Synthesis of Substituted 1,4-Diazepino[5,6,7-*kl*]acridines and Imidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridines

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The synthesis of some substituted 11-methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridines **4** with more diversified chains at position 4 is described. A convenient method for transformation of these compounds into the corresponding 4-substituted 12-methoxy-4*H*-2,3-dihydroimidazo[4,5,1-*de*][1,4]diazepino-[5,6,7-*mn*]acridine (**5**) is reported.

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Introduction.

Recently, we have reported the synthesis of some substituted 1-amino-9-imino-4-nitro-9,10-dihydroacridines **1** as potential antitumor agents [1]. These compounds, which constitute an "open" model of the anticancer 5-nitropyrazoloacridines **2**, were synthesized with the assumption that they could by helpful in explanation of the role played by the pyrazolo ring in the new, highly active, antitumor agents such as **2** [2], anthrapyrazoles [3] or benzothiopyranoindazoles [4]. Continuing our studies on structural modifications of the antitumor acridine chromophore we were interested in the synthesis of analogues of **1** in which the two nitrogen atoms at positions 1 and 9 are not separated as in **1** but are bridged by two methylene units as in **4**. A convenient method of synthesis, and two examples of such derivatives, have been recently reported [5]. Additionally, on the basis of previous findings that also condensation of an imidazolo ring with an acridone chromophore, **3**, gives compounds with antitumor activity [6], it seemed to us that a similar modification of structure **4** would be of interest. Such a pentacyclic ring system **5** has never been reported in the literature. Derivatives of **5** are valuable materials for a structure-activity relationship study in the group of 5-substituted 8-methoxy(hydroxy)-6*H*-imidazo-[4,5,1-*de*]acridin-6-ones as antitumor agents [7]. Additionally, whereas **4** can exist in solution as imino tautomeric form [5], in derivatives with structure **5** the imino form is permanently blocked. From this point of view, both **4** and **5** are also interesting as far as Denny's "iminoacridan hypothesis" is concerned [8].

We report in this paper the synthesis of some 4-substituted 11-methoxy-7-nitro-1,4-diazepino[5,6,7-*kl*]acridines, and a convenient method for their transformation into the corresponding imidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]-acridines in one step synthesis.

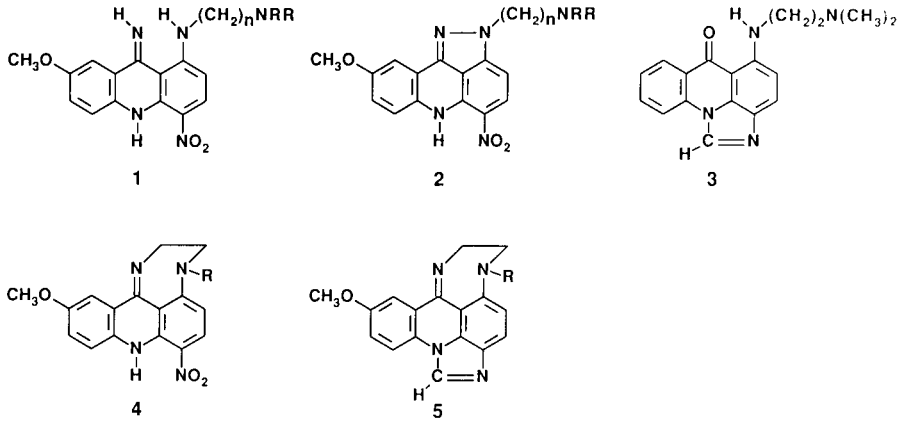
Results and Discussion.

The synthetic procedure used in obtaining compounds **5** is presented in Scheme 1. The starting 1-chloro-7-methoxy-4-nitro-9-phenoxyacridine (**6**) was obtained according to the method described earlier [1]. Compounds **4b-c** were previously described [5]. To obtain the other compounds with structure **4** we have used the same method, consisting in heating **6** with *N*-substituted ethylenediamines.

