Cyclic Oxalylation of Primary *N*-Substituted Anthranilamides: 1*H*-Benzo[*e*][1,4]diazepine-2,3,5(4*H*)-triones and 11a-Chloro-benzo[*e*]oxazolo[3,2-*a*][1,4]diazepine-2,3,5,11(10*H*,11a*H*)-tetraones

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Dedicated to Professor Gerwalt Zinner

In dependence on the molar ratio, the reaction of primary anthranilamides **3** with oxalyl chloride produced 1*H*-benzo[*e*][1,4]diazepine-2,3,5(4*H*)-triones **4** or 10-substituted 11a-chloro-benzo[*e*]-oxazolo[3,2-*a*][1,4]diazepine-2,3,5,11(10*H*, 11a*H*)-tetraones **5**, the structures of which were unambiguously proven by X-ray diffraction analysis.

Key words: Anthranilamides, Cyclization, Fused Heterocycles, Oxalyl Chloride, Acylation

Introduction

The anthranilic scaffold plays an important role as a pharmacophore and toxophore in medicinal and agricultural chemistry and contributes to a variety of biological activities [1 – 9]. Although ring-closure reactions of *N*-unsubstituted anthranilic acid derivates have been extensively elaborated, investigations towards the corresponding chemistry of *N*-alkyl(aryl)-anthranilic acids remained fragmentary until hitherto.

Recent results from our studies directed to bioactive seven-membered heterocycles with the anthranilic skeleton disclosed a facile access to novel and stable 1,4-benzodiazepine-triones **1** and **2** by oxalylation of anthranilic hydroxamates and hydrazides in the presence of imidazole [10, 11] (Fig. 1).

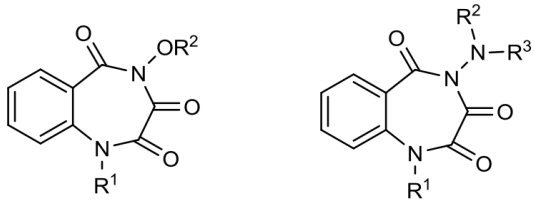

Fig. 1. 4-Alkoxy- and 4-amino-1,4-benzodiazepine-2,3,5-triones **1** and **2**.

Table 1. 1*H*-Benzo[*e*][1,4]diazepine-2,3,5(4*H*)-triones **4** and 11a-chloro-benzo[*e*]oxazolo[3,2-*a*][1,4]diazepine-2,3,5,11(10*H*, 11a*H*)-tetraones **5**.

Entry	R	Yield of **4** (%)	Yield of **5** (%)
a	benzyl	75	70
b	4-F-benzyl	54	87
c	4-Br-benzyl	60	65
d	2-phenylethyl	68	65
e	phenyl	71	67
f	methyl	59	75
g	ethyl	75	78

Results and Discussion

In continuation of our studies on 1,4-benzotriazepinetriones we considered the reaction of *N*-2-substituted primary anthranilamides **3** with oxalyl chloride in the presence of imidazole as a base. We observed the formation of either 4-unsubstituted 1,4-benzodiazepine-triones **4** or 10-substituted 11a-chloro-benzo[*e*]oxazolo[3,2-*a*][1,4]diazepine-2,3,5,11(10*H*, 11a*H*)-tetraones **5**, the outcome of the reaction depending on the molar ratio of the reactants (Table 1).

When anthanilamides **3a – g** were reacted with imidazole/oxalyl chloride in anhydrous tetrahydrofuran in a molar ratio of 1 : 2.2 : 1.1, 1,4-benzodiazepine-triones **4a – g** were obtained exclusively in 54 – 75 % yield (Scheme 1). Structural assignment is based on IR, ^{1}H NMR, ^{13}C NMR spectra, as well as microanalysis. In addition, unambiguous structural proof

