

Shuijiang Tu,* Xiaojing Zhang, Feng Shi, Tuanjie Li, Qian Wang, Xiaotong Zhu,
Jinpeng Zhang, Jianing Xu

Department of Chemistry, Xuzhou Normal University, Key Laboratory of Biotechnology on Medical Plant,
Xuzhou, Jiangsu, 221009, P. R. China
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A series of new *N*-cyclopropyldecahydroacridine-1,8-dione derivatives were synthesized by one-pot reaction of aromatic aldehyde, dimedone (or 1,3-cyclohexanedione) and cyclopropanamine in solution of glycol and water under microwave irradiation with excellent yields (78-94%) and short reaction time (5-10 min).

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Many natural and synthetic compounds containing the acridine skeleton display interesting biological and physical activities [1]. Acridinedione, for example, has been identified as antimalarial and antitumor agents [2]. Decahydroacridine-1,8-dione derivatives are also reported to possess important properties such as high fluorescence efficiency [3]. As a consequence, the interest of organic chemists in the synthesis or structure modifications of acridine derivatives remains high.

Apart from the synthesis of decahydroacridine-1,8-diones reported by Martin, Suarez and us [4-6], it has also been discovered that the introduction of aryl or methyl group to the nitrogen atom of these compounds leads to enhanced fluorescence activity [7-8].

Recently, Hubschwerlen *et al* found that the introduction of a cyclopropyl group to the nitrogen atom of the pyridine ring results in a wide spectrum of antibacterial activities [9]. Since the pyridine scaffold is included in decahydroacridine-1,8-diones, a question was aroused whether the same modification on the nitrogen of the decahydroacridine-1,8-dione may bring about some significant activity. However, the introduction of a cyclopropyl group to the nitrogen atom of the decahydroacridine-1,8-dione has not been reported yet. It would seem, therefore, that further investigations are needed in order to screen novel compounds with peculiar properties.

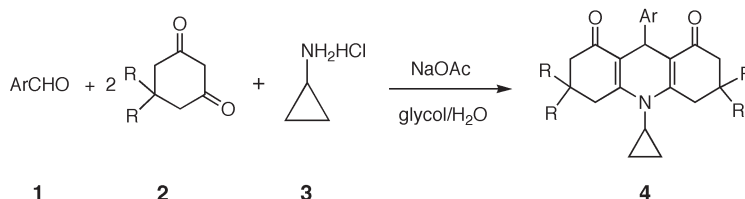
dihydropyridones [13], pyridopyrimidones [14] as well as decahydroacridines [15] with good yields and short reaction time. The efficiency of microwave irradiation (MWI) in promoting organic synthesis and the success of its application in these heterocyclic syntheses triggered us to extend those procedures to the nitrogen modification of decahydroacridine-1,8-diones.

In our previous study [10], we have introduced hydroxyl group to the nitrogen atom of decahydroacridine-1,8-dione under microwave irradiation. Through intensive research, we have successfully achieved the introduction of cyclopropyl group to the nitrogen atom of these compounds under microwave irradiation with excellent yields and short reaction time.

Herein, we would like to describe the one-pot synthesis of this novel type of heterocyclic compounds, the *N*-cyclopropyldecahydroacridine-1,8-dione derivatives.

For the aim of contrast, we carried out the reaction not only under microwave irradiation but under traditional heating conditions (Scheme 1). As a result, we found that microwave can efficiently promote this reaction. By employing microwave irradiation, the reaction time was shortened to 5-10 min from 10 hours required in the conventional heating mode and the yields were sharply increased to 78%-94% from the 15% afforded in the conventional heating mode.