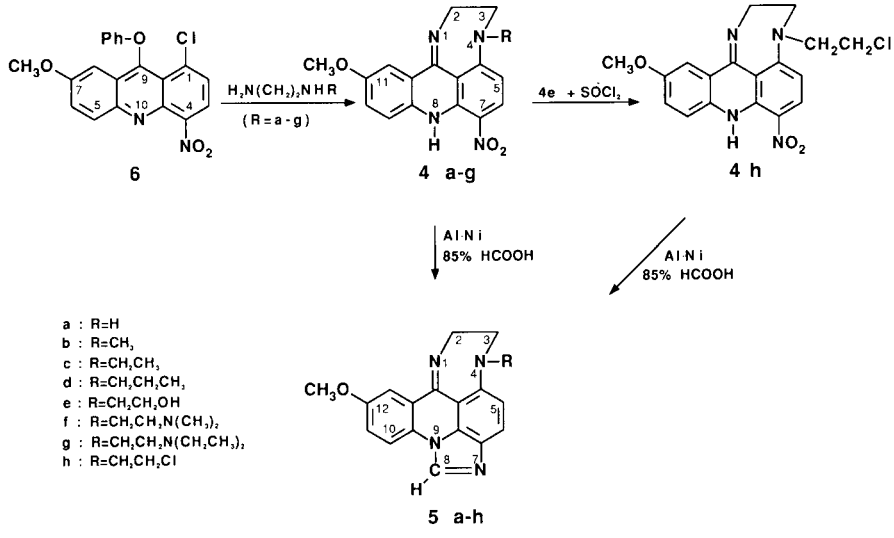
We have found that, due to the special reactivity of **6**, the formation of **4** occurred easily, with very good yield and purity, independently from the kind of substituents in ethylenediamine. Compound **4h** was obtained by refluxing **4e** with an excess of thionyl chloride. All compounds with structure **4** were isolated from the reaction mixture as free bases by addition of alkali to remove phenol and filtration of the precipitate. One crystallization was sufficient to obtain analytically pure samples.

In preliminary attempts to obtain imidazodiazepinoacridines **5** we tried a procedure analogous to that described in the case of imidazoacridinones [6,7], but we found it unsatisfactory. In the course of further attempts, we found a new, more convenient method consisting in heating 7-nitrodiazepinoacridines with 85% formic acid and Raney alloy. With this method, the corresponding imidazodiazepinoacridines were formed as final products. In general, the yields were high. To isolate the target compounds from the reaction mixture, extraction methods were usually used. For analyses and ^{1}H nmr spectra the compounds were crystallized from suitable solvent mixtures. In the case of **5a** some unidentified side products were formed and it was necessary to isolate the main product on silica gel column.

Selected compounds from both groups were preliminarily tested as potential inhibitors of viral reverse transcriptase. Results of the study, after completing, will be published separately.



Scheme 1



Scheme 2

EXPERIMENTAL

Melting points were taken on a Buchi 510 capillary apparatus and are uncorrected. Microanalytical results were obtained from the Laboratory of Elemental Analyses, Department of Chemical Sciences, University of Camerino. The ^{1}H nmr spectra were recorded on a Varian VXR-300 spectrometer. Chemical shifts are reported as δ values (ppm) downfield from internal tetramethylsilane. The nmr abbreviations used are as follows: br (broad), s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), ex (exchangeable with deuterium oxide). Coupling constants are given in Hz. Single frequency decoupling was utilized in some cases for the assignment of specific protons.

11-Methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridine (**4a**).

To a mixture of 762 mg (2 mmoles) of **6** and 10 ml of freshly distilled *N*,*N*-dimethylformamide stirred at 60°, 240 mg (4 mmoles) of ethylenediamine was added. The temperature was kept at 60-70° and stirring was continued for 2 hours. To the reaction mixture 80 ml of acetone was added with stirring. The precipitate obtained was collected, washed with acetone and poured into 200 ml of water. The suspension was heated to boil, made basic with aqueous ammonia and stirred for 10 minutes. The precipitate was filtered, washed with water and crystallized from *N*,*N*-dimethylformamide-water to give 552 mg (89%) of orange **4a**, mp 255-257° dec; ^{1}H nmr (deuteriochloroform): δ 12.22 (br s, 1H, ex, N8-H), 8.16 (d, 1H, J = 10.1, C6-H), 7.72 (d, 1H, J = 2.5, C12-H), 7.08 (m, 2H, C9-H and C10-H), 6.08 (d, 1H, J = 10.1, C5-H), 5.62 (br s, 1H, ex, N4-H), 4.16 (m, 2H, C2-H), 3.90 (s, 3H, C11-OCH_3), 3.66 (m, 2H, C3-H).

