Novel Route to 4-(Adamantan-1-yl)quinoline Derivatives Based on the *Friedländer* Condensation

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2,3,4-Trisubstituted quinolines, substituted with adamantan-1-yl or (adamantan-1-yl)methyl in the 4-position, were prepared from the corresponding admantan-1-yl 2-aminophenyl ketones or admantan-1-ylmethyl 2-aminophenyl ketones and ketones with an α-CH_2 group. These reactions were carried out under neat conditions or in toluene, and the products were obtained in moderate-to-excellent yields. The scope and limitations of the examined procedures are discussed. All new compounds are fully characterized by IR and NMR spectroscopy and mass spectrometry. The molecular structures of five new quinolines, obtained *via* single-crystal X-ray diffraction analyses, are discussed.

Introduction. – The quinoline ring system is an important structural unit that occurs in a variety of natural alkaloids, therapeutics, and synthetic analogs with interesting biological activities. Further information on their importance can be found in recent reviews [1]. Additionally, considerable attention has been focused in the unique properties of the adamantane scaffold. The highly lipophilic nature of the adamantane cage facilitates the permeability of adamantylated compounds through biological membranes. In contrast, the formation of inclusion host–guest complexes with cyclodextrins may increase drug solubility in polar media. Combining these two areas of chemistry, several quinoline derivatives substituted with adamantan-1-yl group have been prepared, and their significant biological activities have been described.

In addition to more complex compounds, such as *N*-[4-(adamantan-1-yl)thiazol-2-yl]-4-hydroxy-2-oxoquinoline-3-carboxamide, which possess potential antituberculosis activity [2], *N*-(adamantan-1-yl)-4-oxo-1,4-dihydroquinoline-3-carboxamides, which are CB_2-selective cannabinoid receptor ligands [3], and various potential noncompetitive metabotropic glutamate receptor antagonists [4], some directly adamantylated quinoline-based compounds exhibit interesting biological activities. Thus, 4-(adamantan-1-yl)-2-(4-methylpiperazin-1-yl)quinoline has been studied as a 5-HT_3 receptor ligand with potential therapeutic applications against diseases related to the central nervous system (CNS) malfunction [5]. Derivatives of 4-(adamantan-1-yl)quinoline-2-carboxylic acid have been introduced as promising antituberculosis agents [6], and 2-(adamantan-1-yl)quinolines have been studied for their potential antimalarial [7] or antimicrobial [8] activities.

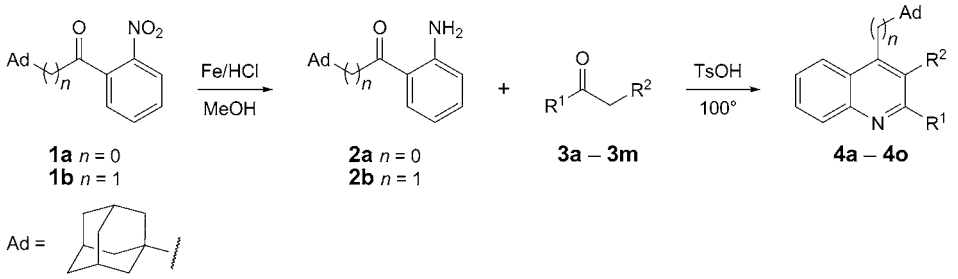
For the preparation of adamantylated quinoline skeletons, two approaches can be found in the literature. While the direct substitution of the quinoline ring at C(4) under electrochemical [9] or radical [10] conditions suffers from the formation of a complex

mixture of products, the cyclization reaction of suitable precursors has been described for only one compound [5]. On the other hand, 2-adamantylated quinolines and their preparations have been reported more frequently [9][11].

In this article, we describe a new convenient synthetic route to various novel 2,3,4-trisubstituted quinolines bearing an adamantan-1-yl moiety at C(4) *via* the *Friedländer* condensation (for reviews, see [12]) from adamantan-1-yl 2-aminophenyl ketone/adamantan-1-ylmethyl 2-aminophenyl ketone and the corresponding carbonyl compounds.

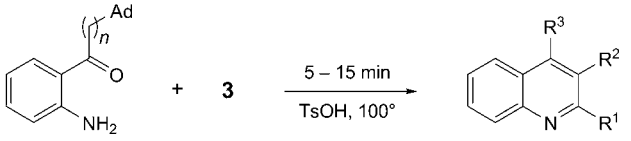
Results and Discussion. – The key starting materials for the quinoline synthesis, adamant-1-yl 2-nitrophenyl ketones **1a**–**1c**, were prepared according to a previously published procedure. These ketones were obtained from a Cu^{I}/Al^{III}-catalyzed reaction of *Grignard* reagents and acyl chlorides [13]. The consecutive nitration by acetyl nitrate in Ac_2O yielded a mixture of mononitrated regioisomers. The required *ortho*-isomers were isolated by column chromatography in yields ranging from 35 to 80% [14a]. The selective reduction of nitro ketones [14b] proceeded smoothly using Fe powder in methanolic HCl, and the corresponding 2-aminophenyl ketones **2a** and **2b** were isolated by column chromatography in nearly quantitative yields (*Scheme 1*). The rationale for compound **2c** not being obtained *via* this reaction is discussed below. Compounds **1a** and **1b** have been prepared previously *via* the directed *ortho*-metalation of *tert*-butyl phenylcarbamate, followed by the acylation with methyl adamantane-1-carboxylate [5] and *via* photochemical transformation of *N*-phenyl-2-(adamantan-1-yl)acetamide [15]. Nevertheless, our procedure provided comparable (or, in some cases, slightly better) yields and allowed us to circumvent the less convenient reaction conditions. The final step to give the desired quinolines **4** was carried out in the presence of an equimolar amount of TsOH under solvent-free conditions and with conventional heating [16]. The mixture became solid within a few minutes, probably due to the formation of the sulfonates of the products and/or starting 2-aminophenyl ketones, and no further reaction progress was observed. This was the most probable rationale for the decrease in the yield of the required quinolines. In some cases, when the treatment of the mixture during the workup procedure with base was insufficient, the corresponding quinolinium toluenesulfonate, *e.g.*, **4o** · TsOH (*Fig. 3*), was isolated by crystallization. Nevertheless, the composition of the crude product was monitored by GC/MS and/or TLC; in all cases, no significant amount of side-products was detected, and the unreacted starting

Scheme 1



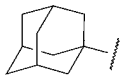
2-aminophenyl ketones were recovered by column chromatography. Structures of the prepared quinolines, reaction details, and yields are compiled in *Table 1*.

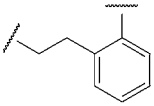
Table 1. *Results of the Reactions Conducted under Neat Conditions*



2a *n* = 0
2b *n* = 1

4

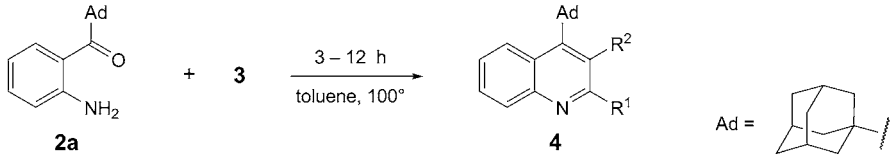
Ad = 

Entry	Amine **2**	Ketone **3**	Product **4**				Time [min]	Yield [%]
				R^3	R^2	R^1		
1	**2a**	$MeC(O)CH_2C(O)Me$ (**3a**)	**4a**	Ad	Ac	Me	10	95
2	**2a**	$MeC(O)CH_2CO_2Et$ (**3b**)	**4b**	Ad	CO_2Et	Me	15	50
3	**2a**	$MeC(O)CO_2Et$ (**3c**)	**4c**	Ad	H	CO_2Et	5	33
4	**2a**	$PhC(O)CH_2C(O)Me$ (**3d**)	**4d**	Ad	Ac	Ph	10	6
5	**2a**	Acetophenone (**3e**)	**4e**	Ad	H	Ph	15	44
6	**2a**	4-F–$C_6H_4C(O)Me$ (**3f**)	**4f**	Ad	H	4-F–C_6H_4	15	31
7	**2a**	Cyclopentanone (**3g**)	**4g**	Ad		$–(CH_2)_3–$	5	63
8	**2a**	Cyclohexanone (**3h**)	**4h**	Ad		$–(CH_2)_4–$	15	62
9	**2a**	Cycloheptanone (**3i**)	**4i**	Ad		$–(CH_2)_5–$	5	52
10	**2a**	Cyclooctanone (**3j**)	**4j**	Ad		$–(CH_2)_6–$	5	44
11	**2a**	Cyclododecanone (**3k**)	**4k**	Ad		$–(CH_2)_{10}–$	10	19
12	**2a**	3,4-Dihydronaphthalen-1(2*H*)-one (**3l**)	**4l**	Ad			5	39
13	**2a**	Cyclohexane-1,3-dione (**3m**)	**4m**	Ad		$–C(O)(CH_2)_3–$	15	84
14	**2b**	Acetophenone (**3e**)	**4n**	$AdCH_2$	H	Ph	10	22
15	**2b**	Cyclohexane-1,3-dione (**3m**)	**4o**	$AdCH_2$		$–C(O)(CH_2)_3–$	5	31

To improve the unsatisfactory yields, the reaction was performed in a small amount of toluene at 100°. The mixture remained liquid under such conditions, but the time required for the reactions to go to completion was prolonged. Nevertheless, the yields of the desired quinolines increased in all examined cases (*Table 2*). The significantly lower yields (*Entry 4*, *Table 1*, and *Entry 19*, *Table 2*) may be attributed to the bulkiness of the substituents at C(2), C(3), and C(4). In addition, the preparation of compounds with R^3 = Ad, (in all cases) and $R^1 = R^2$ = Ph, R^1 = Ph and R^2 = Bz, R^1 = Ad and R^2 = H; or R^1 = Ad and R^2 = Me completely failed, and only the starting compounds were recovered. The bulkiness of these substituents is the most limiting parameter in this procedure.