Scheme 1



Since 1986 when microwave heating was first used in organic synthesis by Gedye [10], microwave irradiation has been widely utilized in the synthesis of heterocyclic compounds such as hexahydroquinolines [11], unsymmetrical 1,4-dihydropyridines [11], octahydroquinolines [12],

In addition, we discovered that the reaction condition was crucial to the procedure. Firstly, cyclopropanamine is easy to volatilize because of its lower boiling point (30 °C), so we convert it into the hydrochloride salt and then add NaOAc to liberate the free amine. Secondly, the com-

position of the solvent plays a key role in the process. For example, when anhydrous ethanol or glycol is used as a solvent, the main product is **10** (yield: 92% or so) or **11** (yield: 90% or so), while **4** is the by-product (Scheme 2). When water acts as solvent, **11** and **4** can be obtained simultaneously. Therefore, we investigated the relationship between the contents of **4** and the ratio of water to glycol by HPLC. The optimal ratio of water to glycol is found to be 2:1 (Table 1).

Scheme 2

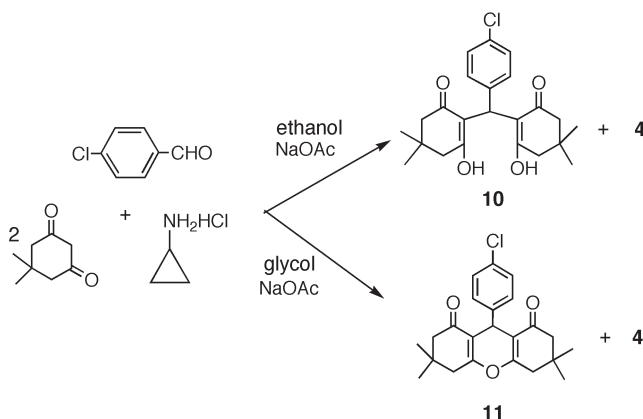


Table 1

The Relationship Between the Contents of **4c** and the Ratio of Water to Glycol by HPLC (water is 0.50 mL)

Volume of glycol (mL)	Content of 4c (%)	Content of 11 (%)
0.00	48.1	52.9
0.13	43.7	56.3
0.19	50.6	49.4
0.25	98.2	1.8
0.31	24.8	75.2
0.38	25.6	74.4
0.50	9.8	90.2

The results (Table 2) show that a series of aromatic aldehydes can undergo the cyclocondensation reaction to give products in excellent yields (78–94%).

This reaction may occur *via* a mechanism of condensation, addition, cyclization and elimination (Scheme 3). At first, the condensation between aldehyde and dimedone gave 2-arylidene-5,5-dimethyl-1,3-cyclohexanedione (**5**). Then, Michael addition between **5** and **6** obtained from dimedone and cyclopropanamine furnished the intermediate **7**, which tautomerized to **8**. After that, intermolecular cyclization of **8** gave **9**, which finally afforded **4** by dehydration.

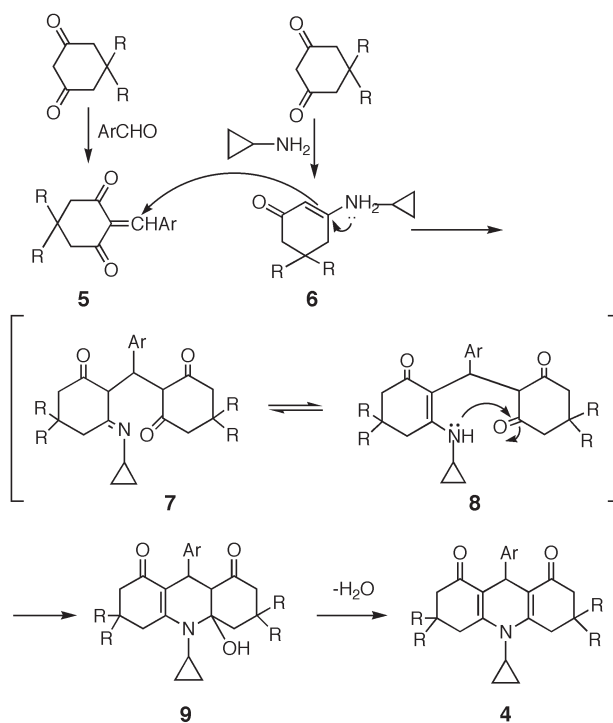
All the products were characterized by IR, ¹H NMR and elemental analysis. Moreover, the structure of **4a** and **4l** were further conformed by X-ray crystallographic analysis