Anal. Calcd. for $C_{16}H_{14}N_4O_3$: C, 61.93; H, 4.55; N, 18.05. Found: C, 61.67; H, 4.53; N, 17.90.

11-Methoxy-7-nitro-4-propyl-4*H*,8*H*-2,3-dihydro-1,4-diazepino-[5,6,7-*kl*]acridine (**4d**).

To a mixture of 762 mg (2 mmoles) of **6** and 15 ml of freshly distilled *N*,*N*-dimethylformamide, stirred at 80°, 408 mg (4 mmoles) of *N*-propylethylenediamine was added. Stirring was continued at this temperature for 2 hours. To the reaction mix-

ture 200 ml of 5% aqueous solution of potassium hydroxide was added and stirring was continued for 20 minutes. The product was filtered off, washed with water and crystallized from ethanol-water to give 660 mg (93%) of **4d** as red needles, mp 179-180°; ^{1}H nmr (deuteriochloroform): δ 12.18 (br s, 1H, ex, N8-H), 8.23 (d, 1H, J = 10.0, C6-H), 7.68 (d, 1H, J = 2.4, C12-H), 7.08 (m, 2H, C9-H and C10-H), 6.32 (d, 1H, J = 10.0, C5-H), 4.16 (m, 2H, C2-H), 3.90 (s, 3H, C11-OCH$_3$), 3.78 (m, 2H, C3-H), 3.40 (m, 2H, N4-C*H*$_2$-CH$_2$-CH$_3$), 1.77 (m, 2H, -CH$_2$-C*H*$_2$-CH$_3$), 1.00 (t, 3H, -CH$_2$-C*H*$_3$).

Anal. Calcd. for $C_{19}H_{20}N_4O_3$: C, 64.76; H, 5.72; N, 15.90. Found: C, 64.53; H, 5.64; N, 15.98.

4-(2-Hydroxyethyl)-11-methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridine (**4e**).

This compound was obtained in an analogous manner with that of **4d** using *N*-(2-hydroxyethyl)ethylenediamine in place of *N*-propylethylenediamine, yield 84%, red crystals, mp 202-204° dec (from chloroform-petroleum ether); ^{1}H nmr (DMSO-d$_6$): δ 12.06 (s, 1H, ex, N8-H), 8.09 (d, 1H, J = 10.1, C6-H), 7.62 (d, 1H, J = 3.0, C12-H), 7.42 (d, 1H, J = 8.8, C9-H), 7.09 (dd, 1H, J$_o$ = 8.8, J$_m$ = 3.0, C10-H), 6.66 (d, 1H, J = 10.1, C5-H), 4.96 (t, 1H, ex, -CH$_2$-OH), 4.06 (m, 2H, C2-H), 3.79 (s, 3H, C11-OCH$_3$), 3.70 (m, 4H, C3-H and N4-C*H*$_2$-CH$_2$-OH), 3.65 (m, 2H, -CH$_2$-C*H*$_2$-OH).

Anal. Calcd. for $C_{16}H_{18}N_4O_4$: C, 61.02; H, 5.12; N, 15.81. Found: C, 60.61; H, 5.24; N, 15.57.

4-[2-(Dimethylamino)ethyl]-11-methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridine (**4f**).