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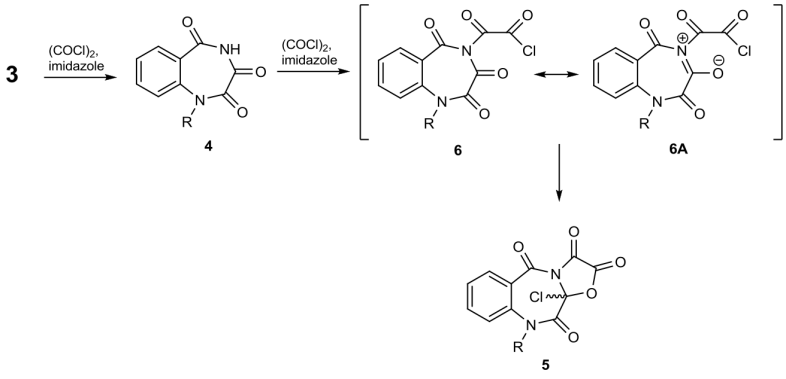
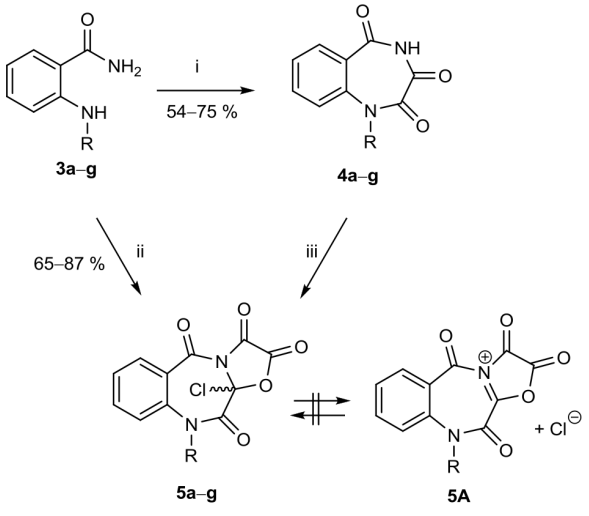


Scheme 2. Proposed reaction mechanism for the conversion of **3** to **5**.



i: imidazole, $(COCl)_2$, THF;
ratio of **3**/imidazole/$(COCl)_2$ = 1:2.2:1.1
ii: imidazole, $(COCl)_2$, THF;
ratio of **3**/imidazole/$(COCl)_2$ = 1:3:2.3
iii: imidazole, $(COCl)_2$, THF;
ratio of **4**/imidazole/$(COCl)_2$ = 1:1:1.2

Scheme 1. Cyclic oxalylation of anthranilamides **3** to heterocycles **4** and **5**.

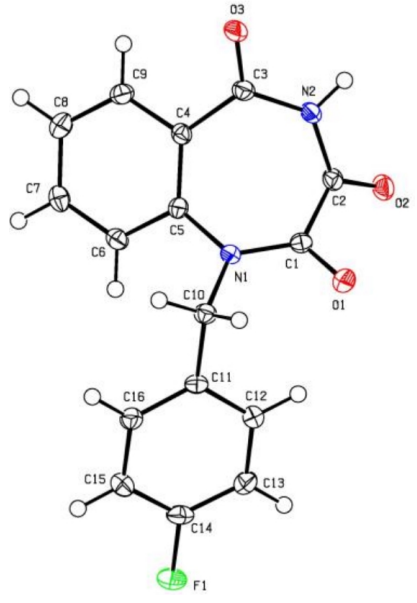


Fig. 2 (color online). Molecular structure of **4b** in the crystal.

could be obtained from X-ray diffraction analysis of **4b** (Fig. 2).

However, when **3a – g** were reacted with imidazole/oxalyl chloride in a molar ratio of 1 : 3 : 2.3, crystalline compounds resulted with sharp ν(C=O) absorption bands at 1850, 1800 and 1700 cm^{-1} in the IR spectra, and microanalysis data of these compounds revealed the presence of one chlorine atom, two oxalic subunits and one anthranilic skeleton within the molecules.