Table 2

Synthesis of **4** Under Microwave Irradiation

Entry	Ar	R	Time	Yield (min)	Mp (°C) (%)
4a	3-OCH ₃ -4-OHC ₆ H ₃	CH ₃	6	85	274-275
4b	3-NO ₂ C ₆ H ₄	CH ₃	7	80	235-236
4c	4-ClC ₆ H ₄	CH ₃	6	79	202-203
4d	4-BrC ₆ H ₄	CH ₃	6	85	204-205
4e	4-CH ₃ OC ₆ H ₄	CH ₃	6	88	248-250
4f	3,4-Cl ₂ C ₆ H ₃	CH ₃	7	82	230-231
4g	2-ClC ₆ H ₄	CH ₃	9	85	226-227
4h	4-FC ₆ H ₄	CH ₃	7	80	227-228
4i	4-BrC ₆ H ₄	H	5	92	222-223
4j	4-NO ₂ C ₆ H ₄	H	6	85	222-223
4k	3-NO ₂ C ₆ H ₄	H	10	78	193-194
4l	4-CH ₃ OC ₆ H ₄	H	5	94	233-234
4m	3,4-Cl ₂ C ₆ H ₃	H	6	90	230-231
4n	2-ClC ₆ H ₄	H	6	86	234-235
4o	3-OCH ₃ -4-OHC ₆ H ₃	H	8	88	242-243
4p	4-ClC ₆ H ₄	H	6	90	204-205

Scheme 3



(Figure 1-2). In the structure of **4a** and **4l**, the aromatic rings are vertical to the pyridine rings which adopt the boat conformation, whereas both of the cyclohexanone rings adopt envelope conformations. The dihedral angles of **4a** and **4l** between the pyridine rings and the cyclopropyl rings are 72.19° and 66.01°, respectively. The ¹H NMR

data of all the compounds are consistent with their assigned structures.

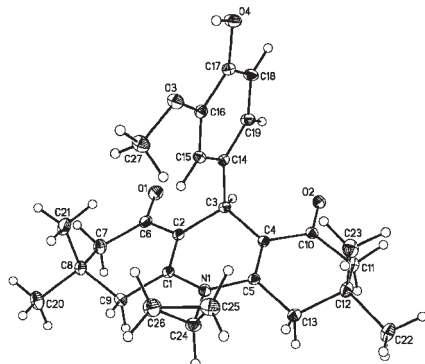


Figure 1 The structure of **4a**.

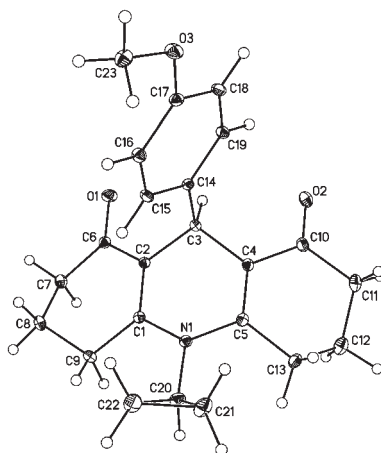


Figure 2 The structure of **4l**.

In conclusion, we have disclosed a novel microwave-assisted reaction by aromatic aldehyde, 1,3-cyclohexanedione or dimedone and cyclopropanamine, thus realizing the introduction of cyclopropyl group on the nitrogen atom of decahydroacridine-1,8-dione derivatives. Therefore, this one-pot synthesis of *N*-cyclopropyldecahydroacridine-1,8-dione derivatives therefore is a simple, timesaving, high-yielding and environmentally friendly process. Great efforts are underway to clarify the bioactivity of these new compounds and the results will be reported in due course.