Unfortunately, our attempt at extending this protocol to produce seven-membered rings failed. Instead, the starting compound for this reaction, 1-(adamantan-1-yl)-2-(2-nitrophenyl)ethanone (**2c**), underwent a cyclization during the reduction step (*Scheme 2*). The expected amino ketone was not obtained, and only the corresponding

Table 2. *Results of the Condensation Reactions Performed in Toluene*

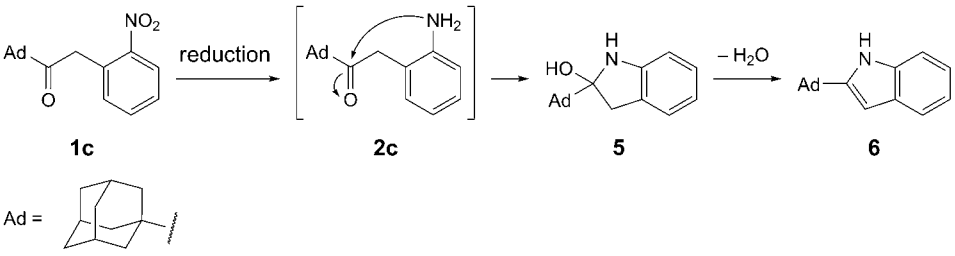


For R^1 and R^2, see *Table 1*.

Entry	Ketone	Product	Time [h]	Yield [%]
18	**3c**	**4c**	5	68
19	**3d**	**4d**	12	34
20	**3e**	**4e**	8	96
21	**3f**	**4f**	6	96
22	**3j**	**4j**	8	95
23	**3k**	**4k**	8	92
24	**3l**	**4l**	8	96

2-(adamantan-1-yl)-2,3-dihydro-1*H*-indol-2-ol (**5**) and 2-(adamantan-1-yl)-1*H*-indole (**6**) were detected in the mixture by GC/MS. The latter compound was the only isolated product, and its spectroscopic data corresponded to those described in [17]. Compound **5** underwent spontaneous H_2O elimination during the workup and yielded **6**. The same results were obtained, when combinations of various reducing agents (Sn^{II}, Fe^0, Zn^0, Al^0) with various acids (AcOH, HCl, NH_4Cl) in H_2O, MeOH, or EtOH were used. Additionally, the attempt to carry out the cyclization reaction using a nitro ketone and acetylacetone under reducing conditions [18] was unsuccessful, and again **6** was isolated.

Scheme 2



Electrospray ionization mass spectrometry (ESI-MS) measurements of all of the prepared compounds **4a**–**4o** were carried out in the positive-ion scanning mode. In the first-order mass spectra, two peaks at *m*/*z* values corresponding to the protonated molecular ion ($[M+H]^+$) and the Na adduct of the dimer ($[2M+Na]^+$), were detected for all examined structures. With the exception of compound **4c**, $[M+H]^+$ represents the dominant signal in all of the first-order MS. The peak of the $[M+Na]^+$ ion was observed in the positive-ion mode ESI mass spectra of some compounds.

As an example, the results of the ESI-MS analysis of compound **4b**, as well as the suggested fragmentation pathways, are depicted in *Fig. 1*. The MS^2 of $[M+H]^+$ (*m/z* 350) provided two signals at *m/z* 322 and 306, respectively. The additional fragmentation (MS^3) of these two product ions displayed similar cleavage patterns. In comparison, the analysis of compound **4b** by the electron impact ionization (EI) MS, provided the base peak at *m/z* 304, and only one fragmentation pathway, beginning with the loss of C_2H_5O fragment, was observed.

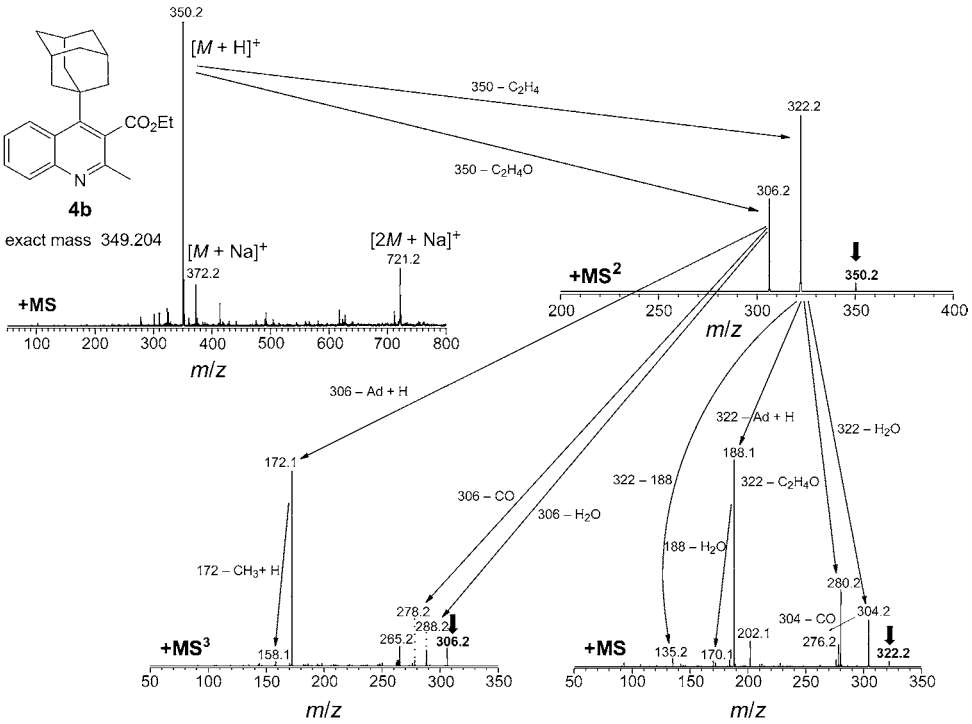


Fig. 1. *The positive-ion mode ESI/mass spectra of compound* **4b**. The proposed ions corresponding to the signals observed in the first-order mass spectra are indicated in the brackets. The fragment-ion signals in tandem mass spectra are marked with bold arrows.

Compound **4o** was crystallized from a $CHCl_3$ solution of the crude product as the 4-methylbenzenesulfonate salt (**4o**·TsOH). The torsion angle of C(8)–C(7)–C(14)–C(15), describing the arrangement of the Ad substituent and the quinoline ring system, is 85.83(16)°. This conformation is chiral, and the unit cell contains both atropisomers arranged around the center of symmetry. The cyclohexenone ring exhibits a half-boat conformation with the atoms C(8)–C(10), C(12), and C(13) essentially in a plane (the maximum deviation from the best plane is 0.0427(11) Å for C(13)). The *Cremer* and *Pople* puckering parameters [19] are $Q = 0.5023(17)$ Å, $\theta = 130.72(19)°$, and $\varphi = 52.9(3)°$. The crystal structure is stabilized by H-bonds between the sulfonate and the quinolinium units N(1)–H(1A)···O(2) with a D···A distance of 2.7758(14) Å and a D–H···A angle of 168.5°. Further stabilization *via* offset $\pi\cdots\pi$ stacking interactions

is also present. The distance of C(6) from the best planes of the quinoline rings in the positions $-x+1,\ -y+1,\ -z+1$, and $-x+2,\ -y+1,\ -z+1$ are 3.4887(16) and 4.0949(19) Å, respectively. From the ^{1}H-NMR data of **4o** in $CDCl_3$, similar chiral conformations of the molecules may be assumed to predominate in solution. The strongly hindered rotation of the (adamantan-1-yl)methyl substituent renders the CH_2 H-atoms *i.e.*, AdCH_2, non-equivalent, and a large separation ($\Delta\delta = 1.33$ ppm) of the signals of the geminal *AB* system was observed at 30° due to the adjacent C=O group. The same signal separation was observed in $CDCl_3$ at 55° ($\Delta\delta = 1.32$ ppm) (*Fig. 2*).