On the basis of these surprising results, and taking into account literature reports on the oxalylation of secondary amides [12] and imides [13], constitutions **5/5A** came into consideration for the cyclization products (Scheme 1). Unambiguous structural proof was obtained from X-ray diffraction analysis of **5e** (Fig. 3), which unveiled a 11a-chloro-10-phenylbenzo[*e*]oxazolo[3,2-*a*][1,4]diazepine-2,3,5,11(10*H*, 11a*H*)-tetraone with covalently bonded chlorine at C11a, ruling out the possible ionic structure **5A**.

As shown by an additional experiment, **4b** could be converted in 81 % yield into **5b** with imidazole/oxalyl chloride in a molar ratio of 1 : 1 : 1.2, thus offering a rationale for a plausible reaction mechanism for the heterocyclization of **3** to **5** as outlined in Scheme 2: the oxalylation of **3** produces primarily the 1,4-benzodiazepine-trione **4**, which takes up unconsumed oxalyl chloride to form interme-

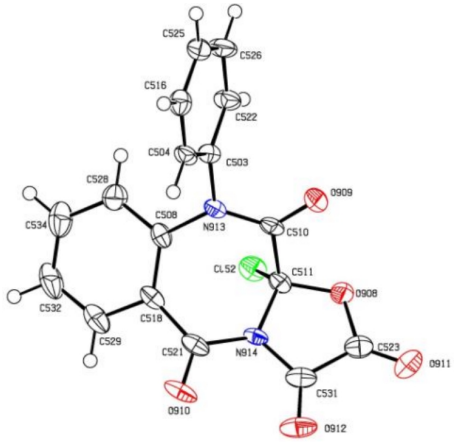


Fig. 3 (color online). Molecular structure of **5e** in the crystal.

diate **6/6A** that finally undergoes ring closure to form **5**.

Conclusion

In summary, the cyclic oxalylation of primary anthranilamides to 1,4-benzodiazepine-triones **4** or their oxazolo-condensed derivatives **5**, which are characterized by an uncommon orthoacetalic (Cl, N, O) functionality at C11a, was investigated. The outcome of the reactions was found to depend crucially on the molar ratio of anthanilamide **3**, imidazole and oxalyl chloride.

Experimental Section

IR spectra were obtained on a Varian 800 FT-IR spectrometer from KBr pellets. ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$, [D_6]DMSO and [D_8]THF on a Bruker AMX 400 spectrometer, with TMS as internal reference. Purification by column chromatography was carried out with ICN silica gel 100 – 200 (active, 60 Å). Elemental analyses (C, H, N) were conducted using the Elemental Analyzer Heraeus CHN-O-Rapid.

*General procedure for the synthesis of compounds **3b** and **3c***

Ammonia was slowly bubbled in an ice-cooled solution of the corresponding isatoic anhydride (14 mmol) in anhydrous THF (40 mL) until the reaction was complete (DC, IR). After removal of the solvent under reduced pressure the product was recrystallized from CH_2Cl_2/Et_2O.

*2-(4-Fluorobenzylamino)benzamide (**3b**)*

Yield: 63 %, m. p. 136 °C. – IR (KBr): ν = 3475, 3326, 3178 (NH), 1647 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D_6]DMSO): δ = 4.37 (d, J = 5.77 Hz, 2 H, CH_2), 6.52 – 7.86 (m, 10 H, Ar-H and NH_2), 8.58 (t, J = 5.77 Hz, 1 H, NH). – ^{13}C NMR (100 MHz, [D_6]DMSO): δ = 45.17 (CH_2), 111.47, 114.29 (aryl-CH), 115.12 (d, $^2J_{C\text{-}F}$ = 20.81 Hz, aryl-CH), 128.85 (aryl-CH), 128.97 (d, $^3J_{C\text{-}F}$ = 8.48 Hz, aryl-CH), 132.41 (aryl-CH), 135.79 (d, $^4J_{C\text{-}F}$ = 3.08 Hz, aryl-C), 149.38 (aryl-C), 161.12 (d, $^1J_{C\text{-}F}$ = 242.76 Hz, CF), 171.56 (C=O). – $C_{14}H_{13}FN_2O$ (244.26): calcd. C 68.84, H 5.36, N 11.47; found C 68.84, H 5.53, N 11.47.