To a mixture of 5.715 g (15 mmoles) of **6** and 50 ml of freshly distilled *N*,*N*-dimethylformamide stirred at 90°, 3.28 g (25 mmoles) of freshly distilled *N*-(2-dimethylaminoethyl)ethylenediamine [9] was added and stirring was continued at this temperature for 2 hours. To the reaction mixture 200 ml of 5% aqueous solution of potassium hydroxide was added and the reaction product was extracted with benzene (3 x 100 ml). The benzene extracts were dried and acidified with gaseous hydrogen chloride. The precipitated salt was collected, washed with ether, dried and dissolved in water (200 ml). The solution was alkalinized with aqueous ammonia and the precipitate obtained was filtered, dried and crystallized from chloroform-petroleum ether to give 4.02 g (70%) of **4f** as red crystals, mp 163-164°; ^{1}H nmr (deuteriochloroform): δ 12.16 (s, 1H, ex, N8-H), 8.24 (d, 1H, J = 10.1, C6-H), 7.66 (d, 1H, J = 2.5, C12-H), 7.08 (m, 2H, C9-H and C10-H), 6.38 (d, 1H, J = 10.1, C5-H), 4.16 (m, 2H, C2-H), 3.90 (s, 3H, C11-OCH$_3$), 3.80 (m, 2H, C3-H), 3.60 (t, 2H, N4-C*H*$_2$-CH$_2$-NMe$_2$), 2.62 (t, 2H, -CH$_2$-C*H*$_2$-NMe$_2$), 2.30 (s, 6H, -N(C*H*$_3$)$_2$).

Anal. Calcd. for $C_{20}H_{23}N_5O_3$: C, 62.98; H, 6.08; N, 18.36. Found: C, 62.54; H, 5.95; N, 17.98.

4-[2-(Diethylamino)ethyl]-11-methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridine (**4g**).

This compound was obtained in an analogous manner as **4f** using *N*-(2-diethylaminoethyl)ethylenediamine [9] in place of *N*-(2-dimethylaminoethyl)ethylenediamine, yield 84%, red crystals, mp 179-180°; ^{1}H nmr (deuteriochloroform): δ 12.20 (s, 1H, ex, N8-H), 8.22 (d, 1H, J = 10.1, C6-H), 7.68 (d, 1H, J = 2.5, C12-H), 7.08 (m, 2H, C9-H and C10-H), 6.42 (d, 1H, J = 10.1, C5-H), 4.18 (m, 2H, C2-H), 3.88 (s, 3H, C11-OCH$_3$), 3.78 (m, 2H, C3-H), 3.58 (t, 2H, N4-C*H*$_2$-CH$_2$-NEt$_2$), 2.74 (t, 2H, -CH$_2$-C*H*$_2$-NEt$_2$), 2.58 (q, 4H, -N(C*H*$_2$CH$_3$)$_2$), 1.04 (t, 6H, -N(CH$_2$C*H*$_3$)$_2$).

Anal. Calcd. for $C_{22}H_{27}N_5O_3$: C, 64.53; H, 6.65; N, 17.10. Found: C, 64.76; H, 6.76; N, 17.01.

4-(2-Chloroethyl)-11-methoxy-7-nitro-4*H*,8*H*-2,3-dihydro-1,4-diazepino[5,6,7-*kl*]acridine (**4h**).

A mixture of 708 mg (2 mmoles) of **4e** and 10 ml (137 mmoles) of thionyl chloride was refluxed with stirring for 2 hours. Thionyl chloride was evaporated and to the residue 50 ml of chloroform was added with stirring. The precipitate was filtered, washed with chloroform and dried. The crude product was poured into 200 ml of water, alkalinized with aqueous NH$_3$ and stirred for 15 minutes. The solid was filtered, washed with water and crystallized from acetone-water to give 544 mg (73%) of **4h** as red crystals. For analytical purpose, a small sample was recrystallized from chloroform-petroleum ether, mp 174-175°; ^{1}H nmr (deuteriochloroform): δ 12.02 (s, 1H, ex, N8-H), 8.28 (d, 1H, J = 10.1, C6-H), 7.68 (d, 1H, J = 2.5, C12-H), 7.08 (m, 2H, C9-H and C10-H), 6.35 (d, 1H, J = 10.1, C5-H), 4.17 (m, 2H, C2-H), 3.90 (s, 3H, C11-OCH$_3$), 3.85 (m, 4H, C3-H and -CH$_2$-C*H*$_2$-Cl), 3.76 (m, 2H, N4-C*H*$_2$-CH$_2$-Cl).