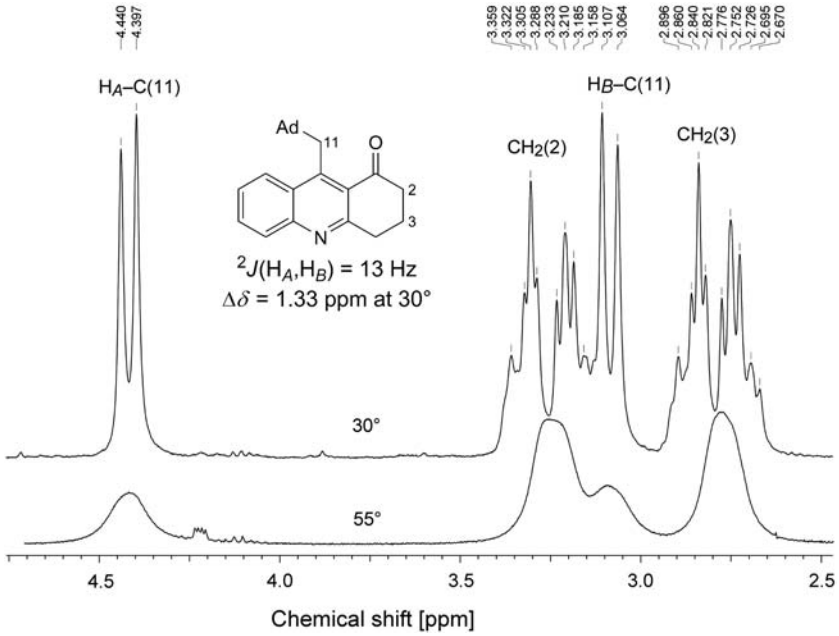


Fig. 2. *Partial ^{1}H-NMR spectra of compound* **4o** *in $CDCl_3$ at 30 and at 55°, respectively*

The asymmetric unit of compound **4n** contains two crystallographically independent molecules. The relationship between them may be expressed as conformational enantiomers. However, the distinct conformers were observed only in the solid state. The ^{1}H-NMR spectrum in $CDCl_3$ solution displaced no diastereotopic *AB* pattern for CH_2(16) owing to the low rotation barrier in solution at room temperature. The torsion angles describing the mutual orientation of the benzene, quinoline, and adamantane moieties in the first conformer, N(1)–C(9)–C(10)–C(15) and C(8)–C(7)–C(16)–C(17), are 26.8(2) and $-87.9(2)$°, respectively. The values of the corresponding angles in the second conformer are $-29.1(2)$ and 91.57(19)°, respectively. The crystal structure is stabilized by weak intramolecular edge-to-face interactions. The distance of H(14) from the best plane of the quinoline ring in the position $-x+1, y+0.5, -z+0.5$ is 2.55 Å.

Compound **4g** was crystallized from $CHCl_3$ with one molecule of the solvent included in its asymmetric unit. The cyclopentene ring adopted an envelope conformation with the *Cremer* and *Pople* puckering parameters of $Q = 0.231(2)$ Å,

and $\varphi = 288.5(6)^\circ$. The solvent molecules are stabilized in the crystal structure *via* weak C–H···N interactions. The distance between H(51A) and N(1) in the $-x+1, -y+1, -z$ position is 2.22 Å. The torsion angle C(6)–C(7)–C(13)–C(14) describing the orientation of the adamantane moiety and the quinoline ring is 179.49(15)°.

The quinoline ring in compound **4e**, although being essentially planar, is markedly deformed. The most affected valence angles C(5)–C(6)–C(7), C(5)–C(6)–C(1), C(6)–C(7)–C(16), and C(6)–C(7)–C(8) are 126.15(10), 116.58(10), 123.38(9), and 116.42(10)°, respectively.

In the molecular structure of **4k**, the adamantan-1-yl moiety is pushed towards the benzene ring due to steric hindrance, whereas the deflection of the adamantan-1-yl out of the best quinoline plane is negligible. The angle between the virtual three-fold axis, C_3 (passing through the C(20)), of the adamantan-1-yl substituent and N(1)–C(11) line is 11.75(5)°. The corresponding angles in compounds **4e** and **4g** are 2.83(4) and 5.58(6)°, respectively. The angle between the best quinoline plane and the C_3 axis is 86.00(3)°. The crystal packing is stabilized only *via* weak *Van der Waals* interactions.

Asymmetric units of all of the determined structures are depicted in *Fig. 3*. The full crystallographic data can be obtained free of charge *via* http://www.ccdc.cam.ac.uk/data_request/cif. For the respective reference numbers, see *Table 3*.

Conclusions. – The described synthetic approach leading to the formation of 2,3-disubstituted quinolines with an adamantan-1-yl or (adamantan-1-yl)methyl substituent at C(4) represents a convenient procedure to access potentially bioactive compounds that combine properties of the quinoline ring and the adamantane moiety. Despite the promising biological activities of some 4-(adamantan-1-yl)quinoline derivatives [5][6], the systematic study of *Friedländer* condensation-based procedures providing such compounds has not yet been published.

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Experimental Part

General. TLC: *Alugram® Sil G/UV$_{254}$* foils (*Machrey-Nagel*); mobile phase: petroleum ether (PE)/AcOEt 4:1 (*A*) or *PE*/AcOEt 8:1 (*B*). Column chromatography (CC): silica gel (SiO_2; *Merck*, grade *60*, 70–230 mesh); mobile phase the same as for TLC. M.p.: *Kofler* block; uncorrected. IR Spectra: *Nicolet Avatar*-380 spectrophotometer; in KBr pellets; $\tilde{\nu}$ in cm^{-1}. NMR Spectra: *Bruker Avance-300* spectrometer at 300.13 (^1H) and 75.77 MHz (^{13}C); δ in ppm rel. to the signal of the solvent (^1H: δ(residual $CHCl_3$) = 7.27 ppm; ^{13}C: $\delta(CDCl_3)$ = 77.23 ppm), *J* in Hz. EI-MS (pos.-ion): *Shimadzu QP-2010* instrument with in the range of *m*/*z* 50–600, using GC separation or direct inlet probe (DI) with ion-source temp. of 200° and ionization energy of 70 eV. Only signals exceeding rel. abundancies of 5% are listed. GC Data were obtained using a *Supelco SLB-5ms* (30 m, 0.25 mm) column with He as the carrier gas in a constant linear flow mode (38 $cm \cdot s^{-1}$). The instrument was held at 100° for 7 min, then ramped at a rate of 25°/min until the oven reached 250°, and then held for the required time. For DI, 10 µl of a sample soln. in CH_2Cl_2 (30 $\mu g \cdot ml^{-1}$) was evaporated in a DI cuvette at 50°. The probe was heated at a rate of 40°/min. Elemental analyses (C, H, N): Flash *EA 1112* elemental analyser (*Thermo Fisher Scientific*).

ESI-MS (pos.) Measurements were performed with an *amaZon X* ion-trap mass spectrometer (*Bruker Daltonics*, D-Bremen). Individual samples (in concentrations of 500 ng ml^{-1}) were infused into