EXPERIMENTAL

Microwave irradiation was carried out with a modified commercial microwave oven (2450 MHz, 650W) under atmospheric pressure. Melting points were determined in open capillaries and are uncorrected. IR spectra were recorded on a Shimadzu spectrometer. ¹H NMR spectra were measured on a DPX 400 MHz

spectrometer using TMS as an internal standard, DMSO-*d*₆ as solvent. Elemental analysis was determined by using a Perkin-Elmer 240c elemental analysis instrument. X-ray crystallographic analysis was performed with a Siemens SMART CCD and a Siemens P4 diffractometer.

General Procedure for the Synthesis of 9-Aryl-3,3,6,6-tetramethyldecahydroacridine-1,8-diones **4a-4h**.

A solution of the appropriate aromatic aldehyde (2 mmol), dimedone (4 mmol), cyclopropanammonium chloride (4 mmol) and NaOAc (4 mmol) in glycol (0.25 mL) and water (0.50 mL) was irradiated for 6-9 min. The reaction mixture was cooled to room temperature, then poured into water (50 mL), filtered to give the crude product, which was further purified by recrystallization from 95% EtOH.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(3-methoxy-4-hydroxyphenyl)-decahydroacridine-1,8-dione (**4a**).

This compound has the following properties: IR (KBr, ν , cm^{-1}): 3185, 2954, 1646, 1635, 1569, 1510, 1465, 1428, 1370, 1370, 1269, 1226, 1141, 1040, 845, 743, 666, 568, 466. ¹H NMR (δ , ppm): 8.58(s, 1H, OH), 6.54-6.40(m, 3H, ArH), 4.93(s, 1H, CH), 3.63(s, 3H, OCH₃), 3.09-3.06(m, 1H, CH), 3.00-2.96(m, 2H, CH₂), 2.57-2.52(m, 2H, CH₂), 2.22-2.12(m, 4H, CH₂), 1.18-1.16(m, 2H, CH₂), 1.04(s, 6H, CH₃), 1.01(s, 6H, CH₃), 0.59-0.57(m, 2H, CH₂).

Anal. Calcd. for C₂₇H₃₃NO₄: C, 74.45; H, 7.64; N, 3.22. found: C, 74.57; H, 7.83; N, 3.12.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(3-nitrophenyl)-decahydroacridine-1,8-dione (**4b**).

This compound has the following properties: IR (KBr, ν , cm^{-1}): 3083, 2953, 2866, 1670, 1626, 1570, 1525, 1467, 1452, 1369, 1344, 1318, 1273, 1221, 1120, 977, 909, 810, 846, 733, 710, 589. ¹H NMR (δ , ppm): 7.97-7.94 (m, 1H, ArH), 7.51-7.49 (m, 2H, ArH), 7.23-7.16 (m, 1H, ArH), 5.12 (s, 1H, CH), 3.12-3.09 (m, 1H, CH), 3.04-3.00 (m, 2H, CH₂), 2.62-2.59 (m, 2H, CH₂), 2.24-2.17(m, 4H, CH₂), 1.24-1.19 (m, 2H, CH₂), 1.03 (s, 6H, CH₃), 0.99 (s, 6H, CH₃), 0.71-0.68 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₃₀N₂O₄: C, 71.87; H, 6.96; N, 6.45. Found: C, 71.98; H, 6.84; N, 6.32.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(4-chlorophenyl)-decahydroacridine-1,8-dione (**4c**).

