Hz, C), 184.8 (C).

MS (GC, 70 eV): *m/z* (%) = 458 (19) [M$^+$], 353 (100).

HRMS (EI): *m/z* [M$^+$] calcd for $C_{32}H_{30}N_2O$: 458.59341; found: 458.59344.

1-(3,5-Dimethylphenyl)-7-(hexylamino)-2-(4-tolyl)quinolin-4(1*H*)-one (9b)
Yellow oil; yield: 0.346 g (79%).

IR (ATR): 3307 (w), 2922 (w), 1596 (s), 1556 (s), 1512 (m), 1441 (s), 1396 (m), 1296 (m), 1220 (m), 1148 (m), 1017 (m), 848 (m), 815 (m), 706 (m), 636 (m) cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 0.84–0.91 [m, 3 H, $CH_3(CH_2)_4CH_2$], 1.13–1.30 [m, 6 H, $CH_3(CH_2)_4CH_2$], 1.43–1.50 [m, 2 H, $CH_3(CH_2)_4CH_2$], 2.23 (s, 6 H, 2 × Me), 2.24 (s, 3 H, Me), 2.91–3.00 [m, 2 H, $CH_3(CH_2)_4CH_2$], 4.06 (br s, 1 H, NH), 5.80 (d, ^4J = 2.0 Hz, 1 H, CH_{Ar}), 6.27 (s, 1 H, CH_{Ar}), 6.62 (dd, ^3J = 8.7 Hz, ^4J = 2.0 Hz, 1 H, CH_{Ar}), 6.74 (s, 2 H, CH_{Ar}), 6.90–7.04 (m, 5 H, CH_{Ar}), 8.25 (d, ^3J = 8.2 Hz, 1 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 13.9, 20.9, 21.1 (Me), 22.5, 26.6, 28.9, 31.5, 43.2 (CH_2), 96.9, 111.7 (CH_{Ar}), 117.4 (C_{Ar}), 127.4, 127.5, 128.2, 129.0, 130.0 (CH_{Ar}), 133.3, 138.0, 138.9, 139.3, 144.9, 151.2, 153.1 (C_{Ar}).

MS (GC, 70 eV): *m/z* (%) = 438 (54) [M$^+$], 367 (100).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{30}H_{35}N_2O$: 439.27439; found: 439.27378.

1,1′-[Ethane-1,2-diylbis(4,1-phenylene)]bis[6-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one] (10a)
Yellow oil; yield: 0.335 g (49%).

IR (ATR): 3033 (w), 2920 (w), 1603 (s), 1510 (s), 1469 (s), 1384 (m), 1306 (s), 1253 (w), 1180 (m), 1099 (w), 1021 (w), 927 (s), 854 (m), 817 (s), 725 (s), 632 (m), 596 (m), 553 (s) cm^{-1}.

^1H NMR (300 MHz, DMSO-d_6): δ = 2.20 (br s, 6 H, 2 × CH_3), 2.85 (br s, 4 H, 2 × CH_2), 6.38 (s, 2 H, CH_{Ar}), 6.82 (dd, ^3J = 9.4 Hz, ^3J = 4.4 Hz, 2 H, CH_{Ar}), 6.90–7.06 (m, 16 H, CH_{Ar}), 7.12–7.19 (m, 2 H, CH_{Ar}), 8.11 (dd, ^3J = 8.8 Hz, ^3J = 3.0 Hz, 2 H, CH_{Ar}).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.2 (Me), 37.3 (CH_2), 110.8 (d, *J* = 22.3 Hz, CH), 112.0 (CH), 120.1 (d, *J* = 8.8 Hz, CH), 128.4 (d, *J* = 8.8 Hz, CH), 127.5 (d, *J* = 6.7 Hz, C), 128.6, 129.1, 129.6, 129.9 (CH), 132.7, 137.2, 138.6, 139.2, 141.9, 154.2, 157.2, 161.1 (C), 176.9 (d, *J* = 2.5 Hz, C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –117.6.

MS (EI, 70 eV): *m/z* (%) = 684 (100) [M^+], 342 (44), 314 (10), 226 (43).

HRMS (EI): *m/z* [M^+] calcd for $C_{46}H_{34}F_2N_2O_2$: 684.25829; found: 684.258764.

1,1′-Hexane-1,6-diylbis[6-fluoro-2-(4-tolyl)quinolin-4(1*H*)-one] (10b)
White solid; yield: 0.417 g (71%); mp >350 °C.

IR (ATR): 1613 (w), 1479 (s), 1417 (s), 1293 (w), 1154 (w), 1087 (w), 931 (w), 859 (m), 828 (w), 740 (w) cm^{-1}.

^1H NMR (300 MHz, DMSO-d_6): δ = 0.80 (br s, 4 H, 2 × CH_2), 1.41 (br s, 4 H, 2 × CH_2), 2.36 (s, 6 H, Me), 3.96 (br s, 4 H, 2 × CH_2), 5.89 (s, 2 H, CH_{Ar}), 7.28 (m, 8 H, CH_{Ar}), 7.62–7.68 (m, 2 H, CH_{Ar}), 7.84–7.90 (m, 4 H, CH_{Ar}).