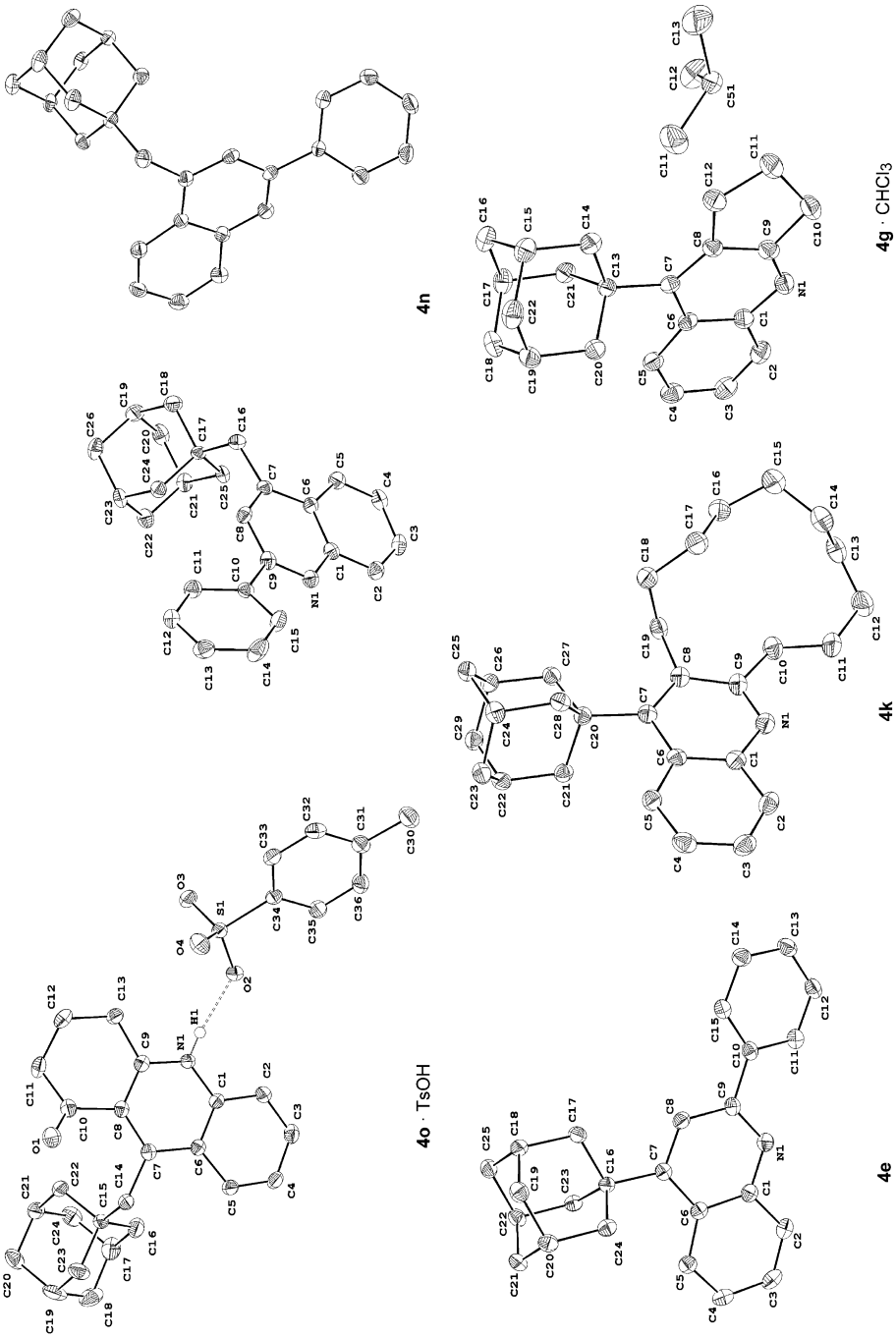

Fig. 3. *Thermal ellipsoid plots* (at 50% probability) *of the asymmetric units of the five prepared derivatives of quinoline.* The H-atoms are omitted for clarity (except for those participating in H-bonding). The H-bond is indicated with a dotted line. In the asymmetric unit of compound **4n**, only one of the two distinct conformers is numbered.

Table 3. *Crystallographic Data for the Five Prepared Quinolines*

Compound	**4e**	**4g** · $CHCl_3$	**4k**	**4n**	**4o** · TsOH
CCDC No.	843853	843854	843855	843856	843857
Molecular formula	$C_{25}H_{25}N$	$C_{23}H_{26}Cl_3N$	$C_{29}H_{39}N$	$C_{26}H_{27}N$	$C_{31}H_{35}NO_4S$
M_r	339.46	422.80	401.61	353.21	517.66
Crystal dimesions [mm]	$0.4 \times 0.3 \times 0.3$	$0.4 \times 0.3 \times 0.1$	$0.3 \times 0.2 \times 0.2$	$0.4 \times 0.3 \times 0.2$	$0.4 \times 0.4 \times 0.2$
Crystal system	triclinic	monoclinic	monoclinic	orthorhombic	triclinic
Space group	$P\bar{1}$	$P2_1/n$	$P2_1$	Pbca	$P\bar{1}$
Z	2	4	2	16	2
Unit cell parameters:					
a [Å]	6.5069(3)	15.3035(5)	7.3987(4)	18.2637(10)	8.7232(2)
b [Å]	11.0027(6)	6.6195(2)	12.8276(5)	12.4704(8)	10.0058(3)
c [Å]	12.6351(7)	20.4905(8)	11.7675(5)	32.8132(18)	15.9688(4)
α [°]	93.745(4)	90.00	90.00	90.00	86.770(2)
β [°]	94.642(4)	103.427(4)	91.071(4)	90.00	86.746(2)
γ [°]	101.103(4)	90.00	90.00	90.00	66.196(3)
V [Å^3]	881.72(8)	2018.98(12)	1116.63(9)	7473.4(8)	1272.32(6)
D_x [Mg · m^{-3}]	1.279	1.391	1.194	1.257	1.351
Absorption coefficient μ [mm^{-1}]	0.073	0.462	0.068	0.072	0.167
θ Range for data collection [°]	3.21–25.00	3.01–25.00	3.18–24.99	3.03–25.00	2.90–25.00
Reflections collected; unique; observed [$I > 2\sigma(I)$]	6633; 3100; 2382	21308; 3544; 2586	11389; 3935; 2952	17326; 6569; 2825	14514; 4465; 3735
Data; restraints; parameters	3100; 0; 235	3544; 0; 244	3935; 1; 271	6569; 0; 487	4465; 0; 335
Final R indices [$I > 2\sigma(I)$]	0.0336; 0.0851	0.0389; 0.1034	0.0312; 0.0533	0.0324; 0.0443	0.0308; 0.0853
$\Delta\rho_{max}$; $\Delta\rho_{min}$ [e Å^{-3}]	0.139; −0.230	0.489; −0.372	0.146; −0.165	0.137; −0.173	0.337; −0.399

the ESI source in MeOH/H_2O or MeCN/H_2O (1:1) with a syringe pump at a constant flow rate of 5 µl min^{-1}. Further instrument conditions: *m/z* range, 50–1000; electrospray voltage, 4.2 kV; cap. exit voltage, 140 V; drying gas temp., 300°; drying gas flow, 6.0 $l \cdot min^{-1}$; nebulizer pressure, 55.16 kPa. N_2 was used for nebulizing as well as drying gas. Tandem mass spectra were obtained by collision-induced dissociation (CID) with He as the collision gas after isolation of the required ions.

Diffraction data were collected on a *KUMA KM-4* κ-axis CCD diffractometer with MoK_α radiation ($\lambda = 0.71073$ Å). The temp. during data collection was 120(2) K. The structures were solved by direct methods and refined using full-matrix least-squares techniques using anisotropic thermal parameters for the non-H-atoms. The software packages used were Xcalibur CCD system for the data collection/reduction [20], ShelXTL for the structure solution and refinement [21], ORTEP-*3* for drawing preparation [22], and PLATON for the calculation of the ring puckering parameters [23].

General Procedure for the Preparation of Quinoline Derivatives **4a**–**4o**. *Method A*. 2-Aminophenyl ketone **2a** or **2b** (0.196–1.0 mmol) [13][14], carbonyl compound **3** (1.0 equiv.), and TsOH (1.0 equiv.) were mixed in a thick-walled tube. The mixture was vigorously stirred and heated up to 100° in an oil bath. The reaction progress was monitored by TLC and/or GC/MS. When two consecutive analyses showed the same result, the mixture was cooled to r.t., and H_2O (3 ml) was added. The resulting suspension was neutralized with 0.4 ml of a 10% NaOH soln., stirred for 5 min, and then filtered. The acquired solid was washed with H_2O (3 × 6 ml) and dried at r.t. The crude product was obtained as a colorless or pale-yellow crystalline powder, and was purified by CC.

Method B. In a thick-walled tube, **2a** or **2b** (0.196–0.392 mmol) and **3** (1.2 equiv.) were dissolved in toluene (2 ml) at 100°. TsOH (1.1 equiv.) was added to the clear soln., and the mixture was vigorously stirred until the TLC (or GC/MS) indicated completion of the reaction. The resulting suspension was neutralized with 0.4 ml of a 10% NaOH soln. and stirred for 5 min. The mixture was extracted with Et_2O (5 × 10 ml), and the collected org. layers were dried (Na_2SO_4) and subsequently evaporated *in vacuo* to obtain the crude product.

1-[2-Methyl-4-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinolin-3-yl]ethanone (**4a**). Purified by CC (system *B*): 303 mg (95%; *Method A*, from 255 mg of **2a**). Yellowish crystalline powder. M.p. 224–227°. R_f (system *A*) 0.20. IR (KBr): 2988*w*, 2963*w*, 2900*s*, 2848*m*, 2680*w*, 1699*s*, 1566*m*, 1493*w*, 1455*m*, 1375*m*, 1314*w*, 1256*w*, 1200*m*, 1104*w*, 1052*w*, 961*w*, 869*w*, 760*s*, 684*w*, 655*m*, 576*w*, 535*w*. ^{1}H-NMR: 1.86 (*m*, 3 CH_2(Ad)); 2.19 (*m*, 3 CH(Ad)); 2.38 (*m*, 3 CH_2(Ad)); 2.61 (*s*, Me–C(2)); 2.64 (*s*, COMe); 7.47 (*dd*, *J* = 7.6, H–C(6)); 7.64 (*dd*, *J* = 7.3, H–C(7)); 8.07 (*d*, *J* = 7.9, H–C(5)); 8.71 (*d*, *J* = 8.6, H–C(8)). ^{13}C-NMR: 24.0 (*Me*–C(2)); 29.3 (CH(Ad)); 35.8 (CO*Me*); 36.8 (CH_2(Ad)); 41.7 (C(Ad)); 43.0 (CH_2(Ad)); 124.8 (CH); 125.1 (C); 127.8 (CH); 128.9 (CH); 130.3 (CH); 135.0 (C); 148.0 (C); 150.6 (C); 153.1 (C); 207.8 (C=O). DI-MS: 319 (18, M^+), 305 (23), 304 (100), 301 (9), 286 (6), 276 (8), 244 (6), 210 (7), 194 (6), 135 (26), 115 (6), 107 (6), 93 (13), 91 (8), 81 (5), 79 (17), 77 (9), 67 (8), 55 (7), 43 (14), 41 (9). ESI-MS: 661.3 (48, $[2M + Na]^+$), 342.2 (12, $[M + Na]^+$), 320.2 (100, $[M + H]^+$). Anal. calc. for $C_{22}H_{25}NO$ (319.44): C 82.72, H 7.89, N 4.38; found: C 83.05, H 7.83, N 4.21.