This compound has the following properties: IR (KBr, ν , cm^{-1}): 3001, 2954, 2868, 1636, 1565, 1485, 1364, 1316, 1224, 1116, 1009, 855, 830, 773, 528, 456. ¹H NMR (δ , ppm): 7.21 (d, 2H, *J*=8.0 Hz, ArH), 6.98 (d, 2H, *J*=8.0 Hz, ArH), 5.01 (s, 1H, CH), 3.08-3.05 (m, 1H, CH), 3.00-2.96 (m, 2H, CH₂), 2.58-2.54 (m, 2H, CH₂), 2.23-2.17 (m, 4H, CH₂), 1.18-1.13 (m, 2H, CH₂), 1.01 (s, 6H, CH₃), 0.99 (s, 6H, CH₃), 0.63-0.58 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₃₀ClNO₂: C, 73.65; H, 7.13; N, 3.30. Found: C, 73.78; H, 7.01; N, 3.33.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(4-bromophenyl)-decahydroacridine-1,8-dione (**4d**).

This compound has the following properties: IR (KBr, ν , cm^{-1}): 2954, 2868, 2089, 1633, 1570, 1480, 1363, 1316, 1224, 1144, 1122, 1029, 999, 860, 707, 522. ¹H NMR (δ , ppm): 7.34 (d, 2H, *J*=8.8 Hz, ArH), 6.92 (d, 2H, *J*=8.8 Hz, ArH), 4.99 (s, 1H, CH), 3.09-3.03 (m, 1H, CH), 3.00-2.96 (m, 2H, CH₂), 2.58-2.54

(m, 2H, CH₂), 2.23-2.13 (m, 4H, CH₂), 1.18-1.13 (m, 2H, CH₂), 1.01 (s, 6H, CH₃), 0.99 (s, 6H, CH₃), 0.63-0.58 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₃₀BrNO₂: C, 66.67; H, 6.46; N, 2.99; found: C, 66.52; H, 6.32; N, 3.12.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(4-methoxyphenyl)-decahydroacridine-1,8-dione (**4e**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3062, 3001, 2950, 2832, 1637, 1625, 1565, 1508, 1366, 1292, 1246, 1127, 1106, 1031, 942, 830, 707, 548 cm⁻¹. ¹H NMR (δ, ppm): 6.88(d, 2H, *J*=8.8 Hz, ArH), 6.70 (d, 2H, *J*= 8.8 Hz, ArH), 4.95 (s, 1H, CH), 3.65 (s, 3H, OCH₃), 3.08-3.03 (m, 1H, CH), 2.99-2.95 (m, 2H, CH₂), 2.57-2.53 (m, 2H, CH₂), 2.17-2.13 (m, 4H, CH₂), 1.17-1.14 (m, 2H, CH₂), 1.01 (s, 6H, CH₃), 0.99 (s, 6H, CH₃), 0.62-0.58 (m, 2H, CH₂).

Anal. Calcd. for C₂₇H₃₃NO₃: C, 77.29; H, 7.93; N, 3.34. Found: C, 77.41; H, 7.77; N, 3.39.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(3,4-dichlorophenyl)-decahydroacridine-1,8-dione (**4f**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3093, 3006, 2960, 2863, 1630, 1572, 1462, 1387, 1361, 1302, 1265, 1222, 1146, 1119, 1019, 983, 886, 830, 778, 676, 599, 548, 440. ¹H NMR (δ, ppm): 7.43 (d, 1H, *J*= 8.4 Hz, ArH), 7.13-6.93 (m, 2H, ArH), 5.00 (s, 1H, CH), 3.11-3.05 (m, 1H, CH), 3.03-2.98 (m, 2H, CH₂), 2.59-2.55 (m, 2H, CH₂), 2.25-2.14 (m, 4H, CH₂), 1.21-1.16 (m, 2H, CH₂), 1.01 (s, 6H, CH₃), 1.00 (s, 6H, CH₃), 0.63-0.59 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₂₉Cl₂NO₂: C, 68.12; H, 6.38; N, 3.06; found: C, 68.29; H, 6.29; N, 6.28.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(2-chlorophenyl)-decahydroacridine-1,8-dione (**4g**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3088, 3016, 2956, 2929, 2868, 1637, 1576, 1465, 1368, 1385, 1338, 1304, 1216, 1180, 1144, 1120, 1037, 944, 906, 840, 748, 702, 650, 579, 471. ¹H NMR (δ, ppm): 7.19-7.01 (m, 4H, ArH), 5.25 (s, 2H, CH), 3.09-3.05 (m, 1H, CH), 3.02-2.98 (m, 2H, CH₂), 2.60-2.55 (m, 2H, CH₂), 2.15-2.08 (m, 4H, CH₂), 1.26-1.22 (m, 2H, CH₂), 1.00 (s, 6H, CH₃), 0.97 (s, 6H, CH₃), 0.83-0.79 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₃₀ClNO₂: C, 73.65; H, 7.13; N, 3.30. Found: C, 73.52; H, 7.32; N, 3.38.

