Supporting Information

Rapid Access to Azepine Fused Oxetanols from Alkoxy Substituted Maleimides

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General Experimental

The photochemical reactions carried out in this study were performed using a water cooled, 125 W medium pressure mercury discharge lamp in a pyrex immersion well. All reactions were carried out at ambient temperature and under a nitrogen atmosphere unless otherwise stated. The reaction glassware was flame-dried as standard. Concentration *in vacuo* refers to distillation on a Buchi rotary evaporator. Flash chromatography was performed using Fluorochem silica gel 60 (0.040 – 0.063), eluting with the solvents stated. T.l.c. was performed using Merck plastic coated plates covered with a 0.2 mm layer of silica gel 60 F₂₅₄. Product spots were visualised by UV irradiation at 254 nm and subsequent staining with potassium permanganate solution, followed by heating. UV spectra were recorded in the range 200-400 nm using a Shimadzu UV10 UV/VIS Recording Spectrophotometer and peaks are reported as $\nu_{\max}(\text{MeCN})/\text{nm}$ which refers $\nu_{\max}$ in wavelength. IR spectra were recorded in the range 4000-600 cm^{-1} using an IR Perkin-Elmer Spectrum 1 FTIR Spectrophotometer and peaks were reported as $\nu_{\max}(\text{film})/\text{cm}^{-1}$ which refers to the $\nu_{\max}$ in wavenumbers. Nuclear Magnetic Resonance spectra were recorded as solutions in the deuterated solvent stated, using tetramethylsilane as an internal standard. The spectra were recorded at 400 MHz on a Jeol Delta GX400 spectrometer, and at 300 MHz on a Jeol Lambda GX300 spectrometer. The chemical shift values were measured in parts per million (ppm) and reported as δ for proton and carbon spectra. Coupling constants J , are measured in Hz. Mass spectra were recorded on a micromass analytical machine, using either Chemical Ionisation (CI) or Electron Ionisation (EI). The mass of the fragment is given, followed by the relative intensity as a percentage in brackets. X-ray measurements were made using a Bruker SMART CCD area-detector diffractometer. The compounds in the supplementary information are numbered in the order they appear in this section, and where appropriate their relevant number in the main text is highlighted.

Synthesis of a precursor

3,4-dichloro-1-((4E)-4-hexenyl)-1H-pyrrole-2,5-dione 1:

To a solution of triphenylphosphine (3.17 g, 12.1 mmol) in THF (60 ml) at -78°C was added diisopropyl azodicarboxylate (DIAD) (2.43 g, 2.37 ml, 12.1 mmol). After 1 h at -78°C *trans*-hex-4-en-1-ol (1.33 g, 1.55 ml, 13.3 mmol) was added and the solution stirred for a further 5 min at which point neopentyl alcohol (0.53 g, 6.0 mmol) and dichloromaleimide (2.00 g, 12.1 mmol) were added. The reaction was allowed to warm slowly to RT and stirred for a further 16 h. Concentrated *in vacuo*, followed by purification by column chromatography [EtOAc (10%) in PE], gave title compound **1** (2.1 g, 71%) as a colourless oil; $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1719 (s), 1620 (m), 1394 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.60-1.72 (5 H, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCH_3), 2.00 (2 H, q, J 7.5, $\text{CH}_2\text{CH}_2\text{CH}$), 3.60 (2 H, t, J 7.5, NCH_2CH_2), 5.32-5.49 (2 H, m, CH_2CHCH , CHCHCH_3); ^{13}C NMR (100 MHz; CDCl_3) δ 17.9 (CH_3), 27.9 (CH_2), 29.7 (CH_2), 39.1 (CH_2), 126.3 (CH), 129.4 (CH), 133.3 ($2 \times \text{C}$) 163.0 ($2 \times \text{CO}$); m/z (EI) 247.0166 (M^+ , 22%, requires 247.0167), 249 (15), 251 (2), 179 (42), 81 (100).

Synthesis of alkoxy-chloro maleimides 3-6.

General Procedure

The sodium alkoxide component was formed *in situ* by the addition of sodium (1 equiv) to the desired alcohol. This solution was then added dropwise to a solution of the maleimide (1 equiv) in the alcohol. After 1 h the reaction mixture was concentrated *in vacuo*, then separated between EtOAc and aqueous ammonium chloride solution. The aqueous layer was washed with EtOAc, then the combined organic

extracts washed with water, brine, and dried (MgSO₄). Concentration *in vacuo*, followed by purification by column chromatography [Et₂O (10-30%) in PE] gave the desired maleimides.