Ethyl 2-Methyl-4-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinoline-3-carboxylate (**4b**). Purified by CC (system *B*): 175 mg (50%; *Method A*, from 255 mg of **2a**).Yellow crystalline powder. M.p. 105–106°. R_f (system *A*) 0.29. IR (KBr): 2973*m*, 2917*s*, 2876*m*, 2853*s*, 1715*s*, 1570*m*, 1484*m*, 1460*m*, 1378*m*, 1302*w*, 1280*m*, 1215*s*, 1169*m*, 1094*m*, 1041*m*, 854*w*, 795*w*, 772*s*, 631*w*, 603*w*, 535*w*. ^{1}H-NMR: 1.44 (*t*, *J* = 6.9, *Me*CH_2); 1.87 (*m*, 3 CH_2(Ad)); 1.93 (*m*, 3 CH(Ad)); 2.46 (*m*, 3 CH_2(Ad)); 2.64 (*s*, Me–C(3)); 4.43 (*q*, *J* = 7.0, MeCH_2); 7.44 (*dd*, *J* = 7.3, H–C(6)); 7.62 (*dd*, *J* = 7.3, H–C(7)); 8.03 (*d*, *J* = 8.3, H–C(5)); 8.71 (*d*, *J* = 8.9, H–C(8)). ^{13}C-NMR: 14.1 (*Me*CH_2); 23.9 (*Me*–C(2)); 29.4 (CH(Ad)); 37.0 (CH_2(Ad)); 41.6 (C(Ad)); 41.8 (CH_2(Ad)); 61.7 (MeCH_2); 124.5 (CH); 124.9 (C); 127.0 (C); 127.8, (CH); 128.8 (CH); 130.8 (CH); 148.7 (C); 151.1 (C); 155.0 (C); 171.9 (C=O). GC/MS (t_R 29.8 min): 350 (7), 349 (30, M^+), 348 (8), 305 (23), 304 (100), 303 (12), 276 (7), 246 (6), 218 (6), 194 (5), 135 (22), 107 (8), 97 (6), 93 (14), 95 (5), 93 (13), 91 (13), 85 (6), 83 (6), 81 (8), 79 (15), 77 (8), 71 (8), 69 (9), 67 (10), 57 (13), 55 (13), 43 (8), 41 (10). ESI-MS: 721.3 (17, $[2M + Na]^+$), 372.2 (10, $[M + Na]^+$), 350.2 (100, $[M + H]^+$). Anal. calc. for $C_{23}H_{27}NO_2$ (349.47): C 79.05, H 7.79, N 4.01; found: C 79.32, H 7.88, N 3.81.

Ethyl 4-(Tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinoline-2-carboxylate (**4c**). Purified by CC (system *A*): 109 mg (33%; *Method A*, from 255 mg of **2a**) or 45 mg (68%; *Method B*, from 50 mg of **2a**). Colorless crystalline powder. M.p. 100–101°. R_f (system *A*) 0.36. IR (KBr): 2976*w*, 2903*s*, 2846*w*, 1713*s*, 1583*w*,

1508*w*, 1477*w*, 1452*w*, 1369*m*, 1334*m*, 1310*m*, 1237*s*, 1154*m*, 1108*m*, 1023*w*, 973*w*, 930*w*, 882*w*, 781*s*, 633*w*. ^{1}H-NMR: 1.49 (*t*, *J* = 7.3, *Me*CH$_2$); 1.89 (*m*, 3 CH$_2$(Ad)); 2.23 (*m*, 3 CH(Ad)); 2.33 (*m*, 3 CH$_2$(Ad)); 4.56 (*q*, *J* = 7.3, MeC*H*$_2$); 7.59 (*dd*, *J* = 7.3, H–C(6)); 7.70 (*dd*, *J* = 7.6, H–C(7)); 8.12(*s*, H–C(3)); 8.36 (*d*, *J* = 8.6, H–C(5)); 8.66 (*d*, *J* = 8.9, H–C(8)). ^{13}C-NMR: 14.6 (*Me*CH$_2$); 29.2 (CH(Ad)); 37.0 (CH$_2$(Ad)); 39.2 (C(Ad)); 42.3 (CH$_2$(Ad)); 62.3 (Me*C*H$_2$); 118.2 (CH); 126.3 (CH); 126.9 (CH); 128.3 (C); 128.8 (CH); 132.9 (CH); 148.2 (C); 149.1 (C); 157.3 (C); 166.2 (C=O). GC/MS (t_R 28.9 min): 291 (5), 264 (21), 263 (100), 149 (8), 135 (5), 93 (5), 79 (7), 57 (7), 43 (5), 41 (7). ESI-MS: 693.3 (100, [2*M* + Na]$^+$), 374.2 (9, [*M* + K]$^+$), 358.2 (85, [*M* + Na]$^+$), 336.3 (67, [*M* + H]$^+$). Anal. calc. for $C_{22}H_{25}NO_2$ (335.44): C 78.77, H 7.51, N 4.18; found: C 79.02, H 7.45, N 3.92.

1-[2-Phenyl-4-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinolin-3-yl]ethanone (**4d**). Purified by CC (system *A*): 9 mg (6%; *Method A*, from 100 mg of **2a**) or 50 mg (34%; *Method B*, from 100 mg of **2a**). Pale yellow crystalline powder. M.p. 177–178°. R_f (system *B*) 0.31. IR (KBr): 3045*w*, 3004*w*, 2966*w*, 2908*s*, 2860*m*, 1678*s*, 1593*w*, 1568*w*, 1556*w*, 1492*w*, 1450*w*, 1371*w*, 1317*w*, 1271*w*, 1221*m*, 1176*w*, 1161*w*, 918*w*, 866*w*, 768*m*, 723*m*, 694*w*, 598*w*. ^{1}H-NMR: 1.73 (*m*, 3 CH$_2$(Ad)); 2.06 (*m*, 3 CH(Ad)); 2.32–2.39 (overlapped *m* + *s*, 3 CH$_2$Ad, COMe); 7.48–7.78 (overlapped *m*, 7 H); 8.08 (*d*, *J* = 5.9, H–C(5)); 8.79 (*d*, *J* = 6.9, H–C(8)). ^{13}C-NMR: 24.9 (CO*Me*); 29.3 (CH(Ad)); 36.8 (CH$_2$(Ad)); 41.9 (C(Ad); 43.0 (CH$_2$(Ad)); 124.6 (CH); 124.9 (C); 128.0 (CH); 128.7 (CH); 129.1 (2 CH); 131.0 (CH); 131.8 (C); 133.7 (CH); 139.4 (C); 149.0 (C); 151.8 (C); 155.0 (C); 200.2 (C=O). GC/MS (t_R 45.5 min): 382 (13), 381 (44, *M*$^+$), 380 (6), 364 (17), 306 (5), 305 (24), 304 (100), 303 (7), 276 (8), 231 (5), 230 (10), 218 (5), 135 (22), 107 (8), 106 (5), 105 (59), 93 (15), 91 (13), 81 (7), 79 (24), 78 (5), 77 (50), 67 (12), 55 (7), 41 (12). ESI-MS: 785.4 (5, [2*M* + Na]$^+$), 382.2 (100, [*M* + H]$^+$). Anal. calc. for $C_{27}H_{27}NO$ (381.51): C 85.00, H 7.13, N 3.67; found: C 85.27, H 7.22, N 3.47.