*2-(4-Bromobenzylamino)benzamide (**3c**)*

Yield: 72 %, m. p. 157 °C. – IR (KBr): ν = 3423, 3338 (NH), 1670/1637 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D_6]DMSO): δ = 4.38 (d, J = 5.99 Hz, 2 H, CH_2), 6.53 – 7.86 (m, 10 H, Ar-H and NH_2), 8.62 (t, J = 5.99 Hz, 1 H, NH). – ^{13}C NMR (100 MHz, [D_6]DMSO): δ = 45.19 (CH_2), 111.51 (aryl-CH), 114.32 (CBr), 114.36 (aryl-CH), 119.67 (aryl-C), 129.04, 129.17, 131.27, 132.43 (aryl-CH), 139.30, 149.30 (aryl-C), 171.55 (C=O). – $C_{14}H_{13}BrN_2O$ (305.17): calcd. C 55.10, H 4.29, N 9.18; found C 55.04, H 4.48, N 9.16.

*General procedure for the synthesis of compounds **4a – g***

To a mixture of **3** [14 – 17] (1 mmol) and imidazole (2.2 mmol) in anhydrous THF (8 mL) was added dropwise a solution of oxalyl chloride (1.1 mmol) in anhydrous THF (2 mL) at r. t. The resulting suspension was stirred for another 24 h at ambient temperature and then filtered. After removal of the solvent under reduced pressure the residue was chromatographed on silica gel with CH_2Cl_2/Et_2O (1 : 1) as an eluent and crystallized from CH_2Cl_2/Et_2O.

*1-Benzyl-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4a**)*

Yield: 75 %, m. p. 143 °C. – IR (KBr): ν = 3146 (NH), 1738, 1699, 1665 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, $CDCl_3$): δ = 5.23 (s, 2 H, CH_2), 7.21 – 7.90 (m, 9 H, Ar-H), 8.51 (s, 1 H, NH). – ^{13}C NMR (100 MHz, $CDCl_3$): δ = 53.33 (CH_2), 123.04, 126.78, 127.07 (aryl-CH), 127.21 (aryl-C), 127.93, 128.97, 131.96, 134.08 (aryl-CH), 135.13, 136.74 (aryl-C), 160.18, 161.88, 166.06 (C=O). – $C_{16}H_{12}N_2O_3$ (280.29): calcd. C 68.57, H 4.32, N 9.99; found C 68.55, H 4.33, N 10.00.

*1-(4-Fluorobenzyl)-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4b**)*

Yield: 54 %, m. p. 137 °C. – IR (KBr): ν = 3140 (NH), 1730, 1676, 1664 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D_6]DMSO): δ = 5.22 (s, 2 H, CH_2), 7.11 – 7.70 (m, 8 H, Ar-H), 12.17 (s, 1 H, NH). – ^{13}C NMR (100 MHz, [D_6]DMSO): δ = 50.30 (CH_2), 115.42 (d, $^2J_{C\text{-}F}$ = 21.96 Hz, aryl-CH), 123.43, 126.47 (aryl-CH), 128.64 (aryl-C), 129.19 (d, $^3J_{C\text{-}F}$ = 8.05 Hz, aryl-CH), 130.62 (aryl-CH), 132.09 (d,

$^4J_{C\text{-}F}$ = 3.66 Hz, aryl-C), 133.53 (aryl-CH), 135.51 (aryl-C), 160.81 (C=O), 161.36 (d, $^1J_{C\text{-}F}$ = 242.98 Hz, CF), 163.36, 166.58 (C=O). – $C_{16}H_{11}FN_2O_3$ (298.28): calcd. C 64.43, H 3.72, N 9.39; found C 64.45, H 3.80, N 9.37.