3-chloro-4-methoxy-1-(4-pentenyl)-1H-pyrrole-2,5-dione 3 (number 4 in paper): Sodium metal (0.05 g, 2.2 mmol) in MeOH (10 ml), and known maleimide **2** (number 1 in paper)¹ (0.50 g, 2.2 mmol) in MeOH (10 ml), were reacted according to the general procedure above to give title compound **3** (0.24 g, 50%) as a colourless oil; $\mu_{\text{max}}(\text{MeCN})/\text{nm}$ 330 (dm³mol⁻¹cm⁻¹ 671); $\mu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1713 (s), 1654 (s), 1402 (m), 1290 (s); ¹H NMR (400 MHz; CDCl₃) δ 1.70 (2 H, quintet, *J* 7.5, CH₂CH₂CH₂), 2.06 (2 H, q, *J* 7.5, CH₂CH₂CH), 3.53 (2 H, t, *J* 7.5, NCH₂CH₂), 4.33 (3 H, s, OCH₃), 4.99 (1 H, dd, *J* 10.5 and 1.5, CHCH₂), 5.04 (1 H, dd, *J* 17.0 and 1.5, CHCH₂), 5.78 (1 H, ddt, *J* 17.0, 10.5 and 6.5, CH₂CHCH₂); ¹³C NMR (100 MHz; CDCl₃) δ 27.6 (CH₂), 30.8 (CH₂), 38.0 (CH₂), 59.9 (CH₃), 103.8 (C), 115.1 (CH), 137.1 (CH₂), 150.4 (C), 164.1 (CO), 165.6 (CO); *m/z* (EI) 229.0507 (M⁺, 49%, requires 229.0506), 231 (32), 201 (60), 83 (100).

3-(allyloxy)-4-chloro-1-(4-pentenyl)-1H-pyrrole-2,5-dione 4: Sodium metal (0.094 g, 4.1 mmol) in allyl alcohol (10 ml), and known maleimide **2** (number 1 in paper)¹ (0.96 g, 4.1 mmol) in allyl alcohol (10 ml), were reacted according to the general procedure above to give title compound **4** (0.57 g, 55%) as a colourless oil; (Found: C, 56.07; H, 5.75; N, 5.20; C₁₂H₁₄ClNO₃ requires C, 56.37; H, 5.52; N, 5.48%); $\mu_{\text{max}}(\text{MeCN})/\text{nm}$ 331 (dm³mol⁻¹cm⁻¹ 917); $\mu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3078 (w), 1718 (s), 1653 (m); ¹H NMR (400 MHz; CDCl₃) δ 1.70 (2 H, quintet, *J* 7.5, CH₂CH₂CH₂), 2.06 (2 H, q, *J* 7.5, CH₂CH₂CH), 3.54 (2 H, t, *J* 7.0, NCH₂CH₂), 5.01 (1 H, dd, *J* 10.5 and 1.5 CHCHH), 5.06 (1 H, dd, *J* 17.0 and 1.5 CHCHH), 5.12 (2 H, d, *J* 6.0, OCH₂CH), 5.38 (1 H, d, *J* 11.0, OCH₂CHCHH), 5.47 (1 H, d, *J* 17.0, OCH₂CHCHH), 5.79 (1 H, ddt, *J* 17.0, 10.5 and 6.5 CH₂CHCH₂), 6.03 (1 H, ddt, *J* 17.0, 11.0 6.0, OCH₂CHCH₂); ¹³C NMR (100 MHz; CDCl₃) δ 27.6 (CH₂), 30.8 (CH₂), 38.0 (CH₂), 72.6 (CH₂), 104.8 (C), 115.5 (CH₂), 120.1 (CH₂), 131.4 (CH), 137.1 (CH), 149.7 (C), 164.2 (CO), 165.5 (CO); *m/z* (CI) 256 ((M+H)⁺, 15%), 258 (5), 222 (18), 57 (100).

3-(allyloxy)-4-chloro-1-[(4E)-4-hexenyl]-1H-pyrrole-2,5-dione 5: Sodium metal (0.93 g, 4.0 mmol) in allyl alcohol (10 ml), and maleimide **1** (1.00 g, 4.0 mmol) in allyl alcohol (10 ml), were reacted according to the general procedure above to give title compound **5** (0.47 g, 44%) as a colourless oil;

$\nu_{\max}(\text{film})/\text{cm}^{-1}$ 1714 (s), 1654 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.61-1.68 (5 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCH_3), 1.98 (2 H, q, J 7.5, $\text{CH}_2\text{CH}_2\text{CH}$), 3.52 (2 H, t, J 7.0, NCH_2CH_2), 5.12 (2 H, d, J 5.5, OCH_2CH), 5.33-5.49 (4 H, m, CH_2CHCH , CHCHCH_3 , $\text{OCH}_2\text{CHCH}_2$), 6.03 (1 H, ddt, J 17.0, 10.5 and 5.5 $\text{OCH}_2\text{CHCH}_2$); ^{13}C NMR (100 MHz; CDCl_3) δ 17.9 (CH_3), 28.1 (CH_2), 29.7 (CH_2), 31.1 (CH_2), 72.6 (CH_2), 104.6 (C), 120.1 (CH_2), 126.0 (CH), 129.6 (CH), 131.5 (CH), 149.7 (C), 164.2 (CO), 165.5 (CO); m/z (EI) 269.0824 (M^+ , 38%, requires 269.0819), 271 (12), 234 (37), 83 (100).