2-Phenyl-4-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinoline (**4e**). Purified by CC (system *B*): 150 mg (44%; *Method A*, from 255 mg of **2a**) or 64 mg (96%; *Method B*, from 50 mg of **2a**). Yellow crystalline powder. M.p. 127–129°. R_f (system *A*) 0.59. IR (KBr): 2903*s*, 2848*m*, 1686*w*, 1618*w*, 1587*s*, 1546*m*, 1493*m*, 1451*m*, 1341*m*, 1266*w*, 1180*w*, 1103*w*, 1078*w*, 994*w*, 897*w*, 870*m*, 769*s*, 756*s*, 689*s*, 675*m*, 629*w*, 578*w*, 545*w*. ^{1}H-NMR: 1.94 (*m*, 3 CH$_2$(Ad)); 2.27 (*m*, 3 CH(Ad)); 2.39 (*m*, 3 CH$_2$(Ad)); 7.48–7.58 (overlapped *m*, 3 H of Ph, H–C(6)); 7.69 (*t*, *J* = 7.6, H–C(7)); 7.83 (*s*, H–C(3)); 8.18 (*d*, *J* = 7.9, 2 H$_o$ of Ph); 8.29 (*d*, *J* = 8.3, H–C(5)); 8.65 (*d*, *J* = 8.6, H–C(8)). ^{13}C-NMR: 29.3 (CH(Ad)); 37.2 (CH$_2$(Ad)); 39.2 (C(Ad)); 42.5 (CH$_2$(Ad)); 116.5 (CH); 124.8 (CH); 126.0 (C); 126.3 (CH); 127.8 (CH); 128.4 (CH); 129.0 (CH); 129.3 (CH); 131.9 (CH); 140.5 (C); 149.7 (C); 156.3 (C); 157.3 (C). GC/MS (t_R 48.4 min): 340 (26), 339 (100, *M*$^+$), 338 (61), 296 (8), 283 (7), 282 (24), 244 (8), 243 (6), 232 (5), 230 (7), 219 (7), 203 (8), 152 (5), 135 (7), 91 (6), 79 (10), 77 (9), 67 (6), 41 (7). ESI-MS: 701.3 (16, [2*M* + Na]$^+$), 362.2 (5, [*M* + Na]$^+$), 340.2 (100, [*M* + H]$^+$). Anal. calc. for $C_{25}H_{25}N$ (339.47): C 88.45, H 7.42, N 4.13; found: C 88.21, H 7.49, N 3.95.

2-(4-Fluorophenyl)-4-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)quinoline (**4f**). Purified by CC (system *B*): 44 mg (31%; *Method A*, from 100 mg of **2a**) or 67 mg (96%; *Method B*, from 50 mg of **2a**). Colorless crystalline powder. M.p. 160–163°. R_f (system *A*) 0.55. IR (KBr): 2905*s*, 2855*w*, 1586*m*, 1549*w*, 1501*m*, 1422*w*, 1341*w*, 1224*m*, 1154*m*, 898*w*, 839*s*, 758*s*, 723*w*, 670*w*, 620*w*. ^{1}H-NMR: 1.92 (*m*, 3 CH$_2$(Ad)); 2.25 (*m*, 3 CH(Ad)); 2.37 (*m*, 6 CH(Ad)); 7.22 (*dd*, *J* = 8.6, 2 CF=C*H*); 7.50 (*dd*, *J* = 7.3, H–C(6)); 7.67 (*dd*, *J* = 7.6, H–C(7)); 7.76 (*s*, H–C(3)); 8.14–8.23 (*d*, *dd*, 2 CF=CHC*H*, H–C(5)); 8.27 (*d*, *J* = 8.6, H–C(8)). ^{13}C-NMR: 29.3 (CH(Ad)); 37.2 (CH$_2$(Ad)); 39.2 (C(Ad)); 45.5 (CH$_2$(Ad)); 115.9 (*d*, ^2J(C,F) = 88, CF=*C*H); 116.1 (CH); 124.8 (CH); 126.0 (C); 126.3 (CH); 128.5 (CH); 129.6 (*d*, ^3J(C,F) = 31, CF=CH*C*H); 131.8 (CH); 136.7 (*d*, ^4J(C,F) = 13, CH(Ph)); 149.9 (C); 156.2 (C); 156.4 (C); 163.9 (*d*, ^1J(C,F) = 1000, CF). DI-MS: 358 (26), 357 (100, *M*$^+$), 356 (46), 314 (6), 302 (6), 301 (5), 300 (18), 262 (7), 261 (5), 248 (5), 237 (5), 135 (9), 93 (7), 79 (9), 67 (6), 55 (6), 41 (8). ESI-MS: 737.3 (18, [2*M* + Na]$^+$), 380.2 (8, [*M* + Na]$^+$), 358.2 (100, [*M* + H]$^+$). Anal. calc. for $C_{25}H_{24}FN$ (357.46): C 84.00, H 6.77, N 3.92; found: C 84.19, H 6.75, N 3.75.

*2,3-Dihydro-9-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)-1*H*-cyclopenta[*b*]quinoline* (**4g**). Purified by CC (system *B*): 75 mg (63%; *Method A*, from 100 mg of **2a**). Yellowish crystalline powder. The sample crystallized from $CHCl_3$ was used for elemental analysis. M.p. 188–191°. R_f (system *A*) 0.15. IR (KBr): 2905*s*, 2850*w*, 1561*w*, 1497*w*, 1458*w*, 1223*w*, 1160*w*, 1029*w*, 1007*w*, 758*s*, 680*w*. ^{1}H-NMR: 1.98 (*m*, 3 CH$_2$(Ad)); 2.06 (*m*, CH$_2$(2)); 2.19 (*m*, 3 CH(Ad)); 2.53 (*m*, 3 CH$_2$(Ad)); 3.11 (*t*, *J* = 7.9, CH$_2$(1)); 3.52 (*t*, *J* = 7.3, CH$_2$(3)); 7.40 (*t*, *J* = 8.3, H–C(7)); 7.56 (*t*, *J* = 7.6, H–C(6)); 8.07 (*d*, *J* = 8.3, H–C(8)); 8.70 (*d*,

$J = 8.9$, H–C(5)). ^{13}C-NMR: 23.5 (CH_2); 29.3 (CH(Ad)); 34.0 (CH_2); 35.1 (CH_2); 37.0 (CH_2(Ad)); 42.7 (C(Ad)); 43.0 (CH_2(Ad)); 124.3 (CH); 126.3 (C); 127.5 (CH); 128.3 (CH); 128.7 (CH); 128.9 (C); 133.0 (C); 146.4 (C); 167.7 (C). GC/MS (t_R 27.0 min): 304 (24), 303 (100, M^+), 302 (24), 259 (5), 247 (5), 246 (19), 208 (5), 207 (5), 206 (6), 204 (5), 194 (5), 167 (7), 135 (65), 107 (7), 93 (14), 91 (6), 81 (5), 79 (17), 77 (8), 67 (7), 55 (6), 41 (8). ESI-MS: 629.3 (44, $[2M + Na]^+$), 326.2 (7, $[M + Na]^+$), 304.2 (100, $[M + H]^+$). Anal. calc. for $C_{23}H_{26}Cl_3N$ (422.82): C 65.33, H 6.20, N 3.31; found: C 65.67, H 6.15, N 3.52.

1,2,3,4-Tetrahydro-9-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)acridine (**4h**). Purified by CC (system *B*) 196 mg (62%; *Method A*, from 255 mg of **2a**). Yellow crystalline powder. M.p. 196–199°. R_f (system *A*) 0.21. IR (KBr): 3007*w*, 2976*w*, 2923*s*, 2901*s*, 2847*s*, 1557*w*, 1490*w*, 1474*w*, 1454*m*, 1427*w*, 1387*w*, 1341*w*, 1304*m*, 1255*w*, 1167*w*, 110*w*, 911*w*, 757*s*, 679*w*, 621*w*. ^{1}H-NMR: 1.77–1.91 (*m*, 3 CH_2(Ad), CH_2(6), CH_2(7)); 2.18 (*m*, 3 CH(Ad)); 2.54 (*m*, 3 CH_2(Ad)); 3.12 (*t*, $J = 6.6$, CH_2(8)); 3.22 (*t*, $J = 7.3$, CH_2(5)); 7.32 (*dd*, $J = 7.3$, H–C(2)); 7.50 (*dd*, $J = 7.3$, H–C(3)); 7.96 (*d*, $J = 7.9$, H–C(1)); 8.59 (*d*, $J = 8.9$, H–C(4)). ^{13}C-NMR: 21.4 (CH_2); 22.9 (CH_2); 29.7 (CH(Ad)); 30.9 (CH_2); 33.6 (CH_2); 37.2 (CH_2(Ad)); 43.2 (C(Ad), CH_2(Ad)); 123.0 (CH); 126.6 (C); 126.9 (CH); 127.0 (CH); 129.6 (CH); 131.5 (C); 147.3 (C); 151.8 (C); 160.3 (C). GC/MS (t_R 31.1 min): 318 (18), 317 (74, M^+), 316 (18), 260 (8), 136 (12), 135 (100), 107 (9), 93 (15), 91 (5), 79 (14), 77 (5), 67 (8), 55 (5), 41 (7). ESI-MS: 657.4 (7, $[2M + Na]^+$), 318.2 (100, $[M + H]^+$). Anal. calc. for $C_{23}H_{27}N$ (317.47): C 87.02, H 8.57, N 4.41; found: C 87.29, H 8.65, N 4.22.