*1-(4-Bromobenzyl)-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4c**)*

Yield: 60 %, m. p. 214 °C. – IR (KBr): ν = 3125 (NH), 1745, 1665 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D$_8$]THF): δ = 5.23 (s, 2 H, CH_2), 7.22 – 7.83 (m, 8 H, Ar-H), 11.04 (s, 1 H, NH). – ^{13}C NMR (100.61 MHz, [D$_8$]THF): δ = 51.15 (CH_2), 121.00 (aryl-C), 122.80, 125.87 (aryl-CH), 128.62 (aryl-C), 129.08, 131.28, 131.60, 133.11 (aryl-CH), 135.88, 136.84 (aryl-C), 160.69, 162.37, 165.99 (C=O). – $C_{16}H_{11}BrN_2O_3$ (359.17): calcd. C 53.50, H 3.09, N 7.80; found C 53.29, H 3.15, N 7.61.

*1-Phenylethyl-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4d**)*

Yield: 68 %, m. p. 178 °C. – IR (KBr): ν = 3180 (NH), 1720, 1700, 1676 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.97 (t, 2 H, J = 7.25 Hz, CH_2Ph), 4.34 (t, 2 H, J = 7.25, CH_2N), 7.07 – 7.85 (m, 9 H, Ar-H), 8.64 (s, 1 H, NH). – ^{13}C NMR (100 MHz, $CDCl_3$): δ = 33.33 (CH_2Ph), 50.39 (CH_2N), 123.24, 126.76, 126.94 (aryl-C), 127.72 (aryl-C), 128.60, 128.81, 131.89, 134.09 (aryl-CH), 136.41, 137.10 (aryl-C), 159.77, 161.90, 165.62 (C=O). – $C_{17}H_{14}N_2O_3$ (294.31): calcd. C 69.38, H 4.79, N 9.52; found C 69.24, H 4.83, N 9.49.

*1-Phenyl-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4e**)*

Yield: 71 %, m. p. 200 °C. – IR (KBr): ν = 3144 (NH), 1733, 1668 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, $CDCl_3$): δ = 6.85 – 7.99 (m, 9 H, Ar-H), 8.79 (s, 1 H, NH). – ^{13}C NMR (100 MHz, $CDCl_3$): δ = 125.63, 126.38 (aryl-CH), 126.46 (aryl-C), 128.17, 128.67, 129.92, 132.00, 133.91 (aryl-CH), 137.69, 139.93 (aryl-C), 159.28, 161.87, 165.99 (C=O). – $C_{15}H_{10}N_2O_3$ (266.26): calcd. C 67.67, H 3.79, N 10.52; found C 67.39, H 3.76, N 10.40.

*1-Methyl-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4f**)*

Yield: 59 %, m. p. 199 °C. – IR (KBr): ν = 3184 (NH), 1707, 1665 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D$_6$]DMSO): δ = 3.42 (s, 3 H, CH_3), 7.38 – 7.75 (m, 4 H, Ar-H), 12.08 (s, 1 H, NH). – ^{13}C NMR (100 MHz, [D$_6$]DMSO): δ = 36.16 (CH_3), 122.99, 125.95 (aryl-CH), 127.39 (aryl-C), 130.41, 133.58 (aryl-CH), 137.16 (aryl-C), 160.37, 162.99, 166.54 (C=O). – $C_{10}H_8N_2O_3$ (204.18): calcd C 58.82, H 3.95, N 13.72; found C 58.78, H 4.02, N 13.67.

*1-Ethyl-1H-benzo[e][1,4]diazepine-2,3,5(4H)-trione (**4g**)*

Yield: 75 %, m. p. 142 °C. – IR (KBr): ν = 3148 (NH), 1735, 1660 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D$_6$]DMSO): δ = 1.17 (t, 3H, J = 7.02 Hz, CH_2CH_3), 4.01 (q, 2 H, J = 7.02 Hz, CH_2CH_3), 7.41 – 7.74 (m, 4 H, Ar-H), 12.12 (s, 1 H, NH). – ^{13}C NMR (100 MHz, [D$_6$]DMSO): δ = 12.56 (CH_3), 43.53 (CH_2), 123.29, 126.38 (aryl-CH), 128.69 (aryl-C), 130.59, 133.68 (aryl-CH), 135.65 (aryl-C), 160.25, 163.89, 166.76 (C=O). – $C_{11}H_{10}N_2O_3$ (218.07): calcd. C 60.55, H 4.62, N 12.84; found C 60.31, H 4.69, N 12.73.