3-(benzyloxy)-4-chloro-1-(4-pentenyl)-1H-pyrrole-2,5-dione 6: Sodium metal (0.10 g, 4.3 mmol) in benzyl alcohol (10 ml), and known maleimide **2** (number **1** in paper)¹ (1.00 g, 4.3 mmol) in benzyl alcohol (10 ml), were reacted according to the general procedure above (distillation under reduced pressure was required to remove the benzyl alcohol) to give title compound **6** (0.58 g, 44%) as a colourless oil; $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3072 (w), 2940 (w), 1709 (s), 1651 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.68 (2 H, quintet, J 7.5, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.03 (2 H, q, J 7.5, $\text{CH}_2\text{CH}_2\text{CH}$), 3.51 (2 H, t, J 7.0, NCH_2CH_2), 4.97 (1 H, dd, J 10.5 and 1.5 CHCHH), 5.03 (1 H, dd, J 17.0 and 1.5 CHCHH), 5.64 (2H, s, OCH_2Ph), 5.76 (1 H, ddt, J 17.0, 10.5 and 6.5 CH_2CHCH_2), 7.34-7.43 (5H, m, Ar-H); ^{13}C NMR (100 MHz; CDCl_3) δ 27.6 (CH_2), 30.8 (CH_2), 38.0 (CH_2), 73.8 (CH_2), 105.6 (C), 115.5 (CH_2), 128.0 (CH), 128.8 (2 $\times$ CH), 129.1 (2 $\times$ CH), 134.9 (C), 137.1 (CH), 150.0 (C), 164.2 (CO), 165.4 (CO); m/z (CI) 306.0894 ($(\text{M}+\text{H})^+$, 62%, requires 306.0897), 308 (22), 272 (16), 77 (91).

3-chloro-4-isopropoxy-1-(4-pentenyl)-1H-pyrrole-2,5-dione 32 (number **17** in paper): Sodium metal (0.03 g, 1.3 mmol) in $i\text{PrOH}$ (10 ml), and known maleimide **2** (number **1** in paper)² (0.30 g, 1.3 mmol) in $i\text{PrOH}$ (10 ml), were reacted according to the general procedure above to give title compound **7** (0.22 g, 65%) as a colourless oil; $\nu_{\max}(\text{MeCN})/\text{nm}$ 331 ($\text{dm}^3\text{mol}^{-1}\text{cm}^{-1}$ 854); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 1713 (s), 1643 (s), 1375 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.45 (6 H, d, J 6.0, 2 $\times$ CH_3), 1.70 (2 H, quintet, J 7.0, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.06 (2 H, q, J 7.0, $\text{CH}_2\text{CH}_2\text{CH}$), 3.53 (2 H, t, J 7.0, NCH_2CH_2), 4.99 (1 H, d, J 10.5, CHCHH), 5.04 (1 H, d, J 17.0, CHCHH), 5.40 (1 H, septet, J 6.0, $(\text{CH}_3)_2\text{CH}$), 5.78 (1 H, ddt, J 17.0, 10.0 and 6.5, CH_2CHCH_2); ^{13}C NMR (100 MHz; CDCl_3) δ 22.8 (2 $\times$ CH_3), 27.6 (CH_2), 30.8 (CH_2), 38.0 (CH_2), 76.0 (CH), 102.9 (C), 115.4 (CH_2), 137.2 (CH), 149.4 (C), 164.5 (CO), 166.0 (CO); m/z (EI) 258.0892 (M^+ , 36%, requires 258.0897), 260 (14) 215 (72), 83 (100).

Synthesis of methoxy maleimide 8.

An improved two step procedure for the synthesis of mono-methoxy maleimide has been developed.³

3,3-dimethoxy-2,5-pyrrolidinedione 7: Bromine (12.4 g, 4.0 ml, 77.3 mmol) was added dropwise to a solution of maleimide (5.0 g, 51.5 mmol) in MeOH (200 ml) at 0°C. The reaction mixture was stirred for 16 h at RT, then concentrated *in vacuo*. The crude material was redissolved in MeOH (75 ml) and added dropwise to a solution of sodium metal (4.74 g, 206 mmol) in MeOH (200 ml). After a further 20 h the reaction mixture was concentrated *in vacuo*, then EtOAc (100 ml) was added. The mixture was neutralised by slow addition of 7M HCl, then separated between water (100 ml) and EtOAc (100 ml). The aqueous layer was washed with EtOAc (2 × 200 ml), then the combined organic extracts washed with brine (50 ml), and dried (MgSO₄). Concentration *in vacuo* gave title compound **7** (7.82 g, 96%) as a white solid, mp (EtOAc) 81-82°C (Lit² mp 83-85°C); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3214 (br), 1717 (s); ¹H NMR (400 MHz; MeOD); 2.84 (2H, s, CH₂), 3.39 (6H, s, 2 × OCH₃), 4.86 (1 H, s, NH); ¹³C NMR (100 MHz; MeOD) δ 40.3 (CH₂), 50.0 (2 × CH₃), 99.8 (C), 173.2 (CO), 173.9 (CO); *m/z* (EI) 169 (M⁺, 11%), 131 (33), 84 (100).