*7,8,9,10-Tetrahydro-11-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)-6*H*-cyclohepta[*b*]quinoline* (**4i**) Purified by CC (system *B*): 68 mg (52%, *Method A*, from 100 mg of **2a**). Colorless crystalline powder. M.p. 148–150°. R_f (system *a*) 0.20. IR (KBr): 3053*w*, 3004*w*, 2907*s*, 2848*s*, 1557*m*, 1490*m*, 1453*m*, 1383*m*, 1342*w*, 1309*w*, 1252*w*, 963*w*, 757*s*, 623*w*. ^{1}H-NMR: 1.81–1.94 (*m*, 3 CH_2(Ad), CH_2(7) – CH_2(9)); 2.17 (*m*, 3 CH(Ad)); 2.50 (*m*, 3 CH_2(Ad)); 3.23 (*m*, CH_2(6), CH_2(9)); 7.31 (*dd*, $J = 7.8$, H–C(2)); 7.49 (*dd*, $J = 7.4$, H–C(3)); 7.94 (*d*, $J = 8.3$, H–C(1)); 8.51 (*d*, $J = 8.6$, H–C(4)). ^{13}C-NMR: 27.2 (CH_2); 29.0 (CH_2); 29.7 (CH(Ad)); 31.0 (CH_2); 32.3 (CH_2); 37.2 (CH_2(Ad)); 40.3 (CH_2); 42.9 (C(Ad)); 43.2 (CH_2(Ad)); 122.9 (CH); 126.7 (CH); 126.8 (C); 127.0 (CH); 129.7 (CH); 135.2 (C); 147.1 (C); 151.6 (C); 165.4 (C). GC/MS (t_R 27.4 min): 332 (13), 331 (50, M^+), 330 (12), 136 (11), 135 (100), 107 (7), 93 (13), 79 (13), 67 (7), 55 (5), 41 (6). ESI-MS: 685.4 (4, $[2M + Na]^+$), 332.3 (100, $[M + H]^+$). Anal. calc. for $C_{24}H_{29}N$ (331.49): C 86.96, H 8.82, N 4.23; found: C 87.12, H 8.73, N 4.06.

*6,7,8,9,10,11-Hexahydro-12-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)cycloocta[*b*]quinoline* (**4j**). Purified by CC (system *B*): 60 mg (44%; *Method A*, from 100 mg of **2a**) or 64 mg (95%, *Method B*, from 50 mg of **2a**). Fawn crystalline powder. M.p. 193–194°. R_f (system *A*) 0.35. IR (KBr): 3054*w*, 3009*w*, 2915*s*, 2846*s*, 1551*m*, 1490*m*, 1459*m*, 1439*m*, 1396*w*, 1342*w*, 1308*m*, 1159*m*, 1107*m*, 864*w*, 759*s*, 718*w*, 622*w*. ^{1}H-NMR: 1.11 (*m*, CH_2); 1.57 (*m*, CH_2); 1.69 (*m*, CH_2); 1.83–1.89 (*m*, 3 (CH_2)Ad, CH_2); 2.21 (*m*, 3 CH(Ad)); 2.60 (*m*, 3 CH_2(Ad)); 3.25 (*m*, CH_2(11)); 3.48 (*m*, CH_2(6)); 7.35 (*dd*, $J = 7.3$, H–C(2)); 7.52 (*dd*, $J = 7.6$, H–C(3)); 8.04 (*dd*, $J = 7.9$, H–C(2)); 8.70 (*d*, $J = 8.9$, H–C(4)). ^{13}C-NMR: 24.9 (CH_2); 26.8 (CH_2); 27.7 (CH_2); 29.8 (CH(Ad)); 31.8 (CH_2); 34.2 (CH_2); 37.2 (CH_2(Ad)); 39.0 (CH_2); 43.5 (C(Ad)); 44.1 (CH_2(Ad)); 123.0 (CH); 126.8 (CH); 127.0 (C); 127.7 (CH); 130.7 (CH); 132.8 (C); 148.1 (C); 151.4 (C); 165.4 (C). GC/MS (t_R 37.7 min): 346 (14), 345 (54, M^+), 344 (29), 303 (12), 302 (8), 210 (34), 136 (11), 135 (100), 107 (9), 97 (5), 93 (17), 85 (5), 79 (17), 77 (5), 71 (6), 69 (9), 67 (10), 57 (12), 55 (11), 41 (10). ESI-MS: 713.4 (4, $[2M + Na]^+$), 346.3 (100, $[M + H]^+$). Anal. calc. for $C_{25}H_{31}N$ (345.52): C 86.90, H 9.04, N 4.05; found: C 86.78, H 8.97, N 3.85.

*6,7,8,9,10,11,12,13,14,15-Decahydro-16-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)cyclododeca[*b*]quinoline* (**4k**). Purified by CC (system *B*) 30 mg (19%; *Method A*, from 100 mg of **2a**) or 72 mg (92%, *Method B*, from 50 mg of **2a**). Colorless crystalline powder. M.p. 146–148°. R_f (system *A*) 0.52. IR (KBr): 2909*s*, 2846*s*, 1564*w*, 1550*w*, 1466*m*, 1440*m*, 1385*w*, 1386*w*, 1307*w*, 1245*w*, 1104*w*, 985*w*, 763*s*, 707*w*, 623*w*. ^{1}H-NMR: 1.31–1.57 (*m*, 7 CH_2); 1.82–1.97 (*m*, 3 CH_2(Ad), CH_2); 2.19 (*m*, 3 CH(Ad)); 2.55 (*m*, 3 CH_2(Ad)); 3.05 (br. *m*, CH_2(15)); 3.25 (*m*, CH_2(6)); 7.33 (*dd*, $J = 8.3$, H–C(2)); 7.49 (*dd*, $J = 7.3$, H–C(3)); 7.96 (*d*, $J = 8.3$, H–C(1)); 8.64 (*dd*, $J = 8.9$, H–C(4)). ^{13}C-NMR: 23.0 (CH_2); 23.6 (CH_2); 25.9 (CH_2); 27.7 (2 CH_2); 27.8 (CH_2); 29.2 (CH_2); 29.3 (CH_2); 29.8 (CH(Ad)); 31.7 (CH_2); 35.7 (CH_2); 37.2 (CH_2(Ad)); 40.6 (C(Ad)); 43.5 (CH_2(Ad)); 123.0 (CH); 126.8 (CH); 126.9 (CH); 127.2 (CH); 130.2 (C); 133.6 (C); 147.5 (C); 152.7 (C); 163.6 (C). DI-MS: 402 (14), 401 (61, M^+), 400 (100), 386 (7), 330 (6), 317 (7), 316 (8), 290 (7), 267 (12), 266 (56), 194 (5), 135 (5), 93 (7), 81 (6), 79 (10), 67 (6), 55 (7), 41 (9).

ESI-MS: 825.5 (4, $[2M+Na]^+$), 402.3 (100, $[M+H]^+$). Anal. calc. for $C_{29}H_{39}N$ (401.63): C 86.72, H 9.79, N 3.49; found: C 86.65, H 9.86, N 3.71.

5,6-Dihydro-7-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)benzo[c]acridine (**4l**). Purified by CC (system *B*): 56 mg (39%; *Method A*, from 100 mg of **2a**) or 69 mg (96%; *Method B*, from 50 mg of **2a**). White crystalline powder. M.p. 210–213°. R_f (system *A*) 0.57. IR (KBr): 3012*w*, 2892*s*, 2852*w*, 1545*w*, 1491*m*, 1457*w*, 1382*m*, 1337*w*, 1103*s*, 1033*w*, 965*w*, 915*w*, 771*s*, 723*s*, 669*w*, 619*m*, 484*w*. ^{1}H-NMR: 1.90 (*m*, 3 CH_2(Ad)); 2.20 (*m*, 3 CH(Ad)); 2.55 (*m*, 3 CH_2(Ad)); 2.80 (*m*, CH_2(5)); 3.43 (*m*, CH_2(6)); 7.25 (*d*, *J* = 7.5, 1 H); 7.38(*m*, 2 H); 7.43 (*dd*, *J* = 7.5, 1 H); 7.57 (*dd*, *J* = 7.5, 1 H); 8.21 (br. *s*, 1 H); 8.42 (*d*, *J* = 6.9, 1 H); 8.58 (*d*, *J* = 8.7, 1 H). ^{13}C-NMR: 28.6 (CH_2); 29.6 (CH(Ad)); 31.2 (CH_2); 37.1 (CH_2(Ad)); 42.8 (CH_2(Ad)); 43.2 (C(Ad)); 123.6; 126.6; 126.7; 127.2; 127.2; 127.4; 127.4; 127.6; 129.5; 130.3; 135.4; 139.4; 147.6; 153.4. GC/MS (t_R 51.0 min): 366 (14), 365 (47, M^+), 308 (7), 254 (5), 136 (11), 135 (100), 107 (8), 93 (15), 81 (5), 79 (15), 67 (8), 41 (5). ESI-MS: 753.4 (5, $[2M+Na]^+$), 388.2 (5, $[M+Na]^+$), 366.3 (100, $[M+H]^+$). Anal. calc. for $C_{27}H_{27}N$ (365.51): C 88.72, H 7.45, N 3.83; found: C 88.57, H 7.49, N 3.87.