*General procedure for the synthesis of compounds **5a – g***

To a mixture of **3** [14 – 17] (1 mmol) and imidazole (3 mmol) in anhydrous THF (8 mL) was added dropwise a solution of oxalyl chloride (2.3 mmol) in anhydrous THF (2 mL) at r. t. The resulting suspension was stirred for another 24 h at ambient temperature and then filtered. After removal of the solvent under reduced pressure the residue was chromatographed on silica gel with CH_2Cl_2/Et_2O (95 : 5) as an eluent and crystallized from CH_2Cl_2/Et_2O.

*10-Benzyl-11a-chlorobenzo[e]oxazolo[3,2-a][1,4]-diazepine-2,3,5,11(10H, 11aH)-tetraone (**5a**)*

Yield: 70 %, m. p. 130 °C. – IR (KBr): ν = 1846, 1802, 1701 cm^{-1} (C=O). – ^{1}H NMR (400 MHz, [D$_8$]THF): δ = 5.24 (d, J = 15.77 Hz, 1 H, alkyl CH), 5.35 (d, J = 15.76 Hz, 1 H, alkyl CH), 7.23 – 7.85 (m, 9 H, Ar-H). – ^{13}C NMR (100.61 MHz, [D$_8$]THF): δ = 52.69 (CH_2), 122.57, 126.82, 127.01, 127.38 (aryl-CH), 127.98 (aryl-C), 128.51, 131.28, 134.59 (aryl-CH), 136.12, 138.62 (aryl-C), 147.88, 151.54, 159.39, 160.66 (C=O). – $C_{18}H_{11}ClN_2O_5$ (370.75): calcd. C 58.31, H 2.99, Cl 9.56, N 7.56; found C 58.27, H 3.16, Cl 9.68, N 7.54.

*11a-Chloro-10-(4-fluorobenzyl)benzo[e]oxazolo[3,2-a]-[1,4]diazepine-2,3,5,11(10H, 11aH)-tetraone (**5b**)*

Yield: 87 %, m. p. 133 °C. – IR (KBr): ν = 1844, 1809, 1715, 1698 cm^{-1} (C=O). – ^{1}H NMR (400.14 MHz, [D$_8$]THF): δ = 5.18 (d, J = 15.45 Hz, 1 H, alkyl CH), 5.39 (d, J = 15.77 Hz, 1 H, alkyl CH), 7.02 – 7.86 (m, 8 H, Ar-H). – ^{13}C NMR (100.61 MHz, [D$_8$]THF): δ = 51.89 (CH_2), 96.84 (CCl), 115.30 (d, $^2J_{C\text{-}F}$ = 22.00 Hz, aryl-CH), 122.65, 126.95 (aryl-CH), 128.11 (aryl-C), 129.21 (d, $^3J_{C\text{-}F}$ = 8.25 Hz, aryl-CH), 131.32 (aryl-CH), 132.09 (d, $^4J_{C\text{-}F}$ = 2.75 Hz, aryl-C), 134.62 (aryl-CH), 138.36 (aryl-C), 147.86, 151.49, 159.36, 160.62 (C=O), 162.22 (d, $^1J_{C\text{-}F}$ = 245.61, CF). – $C_{18}H_{10}ClFN_2O_5$ (388.74): calcd. C 55.61, H 2.59, Cl 9.12, N 7.21; found C 55.53, H 2.78, Cl 8.99, N 7.14.