Methoxy maleimide 8: **7** (7.2 g, 45.3 mmol) and TsOH (0.75 g, 3.94 mmol) were dissolved in toluene (200 ml) and heated at reflux for 6 h. No condenser was fitted during this process, instead fresh toluene was dripped in to the reaction flask at such a rate as to maintain a constant volume of solvent. The reaction mixture was allowed to cool to RT, then purified by dry column chromatography [EtOAc (20%-80%) in PE] to give title compound **8** (4.60 g, 80%) as a white solid, mp (EtOAc) 170-171°C (Lit² mp 169°C); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3214 (br), 1714 (s), 1636 (s); ¹H NMR (300 MHz; CDCl₃) δ 3.95 (3 H, s, OCH₃), 5.44 (1 H, s, CH), 7.24 (1 H, s, NH); ¹³C NMR (75 MHz; CDCl₃) δ 59.1 (CH₃), 97.5 (CH), 161.1 (C), 165.2 (CO), 169.3 (CO); *m/z* (EI) 127 (M⁺, 27%), 98 (33), 69 (100).

Synthesis of *N*-alkenylated methoxy maleimides 9-12.

General Procedure

To a solution of triphenylphosphine (1 equiv) in THF (0.2 M) at -78°C was added DIAD (1 equiv). After 1 h at -78°C the alcohol (1.5 equiv) was added and the solution stirred for a further 5 min before addition of **8** (1 equiv). The reaction was allowed to warm slowly to RT and stirred for a further 16 h. Concentration *in vacuo*, followed by purification by column chromatography [MeOH (0-2%) in DCM], gave the desired products;

3-methoxy-1-(4-pentenyl)-1*H*-pyrrole-2,5-dione 9: Triphenylphosphine (6.19 g, 23.6 mmol), DIAD (4.77 g, 4.64 ml, 23.6 mmol), pent-4-en-1-ol (3.05 g, 3.66 ml, 35.4 mmol) and **8** (3.00 g, 23.6 mmol) were reacted according to the general procedure above to give title compound **9** (3.9 g, 85%) as a white solid, mp 39-40°C; $\max(\text{MeCN})/\text{nm}$ 311 ($\text{dm}^3\text{mol}^{-1}\text{cm}^{-1}$ 470); $\max(\text{film})/\text{cm}^{-1}$ 1704 (s), 1627 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.69 (2 H, quintet, J 7.5, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.06 (2 H, q, J 7.0, $\text{CH}_2\text{CH}_2\text{CH}$), 3.51 (2 H, t, J 7.0, NCH_2CH_2), 3.93 (3H, s, CH_3), 4.98 (1 H, d, J 10.0, CHCHH), 5.04 (1 H, dd, J 17.0 and 1.0, CHCHH), 5.40 (1H, s, CH), 5.79 (1 H, ddt, J 17.0, 10.0 and 6.5, CH_2CHCH_2); ^{13}C NMR (100 MHz; CDCl_3) δ 27.7 (CH_2), 30.9 (CH_2), 37.3 (CH_2), 58.9 (CH_3), 96.2 (CH), 115.3 (CH_2), 137.3 (CH), 161.0 (C), 165.9 (CO), 170.2 (CO); m/z (EI) 195.0893 (M^+ , 35%, requires 195.0895), 140 (55), 83 (100).

3-methoxy-1-[(*E*)-4-hexenyl]-1*H*-pyrrole-2,5-dione 10: Triphenylphosphine (1.56 g, 5.94 mmol), DIAD (1.20 g, 1.17 ml, 5.94 mmol), *trans*-hex-4-en-1-ol (0.89 g, 1.05 ml, 8.91 mmol) and **8** (0.76 g, 5.94 mmol) were reacted according to the general procedure above to give title compound **10** (0.92 g, 74%) as a white solid, mp 56-57°C; $\max(\text{film})/\text{cm}^{-1}$ 2943 (w), 1702 (s), 1628 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.62-1.68 (5 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCH_3), 1.98 (2 H, q, J 7.0, $\text{CH}_2\text{CH}_2\text{CH}$), 3.49 (2 H, t, J 7.0, NCH_2CH_2), 3.93 (3H, s, CH_3), 5.35-5.49 (3 H, m, CH_2CHCH , CHCHCH_3 , CH); ^{13}C NMR (100

MHz; CDCl₃) δ 17.9 (CH₃), 28.2 (CH₂), 29.8 (CH₂), 37.4 (CH₂), 58.9 (CH₃), 96.2 (CH), 125.8 (CH), 129.8 (CH), 161.0 (C), 165.6 (CO), 170.2 (CO); m/z (EI) 209.1056 (M⁺, 30%, requires 209.1052), 141 (45), 84 (100).

1-[2-(2-cyclopenten-1-yl)ethyl]-3-methoxy-1H-pyrrole-2,5-dione 11 (number 10 in paper):

Triphenylphosphine (1.56 g, 5.94 mmol), DIAD (1.20 g, 1.17 ml, 5.94 mmol), known alcohol 2-(2-cyclopenten-1-yl)ethanol⁴ (1.00 g, 8.91 mmol) and **8** (0.76 g, 5.94 mmol) were reacted according to the general procedure above to give title compound **11** (0.98 g, 76%) as a white solid, mp 71-72°C; (Found: C, 65.34; H, 7.16; N, 6.47; C₁₂H₁₅NO₃ requires C, 65.14; H, 6.83; N, 6.33%); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 2948 (w), 1704 (s), 1626 (s); ¹H NMR (400 MHz; CDCl₃) δ 1.37-1.78 (3 H, m, NCH₂CH₂CH, CHCHHCH₂), 2.02-2.15 (1 H, m, CHCHHCH₂), 2.20-2.40 (2 H, m, =CHCH₂CH₂), 2.57-2.67 (1 H, m, (CH₂)₂CHCH), 3.54 (2 H, t, J 7.0, NCH₂CH₂), 3.93 (3H, s, CH₃), 5.39 (1 H, s, CH), 5.64-5.69 (1 H, m, CHCHCH), 5.72-5.76 (1 H, m, CHCHCH₂); ¹³C NMR (100 MHz; CDCl₃) δ 29.6 (CH₂), 32.0 (CH₂), 34.5 (CH₂), 36.5 (CH₂), 43.1 (CH), 58.9 (CH₃), 96.2 (CH), 131.1 (CH), 134.0 (CH), 161.2 (C), 165.7 (CO), 170.1 (CO); m/z (EI) 221 (M⁺, 10%), 141 (12), 84 (100).