3,3,6,6-Tetramethyl-*N*-cyclopropyl-9-(4-fluorophenyl)-decahydroacridine-1,8-dione (**4h**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3093, 3006, 2960, 2863, 1630, 1572, 1462, 1387, 1361, 1302, 1265, 1222, 1146, 1119, 1019, 983, 886, 830, 778, 676, 599, 548, 440. ¹H NMR (δ, ppm): 7.01-6.94 (m, 4H, ArH), 5.01 (s, 1H, CH), 3.09-3.04 (m, 1H, CH), 3.01-2.96 (m, 2H, CH₂), 2.58-2.51 (m, 2H, CH₂), 2.23-2.13 (m, 4H, CH₂), 1.18-1.13 (m, 2H, CH₂), 1.01 (s, 6H, CH₃), 0.99 (s, 6H, CH₃), 0.62-0.58 (m, 2H, CH₂).

Anal. Calcd. for C₂₆H₃₀FNO₂: C, 76.63; H, 7.42; N, 3.44. Found: C, 76.52; H, 7.25; N, 3.61.

General Procedure for the Synthesis of 9-Aryl-1,2,3,4,5,6,7,8,9,10-decahydroacridine-1,8-diones **4i-4p**.

A solution of the appropriate aromatic aldehyde (2 mmol), 1,3-cyclohexanedione (4 mmol), cyclopropanammonium chloride (4 mmol) and NaOAc (4 mmol) in glycol (0.25 mL) and water (0.50 mL) was irradiated for 5-10 min. The reaction mixture was

cooled to r.t., then poured into water (50 mL), the solid produce was collected by filtration to give the crude product, which was further purified by recrystallization from 95% EtOH.

N-Cyclopropyl-9-(4-bromophenyl)-decahydroacridine-1,8-dione (**4i**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3088, 2939, 2858, 1632, 1569, 1366, 1293, 1231, 1181, 1134, 1071, 1036, 1008, 937, 896, 835, 543, 466. ¹H NMR (δ, ppm): 7.33 (d, 2H, *J*=8.4 Hz, ArH), 6.93 (d, 2H, *J*= 8.4 Hz, ArH), 5.01 (s, 1H, CH), 3.08-3.05 (m, 1H, CH), 3.04-3.01 (m, 2H, CH₂), 2.72-2.66 (m, 2H, CH₂), 2.33-2.24 (m, 4H, CH₂), 1.98-1.93 (m, 4H, CH₂), 1.11-1.06 (m, 2H, CH₂), 0.67-0.63 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₂BrNO₂: C, 64.09; H, 5.38; N, 3.40. Found: C, 64.18; H, 5.16; N, 3.33.

N-Cyclopropyl-9-(4-nitrophenyl)-decahydroacridine-1,8-dione (**4j**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 2945, 2919, 1632, 1563, 1519, 1360, 1286, 1231, 1180, 1106, 1052, 942, 901, 814, 702, 604, 471. ¹H NMR (δ, ppm): 8.03 (d, 2H, *J*=8.4 Hz, ArH), 7.24 (d, 2H, *J*= 8.4 Hz, ArH), 5.15 (s, 1H, CH), 3.46-3.43 (m, 1H, CH), 3.09-3.06 (m, 2H, CH₂), 2.75-2.72 (m, 2H, CH₂), 2.33-2.27 (m, 4H, CH₂), 2.21-1.95 (m, 4H, CH₂), 1.12-1.05 (m, 2H, CH₂), 0.72-0.68 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₂N₂O₄: C, 69.83; H, 5.86; N, 7.40. Found: C, 70.00; H, 5.99; N, 7.22.