*10-(4-Bromobenzyl)-11a-chlorobenzo[e]oxazolo[3,2-a]-[1,4]diazepine-2,3,5,11(10H, 11aH)-tetraone (**5c**)*

Yield: 65 %, m. p. 146 °C. – IR (KBr): ν = 1848, 1801, 1709 cm^{-1} (C=O). – ^1H NMR (400, [D$_8$]THF): δ = 5.18 (d, J = 15.77 Hz, 2 H, alkyl CH), 5.34 (d, J = 15.76 Hz, 2 H, alkyl CH), 7.17 – 7.87 (m, 8 H, Ar-H). – ^{13}C NMR (100 MHz, [D$_8$]THF): δ = 52.06 (CH_2), 96.81 (CCl), 121.25 (aryl-C), 122.49, 126.97 (aryl-CH), 128.00 (aryl-C), 129.13 (aryl-CH), 131.36 (aryl-C), 131.67, 134.67, 135.44 (aryl-CH), 138.38 (aryl-C), 147.84, 151.46, 159.38, 160.61 (C=O). – $C_{18}H_{10}BrClN_2O_5$ (449.64): calcd. C 48.08, H 2.24, Cl 7.88, N 6.23; found C 48.00, H 2.48, Cl 7.69, N 6.15.

*11a-Chloro-10-phenylethylbenzo[e]oxazolo[3,2-a][1,4]-diazepine-2,3,5,11(10H, 11aH)-tetraone (**5d**)*

Yield: 65 %, m. p. 144 °C. – IR (KBr): ν = 1846, 1803, 1708 cm^{-1} (C=O). – ^1H NMR (400 MHz, [D$_8$]THF): δ = 2.90 – 3.00 (m, 2 H, CH_2Ph), 4.07 – 4.60 (m, 2 H, CH_2N), 7.13 – 7.86 (m, 9 H, Ar-H). – ^{13}C NMR (100 MHz, [D$_8$]THF): δ = 33.29 (CH_2Ph), 51.43 (CH_2N), 96.69 (CCl), 123.04, 126.43, 126.82 (aryl-CH), 128.22 (aryl-C), 128.43, 128.46, 131.27, 134.73 (aryl-CH), 137.87, 138.75 (aryl-C), 147.75, 151.53, 159.01, 160.48 (C=O). – $C_{19}H_{13}ClN_2O_5$ (384.78): calcd. C 59.31, H 3.41, Cl 9.21, N 7.28; found C 59.35, H 3.46, Cl 9.46, N 7.26.

*11a-Chloro-10-phenylbenzo[e]oxazolo[3,2-a][1,4]-diazepine-2,3,5,11(10H, 11aH)-tetraone (**5e**)*

Yield: 67 %, m. p. 141 °C. – IR (KBr): ν = 1849, 1805, 1705 cm^{-1} (C=O). – ^1H NMR (400 MHz, [D$_8$]THF): δ = 6.96 – 6.98 (m, 1 H, Ar-H), 7.39 – 7.62 (m, 7 H, Ar-H), 7.97 – 7.99 (m, 1 H, Ar-H). – ^{13}C NMR (100 MHz, [D$_8$]THF): δ = 96.94 (CCl), 125.10, 126.56 (aryl-CH), 127.44 (aryl-C), 128.12, 128.40, 129.32, 131.39, 134.50 (aryl-CH), 139.65, 140.82 (aryl-C), 147.91, 151.50, 158.44, 160.63 (C=O). – $C_{17}H_9ClN_2O_5$ (356.02): calcd. C 57.24, H 2.54, Cl 9.94, N 7.85; found C 57.10, H 2.71, Cl 9.67, N 7.83.

*11a-Chloro-10-methylbenzo[e]oxazolo[3,2-a][1,4]-diazepine-2,3,5,11(10H, 11aH)-tetraone (**5f**)*

Yield: 75 %, m. p. 156 °C. – IR (KBr): ν = 1842, 1803, 1690 cm^{-1} (C=O). – ^1H NMR (400 MHz, [D$_8$]THF): δ = 3.52 (s, 3 H, CH_3), 7.47 – 7.92 (m, 4 H, Ar-H). – ^{13}C NMR (100 MHz, [D$_8$]THF): δ = 36.76 (CH_3), 96.69 (CCl), 122.06, 126.39 (aryl-CH), 126.98 (aryl-C), 131.17, 134.75 (aryl-CH), 139.93 (aryl-C), 147.95, 151.61, 159.44, 160.68 (C=O). – $C_{12}H_7ClN_2O_5$ (294.65): calcd. C 48.92, H 2.39, Cl 12.03, N 9.51; found C 48.85, H 2.43, Cl 11.88, N 9.49.