1-[2-(2-cyclohexen-1-yl)ethyl]-3-methoxy-1H-pyrrole-2,5-dione 12 (number 14 in paper):

Triphenylphosphine (1.56 g, 5.94 mmol), DIAD (1.20 g, 1.17 ml, 5.94 mmol), 2-(2-cyclohexen-1-yl)ethanol⁵ (1.12 g, 8.91 mmol) and **8** (0.76 g, 5.94 mmol) were reacted according to the general procedure above to give title compound **12** (1.20 g, 87%) as a white solid, mp 82-83°C; $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 2928 (w), 1704 (s), 1625 (s); ¹H NMR (400 MHz; CDCl₃) δ 1.22-1.32 (1 H, m, CH₂CHHCH₂), 1.46-1.88 (5 H, m, CH₂CHHCH₂, CHCH₂CH₂, NCH₂CH₂CH), 1.94-1.99 (2 H, m, =CHCH₂CH₂), 2.02-2.08 (1 H, m, (CH₂)₂CHCH), 3.56 (2 H, t, J 7.0, NCH₂CH₂), 3.93 (3H, s, CH₃), 5.39 (1 H, s, CH), 5.54-5.58 (1 H, m, CHCHCH), 5.67-5.72 (1 H, m, CHCHCH₂); ¹³C NMR (100 MHz; CDCl₃) δ 21.3 (CH₂), 25.2 (CH₂), 28.6 (CH₂), 32.8 (CH), 34.7 (CH₂), 35.7 (CH₂), 58.9 (CH₃), 96.2 (CH), 127.8 (CH), 130.7 (CH), 161.3 (C), 165.8 (CO), 170.1 (CO); m/z (EI) 235.1208 (M⁺, 10%, requires 235.1204), 207 (10), 84 (100).

Photochemical reactions

7-chloro-6-methoxy-2,3,9,9a-tetrahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **13** (number 6 in paper) and (2*aS**,3*aS**)-9-chloro-2*a*-hydroxy-2*a*,3,3*a*,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **14** (number 5 in paper):

A solution of **3** (0.229 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 40 min, then concentrated *in vacuo* and purified by column chromatography [MeOH (2%) in DCM]. Two products were obtained from this process. The minor component was title compound **13**, obtained as a brown oil (0.048 g, 21%); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 1653 (s), 1566 (m), 1448 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.77-1.84 (1 H, m, CHCHHCH_2), 1.94-2.09 (2 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.28-2.38 (1 H, m, CHCHHCH_2), 2.78-2.89 (2 H, m, COCH_2CH), 3.63-3.70 (1 H, m, NCHHCH_2), 3.76-3.83 (1 H, m, NCHHCH_2), 4.03 (3 H, s, OCH_3) 4.32-4.38 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$); ^{13}C NMR (75 MHz; CDCl_3) δ 22.8 (CH_2), 31.7 (CH_2), 46.4 (CH_2), 50.1 (CH_2), 52.6 (CH), 60.1 (CH_3), 120.8 (C), 157.1 (C), 157.5 (CO), 191.5 (CO); m/z (CI) 230.0591 ($(\text{M}+\text{H})^+$, 98%, requires 230.0584), 232 (55), 202 (30), 70 (100).

The major component was title compound **14** (0.169 g, 74%), and was a white solid, mp (EtOAc) 139-142°C; (Found: C, 52.01; H, 5.54; N, 5.99; Cl, 15.20 $\text{C}_{10}\text{H}_{12}\text{ClNO}_3$ requires C, 52.30; H, 5.27; N, 6.10; Cl, 15.44%); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3247 (br), 1690 (s), 1607 (s), 1420 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.72-1.75 (1 H, m, CHCHHCH_2), 1.95-2.18 (4 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCHHCH_2 , $\text{C}(\text{OH})\text{CHHCH}$), 2.51 (1 H, dd, J 14.0 and 6.0, $\text{C}(\text{OH})\text{CHHCH}$), 3.51-3.54 (2 H, m, NCH_2CH_2), 4.10-4.16 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 4.90 (1 H, d, J 6.0, OCHH), 4.98 (1 H, d, J 6.0, OCHH) 6.02 (1 H, s, OH); ^{13}C NMR (100 MHz; CDCl_3) δ 22.8 (CH_2), 30.8 (CH_2), 46.9 (CH_2), 47.1 (CH_2), 58.5 (CH), 75.0 (C), 88.7 (CH_2), 95.8 (C), 164.9 (CO), 172.6 (C); m/z (EI) 229 (M^+ , 73%), 231 (38), 172 (69), 70 (100).