N-Cyclopropyl-9-(3-nitrophenyl)-decahydroacridine-1,8-dione (**4k**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3078, 2939, 2919, 2868, 1632, 1568, 1532, 1429, 1363, 1345, 1289, 1230, 1182, 1134, 906, 825, 671, 548. ¹H NMR (δ, ppm): 7.95-7.93 (m, 1H, ArH), 7.88-7.86 (m, 1H, ArH), 7.74-7.46 (m, 2H, ArH), 5.12 (s, 1H, CH), 3.12-3.08 (m, 1H, CH), 3.05-3.02 (m, 2H, CH₂), 2.76-2.68 (m, 2H, CH₂), 2.33-2.22 (m, 4H, CH₂), 1.98-1.92 (m, 4H, CH₂), 1.16-1.11 (m, 2H, CH₂), 0.75-0.71 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₂N₂O₄: C, 69.83; H, 5.86; N, 7.40. Found: C, 70.01; H, 5.77; N, 7.23.

N-Cyclopropyl-9-(4-methoxyphenyl)-decahydroacridine-1,8-dione (**4l**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3001, 2950, 1637, 1625, 1565, 1508, 1366, 1292, 1246, 1292, 1284, 1031, 942, 830, 707, 548. ¹H NMR (δ, ppm): 6.88 (d, 2H, *J*=8.8 Hz, ArH), 6.79(d, 2H, *J*=8.8 Hz, ArH), 4.97(s, 1H, CH), 3.65(s, 3H, OCH₃), 3.07-3.04(m, 1H, CH), 3.03-3.00(m, 2H, CH₂), 2.70-2.63(m, 2H, CH₂), 2.33-2.18(m, 4H, CH₂), 1.96-1.90(m, 4H, CH₂), 1.12-1.07(m, 2H, CH₂), 0.65-0.61(m, 2H, CH₂).

Anal. Calcd for C₂₃H₂₅NO₃: C, 76.01; H, 6.93; N, 3.85. Found: C, 76.22; H, 6.84; N, 3.61.

N-Cyclopropyl-9-(3,4-dichlorophenyl)-decahydroacridine-1,8-dione (**4m**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3083, 3062, 2939, 2863, 1631, 1568, 1469, 1403, 1385, 1359, 1296, 1229, 1181, 1131, 1028, 943, 910, 825, 753, 661, 533, 420. ¹H NMR (δ, ppm): 7.40 (d, 1H, *J*=8.0 Hz, ArH), 7.14 (s, 1H, ArH), 6.93-6.91 (m, 1H, ArH), 5.01 (s, 1H, CH), 3.09-

3.06 (m, 1H, CH), 3.05-3.01 (m, 2H, CH₂), 2.73-2.66 (m, 2H, CH₂), 2.36-2.20 (m, 4H, CH₂), 1.98-1.93 (m, 4H, CH₂), 1.13-1.09 (m, 2H, CH₂), 0.68-0.64 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₁Cl₂NO₂: C, 65.68; H, 5.26; N, 3.48. Found: C, 65.54; H, 5.10; N, 3.31.

N-Cyclopropyl-9-(2-chlorophenyl)-decahydroacridine-1,8-dione (**4n**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3073, 2949, 1634, 1570, 1473, 1452, 1436, 1357, 1297, 1230, 1181, 1134, 1040, 965, 907, 838, 744, 537, 468. ¹H NMR (δ, ppm): 7.18-6.98 (m, 4H, ArH), 5.26 (s, 1H, CH), 3.09-3.06 (m, 1H, CH), 3.04-2.99 (m, 2H, CH₂), 2.74-2.67 (m, 2H, CH₂), 2.26-2.13 (m, 4H, CH₂), 1.94-1.89 (m, 4H, CH₂), 1.19-1.14 (m, 2H, CH₂), 0.84-0.80 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₂ClNO₂: C, 71.83; H, 6.03; N, 3.81. Found: C, 71.98; H, 5.88; N, 3.62.