*11a-Chloro-10-ethylbenzo[e]oxazolo[3,2-a][1,4]diazepine-2,3,5,11(10H, 11aH)-tetraone (**5g**)*

Yield: 78 %, m. p. 141 °C. – IR (KBr): ν = 1844, 1805, 1686 cm^{-1} (C=O). – ^1H NMR (400 MHz, [D$_8$]THF): δ = 1.22 (t, J = 7.1 Hz, 3 H, CH_2CH_3), 3.90 – 4.25 (m, 2 H, CH_2CH_3), 7.45 – 7.86 (m, 4 H, Ar-H). – ^{13}C NMR (100 MHz, [D$_8$]THF): δ = 12.22 (CH_2CH_3), 45.25 (CH_2CH_3), 96.76 (CCl), 122.58, 126.76 (aryl-CH), 128.11 (aryl-C), 131.29, 134.78 (aryl-CH), 138.63 (aryl-C), 147.92, 151.67, 158.69, 160.80 (C=O). – $C_{13}H_9ClN_2O_5$ (308.68): calcd. C 50.58, H 2.94, Cl 11.49, N 9.08; found C 50.30, H 3.10, Cl 11.23, N 8.99.

*Conversion of **4b** to **5b***

To a mixture of **4b** (1 mmol) and imidazole (1 mmol) in anhydrous THF (8 mL) was added dropwise a solution of oxalyl chloride (1.2 mmol) in anhydrous THF (2 mL) at r. t. The resulting suspension was stirred for another 24 h at ambient temperature and then filtered. After removal of the solvent under reduced pressure the residue was chromatographed on silica gel with CH_2Cl_2/Et_2O (95 : 5) as an eluent to give **5b** in 81 % yield.

Crystal structure determinations

*Crystal data for **4b***: $C_{16}H_{11}FN_2O_3$, M_r = 298.27, 0.31 × 0.14 × 0.07 mm^3, MoK_α radiation, λ = 0.71073 Å, monoclinic, space group $C2/c$, a = 22.059 (7), b = 15.659 (5), c = 7.753 (2) Å, β = 99.267 (4)°, V = 2643.0 (14) $Å^3$, Z = 8, $D_{calcd.}$ = 1.50 Mg m^{-3}, μ(MoK_α) = 0.1 mm^{-1}, F(000) = 1232 e, T = 100 K, θ = 1.2 – 28.5°, h = −27 → 28, k = −13 → 20, l = ±9, 8577 measured reflections, 2974 independent reflections, R_{int} = 0.028, $R[F^2 \geq 2\,\sigma(F^2)]$ = 0.040, $wR(F^2)$ = 0.100 (all data) for 200 refined parameters, S = 1.03, $\Delta\rho_{max}$ = 0.31 e $Å^{-3}$.

*Crystal data for **5e**:* $C_{17}H_9ClN_2O_5$, M_r = 356.71, 0.50 × 0.48 × 0.05 mm^3, MoK_α radiation, λ = 0.71073 Å, triclinic space group $P\bar{1}$, a = 11.662 (4), b = 12.066 (4), c = 12.349 (4) Å, α = 90.154 (6)°, β = 104.391 (6)°, γ = 111.894 (5)°, V = 1552.9 (10) $Å^3$, Z = 4, $D_{calcd.}$ = 1.53 Mg m^{-3}, μ(MoK_α) = 0.3 mm^{-1}, F(000) = 728 e, T = 153 K, h = ±13, k = ±14, l = ±14, 15443 measured reflections, 5458 independent reflections, R_{int} = 0.079, $R[F^2 \geq 2\,\sigma(F^2)]$ = 0.044, $wR(F^2)$ = 0.082 (all data) for 451 refined parameters, S = 0.86, $\Delta\rho_{max}$ = 0.32 e $Å^{-3}$.

CCDC 763443 (**4b**) and 659167 (**5e**) contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre *via* www.ccdc.cam.ac.uk/data_request/cif.

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