6-chloro-7-methoxy-2,3,9,9a-tetrahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **15** and (2*aR**,3*aR**)-9-chloro-2*a*-hydroxy-2*a*,3,3*a*,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **15** (number 7 in paper):

A solution of **3** (0.229 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 10 min then concentrated *in vacuo* and purified by column chromatography [MeOH (2%) in DCM]. Two products were obtained from this process. The first was proposed to be a mixture of regioisomers **13** and **15**, which were inseparable by this method of purification, and was a yellow solid (0.135 g, 59%). NMR investigations showed the mixture was a 1 : 1.8 ratio of **13** : **15**. Repeated trituration with diethyl ether gave **15**, as a white solid, mp (EtOAc) 129-131°C; (Found: C, 52.20; H, 5.58; N, 5.83; Cl, 15.30 $C_{10}H_{12}ClNO_3$ requires C, 52.30; H, 5.27; N, 6.10; Cl, 15.44%); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 1680 (m), 1634 (m), 1573 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.76-1.83 (1 H, m, CHCHHCH_2), 1.93-2.06 (2 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.26-2.35 (1 H, m, CHCHHCH_2), 2.76-2.89 (2 H, m, COCH_2CH), 3.64-3.75 (2 H, m, NCH_2CH_2), 3.82 (3 H, s, OCH_3) 4.34-4.40 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$); ^{13}C NMR (100 MHz; CDCl_3) δ 23.2 (CH_2), 31.7 (CH_2), 47.4 (CH_2), 51.1 (CH_2), 52.3 (CH), 59.9 (CH_3), 125.1 (C), 154.3 (C), 160.1 (CO), 193.3 (CO); m/z (EI) 229 (M^+ , 32%), 231 (10), 201 (78), 166 (100).

The second product was **14** (0.82 g, 36%), data identical to that previously reported.

(2a*S,3a*S**)-9-chloro-2a-hydroxy-2a,3,3a,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **14**:** A solution of **15** (98 mg, 0.43 mmol) in acetonitrile (140 ml) was irradiated for 2h then concentrated *in vacuo* and purified by column chromatography (2% MeOH in DCM) to give title compound **14** (83 mg, 84%), data identical to that previously reported.

6-(allyloxy)-7-chloro-2,3,9a-tetrahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **16 and (2*R**,2a*S**,3a*S**)-9-chloro-2a-hydroxy-2-vinyl-2a,3,3a,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **17**:**

A solution of **4** (0.256 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 50 min then concentrated *in vacuo* and purified by column chromatography [MeOH (5%) in DCM]. Two separable products were obtained from this process. The first component was title compound **16**, obtained as a brown oil (0.051 g, 20%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1643 (s), 1563 (s), 1434 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.75-1.83 (1 H, m, CHCHHCH_2), 1.89-2.08 (2 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.24-2.34 (1 H, m, CHCHHCH_2), 2.81-2.84 (2 H, m, $\text{C(O)CH}_2\text{CH}$), 3.60-3.67 (1 H, m, NCHHCH_2), 3.73-3.80 (1 H, m, NCHHCH_2), 4.25-4.33 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 4.76 (1 H, dd, J 13.0 and 7.0, OCHHCH), 4.93 (1 H, dd, J 13.0 and 5.0, OCHHCH), 5.29 (1 H, dd, J 11.0 and 1.5, CHHCH), 5.39 (1 H, dd, J 17.0 and 1.5, CHHCH), 6.00 (1 H, dddd, J 17.0, 11.0, 7.0 and 5.0, $\text{CH}_2\text{CHCH}_2\text{O}$); ^{13}C NMR (75 MHz; CDCl_3) δ 23.0 (CH_2), 31.8 (CH_2), 46.6 (CH_2), 50.3 (CH_2), 52.5 (CH), 72.8 (CH_2), 119.2 (CH_2), 122.1 (C), 133.2 (CH), 156.2 (C), 157.9 (CO), 192.0 (CO); m/z (EI) 256 (M^+ , 42%), 258, (13), 222 (100), 70 (85).

The second product was title compound **17** obtained as a white solid (0.148 g, 58%, mp 157-159°C); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3161 (br), 1683 (s), 1608 (s), 1425 (s); ^1H NMR (300 MHz; CDCl_3) δ 1.72-1.75 (1 H, m, CHCHHCH_2), 1.93-2.13 (4 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCHHCH_2 , C(OH)CHHCH), 2.47 (1 H, dd, J 14.0 and 6.0, C(OH)CHHCH), 3.50-3.54 (2 H, m, NCH_2CH_2), 4.10-4.18 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 5.31 (1 H, d, J 7.5, OCHCH), 5.53-5.55 (1 H, m, CHHCH), 5.57-5.59 (1 H, m, CHHCH), 6.29-6.42 (2 H, m, CH_2CHCH , OH); ^{13}C NMR (75 MHz; CDCl_3) δ 22.6 (CH_2), 30.8 (CH_2), 46.9 (CH_2), 47.3 (CH_2), 58.3 (CH), 76.7 (C), 95.5 (C), 98.2 (CH), 131.2 (CH_2), 135.5 (CH), 165.0 (CO), 171.3 (C); m/z (EI) 255.0656 (M^+ , 15%, requires 255.0662), 257 (5), 220 (18), 172 (80), 70 (100).