N-Cyclopropyl-9-(3-methoxy-4-hydroxyphenyl)-decahydroacridine-1,8-dione (**4o**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3401, 2949, 1626, 1564, 1511, 1453, 1432, 1364, 1288, 1231, 1182, 1116, 1034, 946, 906, 625, 476. ¹H NMR (δ, ppm): 8.52 (s, 1H, OH), 6.52-6.37 (m, 3H, ArH), 4.94 (s, 1H, CH), 3.64 (s, 3H, OCH₃), 3.08-3.05 (m, 1H, CH), 3.04-3.01 (m, 2H, CH₂), 2.70-2.50 (m, 2H, CH₂), 2.32-2.20 (m, 4H, CH₂), 1.97-1.92 (m, 4H, CH₂), 1.13-1.08 (m, 2H, CH₂), 0.65-0.61 (m, 2H, CH₂).

Anal. Calcd. for C₂₃H₂₅NO₄: C, 72.80; H, 6.64; N, 3.69. Found: C, 72.98; H, 6.83; N, 3.60.

N-Cyclopropyl-9-(4-chlorophenyl)-decahydroacridine-1,8-dione (**4p**).

This compound has the following properties: IR (KBr, v, cm⁻¹): 3416, 3257, 2937, 1644, 1596, 1488, 1366, 1293, 1232, 1183, 1136, 1087, 1037, 1011, 944, 908, 836, 758, 650, 534. ¹H NMR (δ, ppm): 7.20 (d, 2H, *J*=8.4 Hz, ArH), 6.99 (d, 2H, *J*=8.4 Hz, ArH), 5.03 (s, 1H, CH), 3.08-3.05 (m, 1H, CH), 3.03-3.00 (m, 2H, CH₂), 2.73-2.64 (m, 2H, CH₂), 2.35-2.22 (m, 4H, CH₂), 1.98-1.91 (m, 4H, CH₂), 1.11-1.08 (m, 2H, CH₂), 0.66-0.63 (m, 2H, CH₂).

Anal. Calcd. for C₂₂H₂₂ClNO₂: C, 71.83; H, 6.03; N, 3.81. Found: C, 72.01; H, 5.98; N, 3.53.

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- [17] The single-crystal growth was carried out in ethanol at room temperature. X-ray crystallographic analysis was performed with a Siemens SMART CCD and a Siemens P4 diffractometer. Crystal data for **4a**: C₂₇H₃₃NO₄, yellow, crystal dimension 0.30x0.22x0.19 mm, monoclinic, space group P2₁/n, *a*=9.6559(11), *b*=14.9830(16), *c*=16.5393(19) Å, α=γ=90°, β=102.754(1)°, *V*=2333.8(5) Å³, *Mr*=386.28, *Z*=4, *D_c*=1.525 g/cm³, λ=0.71070 Å, μ(*MoKα*)=0.082 mm⁻¹, *F*(000)=9366, *R₁*=0.0607, *wR₂*=0.1290. Crystal data for **4l**: C₂₃H₂₅NO₃, yellow, crystal dimension 0.50x0.30x0.20 mm, monoclinic, space group P2₁/c, *a*=11.2668(10), *b*=16.4542(12), *c*=10.8049(9) Å, α=γ=90°, β=111.798(1)°, *V*=2333.8(5) Å³, *Mr*=363.44, *Z*=4, *D_c*=1.298 g/cm³, λ=0.71070 Å, μ(*MoKα*)=0.085 mm⁻¹, *F*(000)=776, *R₁*=0.0678, *wR₂*=0.1415.