Anal. Calcd. for $C_{18}H_{17}ClN_4O_3$: C, 57.99; H, 4.60; N, 15.03. Found: C, 58.17; H, 4.70; N, 15.11.

12-Methoxy-4*H*-2,3-dihydroimidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5a**).

A mixture of 466 mg (1.5 mmoles) of **4a**, 500 mg of Raney-type alloy and 10 ml of 85% formic acid was stirred under reflux for 2 hours. The reaction mixture was treated with 150 ml of water and the catalyst was filtered and washed with water. The filtrate was alkalinized with aqueous ammonia and the solution was extracted with chloroform. The extracts were dried, concentrated and chromatographed on column with silica gel using a mixture chloroform-methanol (6:1) as eluent. The main fraction was evaporated and the crude product crystallized from chloroform-petrol ether to give 157 mg (36%) of yellow **5a**, mp 263-265° dec; ^{1}H nmr (deuteriochloroform): δ 8.40 (s, 1H, C8-H), 8.09 (d, 1H, J = 2.8, C13-H), 7.70 (d, 1H, J = 8.7, C6-H), 7.65 (d, 1H, J = 8.9, C10-H), 7.17 (dd, 1H, J$_o$ = 8.9, J$_m$ = 2.8, C11-H), 6.69 (d, 1H, J = 8.7, C5-H), 5.16 (br m, 1H, ex, N4-H), 4.32 (m, 2H, C2-H), 3.94 (s, 3H, C12-OC*H*$_3$), 3.54 (m, 2H, C3-H).

Anal. Calcd. for $C_{17}H_{14}N_4O$: C, 70.33; H, 4.86; N, 19.30. Found: C, 70.21; H, 5.00; N, 19.46.

12-Methoxy-4-methyl-4*H*-2,3-dihydroimidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5b**).

A mixture of 325 mg (1 mmole) of **4b** [5], 450 mg of Raney-type alloy and 5 ml of 85% formic acid was stirred under reflux for 3 hours. The reaction mixture was treated with 50 ml of water and the catalyst was filtered and washed with water. The filtrate was alkalinized with aqueous potassium hydroxide. The precipitated product was filtered, washed with water, dried and crystallized from benzene-petroleum ether to give 280 mg (92%) of **5b** as yellow crystals, mp 184-186°; ^{1}H nmr (deuteriochloroform): δ 8.42 (s, 1H, C8-H), 8.09 (d, 1H, J = 2.9, C13-H), 7.81 (d, 1H, J = 9.0, C6-H), 7.63 (d, 1H, J = 8.9, C10-H), 7.15 (dd, 1H, J$_o$ = 8.9, J$_m$ = 2.9, C11-H), 6.88 (d, 1H, J = 9.0, C5-H), 4.26 (m, 2H, C2-H), 3.92 (s, 3H, C12-OCH$_3$), 3.42 (m, 2H, C3-H), 3.28 (s, 3H, N4-CH$_3$).

Anal. Calcd. for $C_{18}H_{16}N_4O$: C, 71.04; H, 5.30; N, 18.41. Found: C, 71.34; H, 5.47; N, 18.79.

4-Ethyl-12-methoxy-4*H*-2,3-dihydroimidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5c**).

A mixture of 340 mg (1 mmole) of **4c** [5], 500 mg of Raney-type allow and 5 ml of 85% formic acid was stirred under reflux for 3 hours. The reaction mixture was treated with 50 ml of water and the catalyst was filtered and washed with water. The filtrate was alkalinized with aqueous potassium hydroxide and the solution was extracted with chloroform. The solvent was evaporated and the crude product crystallized from acetone-water to give 210 mg (66%) of **5c** as yellow crystals, mp 129-131°; ^{1}H nmr (deuteriochloroform): δ 8.42 (s, 1H, C8-H), 8.11 (d, 1H, J = 2.9, C13-H), 7.80 (d, 1H, J = 9.0, C6-H), 7.64 (d, 1H, J = 8.8, C10-H), 7.16 (dd, 1H, J_o = 8.8, J_m = 2.9, C11-H), 6.93 (d, 1H, J = 9.0, C5-H), 4.25 (m, 2H, C2-H), 3.94 (s, 3H, C12-OCH_3), 3.60 (q, 2H, N4-CH_2-CH_3), 3.40 (m, 2H, C3-H), 1.35 (t, 3H, N4-CH_2-CH_3).