^{13}C NMR: not recorded (low solubility).

MS (GC, 70 eV): *m/z* (%) = 588 (44) [M^+], 266 (33), 207 (21), 150 (19).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{38}H_{35}F_2N_2O_2$: 589.26611; found: 589.26599.

(2*Z*)-1-{2-Fluoro-6-[(1-phenylethyl)amino]phenyl}-3-(4-tolyl)-3-[(1-phenylethyl)amino]prop-2-en-1-one (11a)
Yellow solid; yield: 0.33 g (69%); mp 154–156 °C.

IR (ATR): 3342 (w), 2976 (w), 1613 (m), 1557 (s), 1489 (s), 1449 (s), 1412 (m), 1333 (s), 1267 (m), 1241 (m), 1205 (m), 1140 (m), 1085 (m), 1016 (m), 871 (w), 819 (m), 800 (s), 752 (s), 697 (s), 670 (m), 576 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.52 (d, ^3J = 6.8 Hz, 6 H, 2 × CHCH_3), 2.30 (s, 3 H, Me), 4.44–4.46 (m, 1 H, C*H*CH$_3$), 4.54–4.64 (m, 1 H, C*H*CH$_3$), 5.57 (d, ^3J = 4.6 Hz, 1 H, NH), 6.07 (d, ^3J = 8.8 Hz, 1 H, CH_{Ar}), 6.12–6.19 (m, 1 H, CH_{Ar}), 6.81–6.88 (m, 1 H, CH_{Ar}), 7.07–7.42 (m, 14 H, CH_{Ar}), 7.86–7.91 (m, 1 H, CH_{Ar}), 11.49 (d, 1 H, *J* = 10.2 Hz, NH).

^{13}C NMR: not recorded (low solubility).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –108.9.

MS (GC, 70 eV): *m/z* (%) = 478 (2) [M^+], 373 (87), 355 (31), 240 (100), 105 (100).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{32}FN_2O_5$: 479.24932; found: 479.25022.

(2*Z*)-1-{4-Fluoro-2-[(1-phenylethyl)amino]phenyl}-3-[(1-phenylethyl)amino]-3-(4-tolyl)prop-2-en-1-one (11b)
Yellow solid; yield: 0.306 g (64%); mp 174–176 °C.

IR (ATR): 3262 (w), 2968 (w), 1621 (w), 1594 (m), 1556 (s), 1507 (s), 1451 (s), 1371 (w), 1338 (m), 1303 (m), 1279 (m), 1191 (s), 1138 (m), 1105 (s), 1017 (m), 908 (w), 827 (m), 775 (s), 697 (s), 592 (m) cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.48 (d, ^3J = 6.8 Hz, 3 H, CHCH_3), 1.54 (d, ^3J = 6.8 Hz, 3 H, CHCH_3), 2.28 (s, 3 H, Me), 4.39–4.54 (m, 2 H, 2 × C*H*CH$_3$), 5.54 (s, 1 H, CH_{Ar}), 5.95–6.08 (m, 2 H, CH_{Ar}), 7.06 (s, 4 H, CH_{Ar}), 7.09–7.32 (m, 10 H, CH_{Ar}), 7.47–7.52 (m, 1 H, CH_{Ar}), 9.22 (s, 1 H, NH), 11.19 (d, 1 H, *J* = 10.2 Hz, NH).

^{13}C NMR (62.9 MHz, $CDCl_3$): δ = 21.3, 24.6, 25.1 (Me), 53.0, 54.0 (CH), 95.1 (CH), 99.0 (d, *J* = 25.0 Hz, CH), 101.5 (d, *J* = 25.0 Hz, CH), 117.5 (C), 125.7, 125.8, 126.8, 126.9, 127.6, 128.6, 128.7, 128.9 (CH), 130.8 (d, *J* = 200.0 Hz, CH), 131.7 (d, *J* = 11.4 Hz, CH), 133.4, 139.2 (C), 144.7 (d, *J* = 18.7 Hz, C), 151.4 (d, *J* = 11.4 Hz, C), 163.5, 165.0, 167.5, 191.4 (C).

^{19}F NMR (282 MHz, $CDCl_3$): δ = –107.0.

MS (GC, 70 eV): *m/z* (%) = 478 (3) [M^+], 373 (84), 355 (18), 240 (100), 105 (74).

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{32}H_{32}N_2O$: 479.24932; found: 479.24955.

Supporting Information for this article is available online at http://www.thieme-connect.com/ejournals/toc/synthesis.

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(13) Crystallographic data (excluding structure factors) for compounds **5g**, **5q**, **6b**, **8b**, and **11a** have been deposited with the accession numbers 868711, 868712, 868715, 868716, and 907162, respectively, and can be obtained free of charge from the Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB2 1EZ, UK; Fax: +44(1223)336033; E-mail: deposit@ccdc.cam.ac.uk; Web site: www.ccdc.cam.ac.uk/conts/retrieving.html.