(9*S,9*aS**)-6-(allyloxy)-7-chloro-9-methyl-2,3,9,9a-tetrahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **18** and (2*aS**,3*S**,3*aS**)-9-chloro-2*a*-hydroxy-3-methyl-2-vinyl-2*a*,3,3*a*,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **19**:**

A solution of **5** (0.270 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 50 min then concentrated *in vacuo* and purified by column chromatography [MeOH (4%) in DCM]. Two separable products were obtained from this process. The first component was title compound **18**, obtained as a brown oil (0.054 g, 20%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1643 (s), 1575 (s), 1432 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.20 (3 H, d, J 7.0, CHCH_3), 1.86-2.00 (3 H, m, CHCHHCH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.13-2.23 (1 H, m, CHCHHCH_2), 2.66 (1 H, dq, J 11.0 and 7.5, CH_3CHCH), 3.54-3.60 (1 H, m, NCHHCH_2), 3.65-3.72 (1 H, m, NCHHCH_2), 3.95-4.01 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 4.78 (1 H, dd, J 13.0 and 7.0, OCHHCH), 4.88 (1 H, dd, J 13.0 and 5.0, OCHHCH), 5.30 (1 H, dd, J 11.0 and 1.5, CHHCH), 5.39 (1 H, dd, J 17.0 and 1.5, CHHCH), 6.00 (1 H, dddd, J 17.0, 11.0, 7.0 and 5.0, $\text{CH}_2\text{CHCH}_2\text{O}$); ^{13}C NMR (75 MHz; CDCl_3) δ 16.7 (CH_3), 22.8 (CH_2), 29.8 (CH_2), 46.3 (CH_2), 55.1 (CH), 58.0 (CH), 72.3 (CH_2), 119.3 (CH_2), 120.1 (C), 133.5 (CH), 153.9 (C), 158.4 (CO), 197.9 (CO); m/z (EI) 269.0814 (M^+ , 40%, requires 269.0818), 234 (47), 206 (100).

The second product was title compound **19** obtained as a white solid (0.135 g, 50%) and was found to be a 10:1 mixture of diastereomers. Recrystallization (EtOH) gave the major diastereomer as a white solid, mp 170-172°C. $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3181 (br), 1679 (s), 1608 (s), 1423 (s); ^1H NMR (300 MHz; CDCl_3) δ 1.16 (3 H, d, J 7.0, CHCH_3), 1.78-2.15 (5 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCH_2CH_2 , $\text{C}(\text{OH})\text{CH}(\text{CH}_3)\text{CH}$), 3.42-3.62 (3 H, m, NCH_2CH_2 , $\text{CH}_2(\text{N})\text{CHCH}_2$), 5.48-5.57 (3 H, m, OCHCH , CH_2CH), 6.38-6.50 (1 H, ddd, J 17.0, 10.5, and 7.5, CH_2CHCHO), 6.65 (1 H, br s, OH); ^{13}C NMR (75 MHz; CDCl_3) δ 15.5 (CH_3), 22.6 (CH_2), 30.3 (CH_2), 47.0 (CH_2), 50.1 (CH), 65.5 (CH), 80.0 (C), 93.9 (CH), 95.5 (C), 122.5 (CH_2), 131.7 (CH), 165.2 (CO), 171.7 (C); m/z (CI) 270.0892 ($(\text{M}+\text{H})^+$, 100%, requires 270.0897), 272 (50), 172 (75), 70 (55). NOESY data – significant interactions shown;

The ratio of diastereomers in this reaction was determined by analysis of the ^1H -NMR data. The following peaks were distinguishable as belonging to the minor diastereomer;

^1H (400 MHz; CDCl_3) δ 1.11 (3 H, d, J 7.0, CHCH_3), 6.11-6.20 (1 H, m, CH_2CHCHO);

6-(benzyloxy)-7-chloro-2,3,9a-tetrahydro-1H-pyrrolo[1,2-a]azepine-5,8-dione **20 and (2a*S**,3a*S**)-9-chloro-2a-hydroxy-2-phenyl-2a,3,3a,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **21**:**

A solution of **6** (0.305 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 50 min then concentrated *in vacuo* and purified by column chromatography [MeOH (4%) in DCM]. Two separable products were obtained from this process. The first component was title compound **20**, obtained as a brown oil (0.064 g, 21%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1646 (s), 1566 (s), 1443 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.55-1.98 (4 H, m, CHCH_2CH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.61-2.73 (2 H, m, $\text{C}(\text{O})\text{CH}_2\text{CH}$), 3.41-3.48 (2 H, m, NCHHCH_2 , $\text{CH}_2(\text{N})\text{CHCH}_2$), 3.58-3.67 (1 H, m, NCHHCH_2), 5.40-5.47 (2H, m, OCH_2Ph), 7.33-7.38 (5H, m, Ar-H); ^{13}C NMR (75 MHz; CDCl_3) δ 23.0 (CH_2), 31.5 (CH_2), 46.2 (CH_2), 50.3 (CH_2), 52.1 (CH), 76.8 (CH_2), 122.3 (C), 128.6 (CH), 128.7 ($4 \times \text{CH}$), 136.5 (C), 157.6 (C), 157.9 (CO), 192.2 (CO); m/z (CI) 306.0892 (($\text{M}+\text{H}$) $^+$, 60%, requires 306.0897), 308 (20), 216 (55), 91 (100).