Anal. Calcd. for $C_{19}H_{18}N_4O$: C, 71.68; H, 5.70; N, 17.60. Found: C, 71.54; H, 5.48; N, 17.92.

12-Methoxy-4-propyl-4*H*-2,3-dihydroimidazo[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5d**).

This compound was obtained from **4d** in a yield of 83%, in an analogous manner as **5b**, yellow crystals, mp 125-127° (from chloroform-petroleum ether); ^{1}H nmr (DMSO-d_6): δ 9.02 (s, 1H, C8-H), 8.12 (d, 1H, J = 9.0, C10-H), 8.04 (d, 1H, J = 2.4, C13-H), 7.76 (d, 1H, J = 8.8, C6-H), 7.26 (dd, 1H, J_o = 9.0, J_m = 2.4, C11-H), 6.98 (d, 1H, J = 8.8, C5-H), 4.15 (m, 2H, C2-H), 3.85 (s, 3H, C12-OCH_3), 3.49 (m, 2H, CH_2-CH_2-CH_3), 3.34 (m, 2H, C3-H), 1.72 (m, 2H, -CH_2-CH_2-CH_3), 0.98 (t, 3H, -CH_2-CH_2-CH_3).

Anal. Calcd. for $C_{20}H_{20}N_4O$: C, 72.27; H, 6.06; N, 16.85. Found: C, 72.54; H, 5.98; N, 17.02.

4-(2-Hydroxyethyl)-12-methoxy-4*H*-2,3-dihydroimidazo[4,5,1-*de*]-[1,4]diazepino[5,6,7-*mn*]acridine (**5e**).

A mixture of 3.54 g (10 mmoles) of **4e**, 3 g of Raney-type alloy and 50 ml of 85% formic acid was stirred under reflux for 2 hours. Then, an additional 1 g of the alloy was added and refluxing was continued for 6 hours. The excess of formic acid was evaporated. The residue was treated with 150 ml of water under stirring and the catalyst was filtered and washed with water. The filtrate was alkalinized with aqueous ammonia and heated to boiling. The yellow precipitate was filtered, washed with water and crystallized from *N,N*-dimethylformamide-water to give 3.1 g (93%) of **5e**, mp 233-235°; ^{1}H nmr (deuteriochloroform): δ 8.36 (s, 1H, C8-H), 8.06 (d, 1H, J = 3.0, C13-H), 7.72 (d, 1H, J = 8.9, C6-H), 7.58 (d, 1H, J = 8.8, C10-H), 7.11 (dd, 1H, J_o = 8.8, J_m = 3.0, C11-H), 7.06 (d, 1H, J = 8.9, C5-H), 4.70 (br, 1H, ex, -CH_2-OH), 4.26 (m, 2H, C2-H), 4.03 (t, 2H, -CH_2-CH_2-OH), 3.95 (s, 3H, C12-OCH_3), 3.72 (t, 2H, N4-CH_2-CH_2-OH), 3.42 (m, 2H, C3-H).

Anal. Calcd. for $C_{19}H_{18}N_4O_2$: C, 68.25; H, 5.43; N, 16.76. Found: C, 68.03; H, 5.38; N, 16.68.

4-[2-(Dimethylamino)ethyl]-12-methoxy-4*H*-2,3-dihydroimidazo-[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5f**).