*3,4-Dihydro-9-(tricyclo[3.3.1.1^{3,7}]dec-1-yl)acridin-1(2*H*)-one* (**4m**). Purified by CC (system *A*): 109 mg (84%; *Method A*, from 100 mg of **2a**). Pale yellow crystalline powder. M.p. 191–194°. R_f (system *A*) 0.19. IR (KBr): 2915*s*, 2901*s*, 2847*m*, 1671*m*, 1634*w*, 1563*w*, 1520*s*, 1481*s*, 1447*s*, 1417*m*, 1364*s*, 1338*m*, 1314*m*, 1189*m*, 1036*w*, 1000*w*, 853*w*, 762*s*, 615*w*, 567*w*. ^{1}H-NMR: 1.83 (*m*, 3 CH_2(Ad)); 2.14 (*m*, 3 CH(Ad)); 2.22 (*m*, CH_2); 2.35 (*m*, 3 CH_2(Ad)); 2.92 (*m*, CH_2); 3.05 (*m*, CH_2); 7.44 (br. *s*, H–C(7)); 7.64 (br. *s*, H–C(6)); 8.00 (*d*, *J* = 6.3, H–C(8)); 8.60 (*d*, *J* = 8.9, H–C(5)). ^{13}C-NMR: 20.9 (CH_2); 29.5 (CH(Ad)); 34.1 (CH_2); 36.9 (CH_2(Ad)); 40.7 (CH_2); 42.4 (C(Ad)); 42.9 (CH_2(Ad)); 124.1 (CH); 127.4 (CH); 127.6 (C); 129.6 (2 CH); 132.4 (C); 148.2 (C); 160.0 (C); 160.3 (C); 205.5 (C=O). DI-MS: 332 (12), 331 (51, M^+), 330 (52), 316 (13), 314 (14), 313 (8), 304 (23), 303 (100), 258 (5), 256 (5), 248 (5), 246 (5), 234 (5), 232 (5), 223 (5), 222 (9), 220 (6), 218 (5), 204 (5), 182 (5), 180 (6), 167 (5), 135 (6), 128 (5), 127 (5), 93 (9), 92 (5), 91 (7), 83 (5), 81 (5), 79 (13), 77 (7), 69 (5), 67 (8), 57 (11), 55 (13), 43 (9), 41 (14). ESI-MS: 685.3 (16, $[2M+Na]^+$), 332.2 (100, $[M+H]^+$). Anal. calc. for $C_{23}H_{25}NO$ (331.45): C 83.34, H 7.60, N 4.23; found: C 83.08, H 7.45, N 4.16.

2-Phenyl-4-[(tricyclo[3.3.1.1^{3,7}]dec-1-yl)methyl]quinoline (**4n**). Purified by CC (system *B*): 28 mg (22%; *Method A*, from 100 mg of **2b**). Yellow crystalline powder. M.p. 164–168°. R_f (system *A*) 0.36. IR (KBr): 3060*w*, 2903*s*, 2846*s*, 1590*s*, 1546*s*, 1493*m*, 1451*m*, 1412*w*, 1343*m*, 1310*w*, 1232*w*, 1102*w*, 1031*w*, 887*w*, 771*s*, 768*s*, 692*s*, 586*w*, 542*w*. ^{1}H-NMR: 1.56–1.70 (overlapped *m*, 6 CH_2(Ad)); 1.96 (*m*, 3 CH(Ad)); 2.97 (*s*, AdCH_2); 7.47–7.58 (overlapped *m*, 4 H); 7.63 (*s*, H–C(3)); 7.71(*dd*, *J* = 7.7, H–C(7)); 8.12–8.23 (overlapped *m*, 4 H). ^{13}C-NMR: 29.0 (CH(Ad)); 35.1 (C(Ad)); 37.0 (CH_2(Ad)); 43.3 (CH_2(Ad)); 46.4 (AdCH_2); 121.8 (CH); 125.1 (CH); 125.8 (CH); 126.7 (C); 127.8 (CH); 128.3 (CH); 129.0 (CH); 129.3 (CH); 129.4 (CH); 130.5 (C); 139.2 (C); 150.6 (C); 156.4 (C). GC-MS (t_R 61.9 min): 353 (11, M^+), 136 (11), 135 (100), 107 (7), 93 (13), 79 (15), 77 (5), 67 (6). ESI-MS: 729.4 (5, $[2M+Na]^+$), 376.3 (6, $[M+Na]^+$), 354.3 (100, $[M+H]^+$). Anal. calc. for $C_{26}H_{27}N$ (353.50): C 88.34, H 7.70, N 3.96; found: C 88.21, H 7.63, N 3.81.

*3,4-Dihydro-9-[(tricyclo[3.3.1.1^{3,7}]dec-1-yl)methyl]acridin-1(2*H*)-one* (**4o**). Purified by CC (system *A*): to yield 40 mg (31%; *Method A*, from 100 mg of **2b**). Yellow crystalline powder. M.p. 163–166°. R_f (system *A*) 0.13. IR (KBr): 2904*s*, 2847*m*, 1704*s*, 1650*m*, 1579*m*, 1497*m*, 1455*w*, 1371*m*, 1308*w*, 1220*s*, 1161*s*, 1125*s*, 1085*w*, 1029*s*, 1007*s*, 976*w*, 817*m*, 772*m*, 682*s*, 658*w*, 570*s*. ^{1}H-NMR: 1.35–1.61 (overlapped *m*, 6 CH_2(Ad)); 1.85 (*m*, 3 CH(Ad)); 2.20 (*m*, $CO(CH_2)_2CH_2$); 2.79 (*m*, $COCH_2CH_2CH_2$); 3.08 (*d*, *J* = 13.0, 1 H AdCH_2); 3.25 (*m*, $COCH_2(CH_2)_2$); 4.41 (*d*, *J* = 13.0, 1 H, AdCH_2); 7.49 (*dd*, *J* = 7.9, H–C(7)); 7.72 (*dd*, *J* = 7.6, H–C(6)); 8.00 (*d*, *J* = 8.1, H–C(8)); 8.22 (*d*, *J* = 8.4, H–C(5)). ^{13}C-NMR: 21.3 (CH_2); 29.1 (CH(Ad)); 34.8 (CH_2); 36.7 (C(Ad)); 36.9 (CH_2(Ad)); 38.4 (CH_2); 41.4 (CH_2); 43.1 (CH_2(Ad)); 125.8 (CH); 127.1 (CH); 127.8 (C); 128.8 (C); 129.0 (CH); 131.3 (CH); 148.0 (C); 149.7 (C); 161.3 (C); 202.0 (C=O). DI-MS: 345 (9, M^+), 136 (11), 135 (100), 107 (7), 93 (11), 79 (12), 67 (6), 57 (5), 55 (5), 41 (5). ESI-MS: 713.3 (5, $[2M+Na]^+$), 368.2 (4, $[M+Na]^+$), 346.2 (100, $[M+H]^+$). Anal. calc. for $C_{24}H_{27}NO$ (345.48): C 83.44, H 7.88, N 4.05; found: C 83.68, H 7.89, N 3.96.

Data of **4o** · *TsOH*. M.p. >230°. ^{1}H-NMR: 1.35–1.65 (*m*, 6 CH_2(Ad)); 1.91 (*m*, 3 CH(Ad)); 2.30 (*m*, $CO(CH_2)_2CH_2$); 2.37 (*s*, *Me*Ph); 2.87 (*m*, $COCH_2CH_2CH_2$); 3.23 (*d*, *J* = 12.0, 1 H, AdCH_2); 3.78 (*m*, $COCH_2(CH_2)_2$); 4.67 (*d*, *J* = 12.0, 1 H AdCH_2); 7.21 (*d*, *J* = 7.8, 2 H of Ph); 7.82 (*dd*, *J* = 7.6, H–C(7)); 7.90 (*d*, *J* = 7.8, 2 H of Ph); 8.04 (*dd*, *J* = 7.7, H–C(6)); 8.42 (*d*, *J* = 8.3, H–C(8)); 8.72 (*d*, *J* = 8.6, H–C(5)).

^{13}C-NMR: 20.4 (Me); 21.5 (CH_2); 29.1 (CH(Ad)); 29.7 (CH_2); 36.5 (CH_2); 38.5 (C(Ad)); 39.9 (CH_2); 40.6 (CH_2(Ad)); 43.3 (CH_2(Ad)); 122.5 (C); 126.3 (CH); 127.5 (CH); 127.7 (CH); 129.0 (CH); 129.1 (CH); 129.2 (C); 136.4 (CH); 138.2 (C); 140.3 (C); 142.7 (C); 159.3 (C); 161.3 (C); 202.0 (C=O). Anal. calc. for $C_{31}H_{35}NO_4S$ (517.68): C 71.92, H 6.81, N 2.71, S 6.19; found: C 72.23, H 6.72, N 2.89, S 5.83.

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