A mixture of 763 mg (2 mmoles) of **4f**, 1.2 g of Raney-type alloy and 15 ml of 85% formic acid was stirred under reflux for 4 hours. To the reaction mixture 40 ml of methanol was added under stirring and the catalyst was filtered and washed with methanol. The filtrate was condensed and acidified with gasous hydrogen chloride. The product was precipitated by addition of acetone, washed with acetone and dried to give 850 mg of orange salt which was not analysed. The salt was dissolved in water, alkalinized with aqueous ammonia and extracted with benzene. The benzene extract was dried and evaporated. The obtained yellow solid was crystallized from chloroform-petroleum ether to give 545 mg (75%) of **5f**, mp 182-184°; ^{1}H nmr (deuteriochloroform): δ 8.42 (s, 1H, C8-H), 8.12 (d, 1H, J = 3.0, C13-H), 7.81 (d, 1H, J = 8.9, C6-H), 7.64 (d, 1H, J = 8.8, C10-H), 7.16 (dd, 1H, J_o = 8.8, J_m = 3.0, C11-H), 6.96 (d, 1H, J = 8.9, C5-H), 4.24 (m, 2H, C2-H), 3.96 (s, 3H, C12-OCH_3), 3.64 (t, 2H, N4-CH_2-CH_2-NMe_2), 3.40 (m, 2H, C3-H), 2.65 (t, 2H, -CH_2-CH_2-NMe_2), 2.32 (s, 6H, -CH_2-$N(CH_3)_2$).

Anal. Calcd. for $C_{21}H_{23}N_5O$: C, 69.78; H, 6.41; N, 19.38. Found: C, 69.58; H, 6.46; N, 19.20.

4-[2-(Diethylamino)ethyl]-12-methoxy-4*H*-2,3-dihydroimidazo-[4,5,1-*de*][1,4]diazepino[5,6,7-*mn*]acridine (**5g**).

This compound was obtained in a yield of 67% from **4g**, in an analogous manner as **5f**, yellow crystals, mp 101-103° (from chloroform-petroleum ether); ^{1}H nmr (deuteriochloroform): δ 8.43 (s, 1H, C8-H), 8.10 (d, 1H, J = 3.0, C13-H), 7.80 (d, 1H, J = 8.9, C6-H), 7.66 (d, 1H, J = 8.8, C10-H), 7.16 (dd, 1H, J_o = 8.8, J_m = 3.0, C11-H), 6.97 (d, 1H, J = 8.9, C5-H), 4.28 (m, 2H, C2-H), 3.94 (s, 3H, C12-OCH_3), 3.64 (t, 2H, N4-CH_2-CH_2-NEt_2), 3.42 (m, 2H, C3-H), 2.78 (t, 2H, -CH_2-CH_2-NEt_2), 2.62 (q, 4H, -$N(CH_2$-$CH_3)_2$), 1.06 (t, 6H, -$N(CH_2$-$CH_3)_2$).

Anal. Calcd. for $C_{23}H_{27}N_5O$: C, 70.93; H, 6.99; N, 17.98. Found: C, 70.80; H, 6.87; N, 17.71.

4-(2-Chloroethyl)-12-methoxy-4*H*-2,3-dihydroimidazo[4,5,1-*de*]-[1,4]diazepino[5,6,7-*mn*]acridine (**5h**).

This compound was obtained in a yield of 63% from **4h**, in an analogous manner as **5c**, yellow crystals, mp 178-180° (from chloroform-petroleum ether); ^{1}H nmr (deuteriochloroform): δ 8.45 (s, 1H, C8-H), 8.08 (d, 1H, J = 3.0, C13-H), 7.84 (d, 1H, J = 8.9, C6-H), 7.63 (d, 1H, J = 8.8, C10-H), 7.15 (dd, 1H, J_o = 8.8, J_m = 3.0, C11-H), 6.94 (d, 1H, J = 8.9, C5-H), 4.27 (m, 2H, C2-H), 3.94 (s, 3H, C12-OCH_3), 3.88 (t, 2H, N4-CH_2-CH_2-Cl), 3.82 (m, 2H, N4-CH_2-CH_2-Cl), 3.47 (m, 2H, C3-H).

Anal. Calcd. for $C_{19}H_{17}ClN_4O$: C, 64.68; H, 4.86; N, 15.88. Found: C, 65.02; H, 4.87; N, 15.74.

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