The second product was title compound **21** obtained as a white solid (0.159 g, 52%) and was found to be a 4:1 mixture of diastereomers. Recrystallization (EtOH) gave the major diastereomer as a white solid mp 194-195°C; (Found: C, 63.01; H, 5.34; N, 4.44; $\text{C}_{16}\text{H}_{16}\text{ClNO}_3$ requires C, 62.85; H, 5.27; N, 4.58%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3177 (br), 1688 (m), 1596 (s), 1415 (m); ^1H NMR (400 MHz; DMSO) δ 1.63-1.66 (1 H, m, CHCHHCH_2), 1.80-2.08 (4 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCHHCH_2 , $\text{C}(\text{OH})\text{CHHCH}$), 2.71(1 H, dd, J 14.0 and 5.0, $\text{C}(\text{OH})\text{CHHCH}$), 3.29-3.42 (2 H, m, NCH_2CH_2), 4.14-4.21 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 6.04 (1H, s, OCHPh), 6.17 (1H, s, OH), 7.35-7.46 (5H, m, Ar-H); ^{13}C NMR (100 MHz; DMSO) δ 22.9 (CH_2), 30.8 (CH_2), 46.9 (CH_2), 47.1 (CH_2), 58.6 (CH), 78.2 (C), 95.9 (C), 97.0 (CH), 127.8 ($2 \times \text{CH}$), 128.5 ($2 \times \text{CH}$), 129.2 (CH), 134.8 (C), 163.3 (CO), 170.8 (C); m/z (EI) 305 (M^+ , 47%), 307 (15), 172 (85), 103 (100). The ratio of diastereomers in this reaction was determined by analysis of the ^1H -NMR data. The following peaks were distinguishable as belonging to the minor diastereomer; ^1H NMR (400 MHz; CDCl_3) δ 3.90-3.98 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 6.09 (1H, s, OCHPh), 6.43 (1H, s, OH).

6-methoxy-2,3,9,9a-tetrahydro-1H-pyrrolo[1,2-a]azepine-5,8-dione 22 and

2a-hydroxy-2a,3,3a,4,5,6-hexahydro-2H,8H-oxeto[3,2-d]pyrrolo[1,2-a]azepin-8-one 23 (number 22 in paper):

A solution of **9** (0.195 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 40 min then concentrated *in vacuo* and purified by column chromatography [MeOH (5%) in DCM]. Two separable products were obtained from this process. The first component was title compound **22**, obtained as a brown oil (0.027 g, 14%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1637 (s), 1591 (s), 1450 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.69-1.98 (3 H, m, CHCHHCH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.21-2.30 (1 H, m, CHCHHCH_2), 2.60-2.71 (2 H, m, COCH_2CH), 3.62-3.79 (2 H, m, NCH_2CH_2), 3.70 (3 H, s, OCH_3), 4.11-4.19 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$) 5.64 (1 H, s, CH); ^{13}C NMR (75 MHz; CDCl_3) δ 23.1 (CH_2), 32.7 (CH_2), 47.6 (CH_2), 49.4 (CH_2), 53.3 (CH), 56.4 (CH_3), 107.8 (CH), 159.9 (C), 160.4 (CO), 197.7 (CO); m/z (CI) 196.0951 ($(\text{M}+\text{H})^+$, requires 196.0974). m/z (EI) 195 (M^+ , 55%), 140 (82), 70 (100).

The second product, a white solid (0.148 g, 76 %) was found to be **23** as a 6:1 mixture of diastereomers. Recrystallization (EtOAc) gave the major diastereomer, mp 166-168°C; (Found: C, 61.24; H, 6.86; N, 7.22; $\text{C}_{10}\text{H}_{13}\text{NO}_3$ requires C, 61.53; H, 6.71; N, 7.25%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3247 (br), 1690 (s), 1607 (s), 1420 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.68-1.78 (1 H, m, CHCHHCH_2), 1.88-2.20 (4 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCHHCH_2 , $\text{C}(\text{OH})\text{CHHCH}$), 2.48 (1 H, dd, J 14.0 and 5.5, $\text{C}(\text{OH})\text{CHHCH}$), 3.40-3.52 (2 H, m, NCH_2CH_2), 4.06-4.16 (1 H, m, $\text{CH}_2(\text{N})\text{CHCH}_2$), 4.81 (1 H, d, J 6.0, OCHH), 4.88 (1 H, d, J 6.0, OCHH), 5.10 (1H, s, CH), 6.62 (1 H, s, OH); ^{13}C NMR (100 MHz; CDCl_3) δ 22.9 (CH_2), 30.9 (CH_2), 46.5 (CH_2), 47.2 (CH_2), 58.3 (CH), 75.6 (C), 88.4 (CH_2), 93.4 (CH), 169.0 (CO), 179.7 (C); m/z (EI) 195 (M^+ , 47%), 83 (42), 70 (100).

The ratio of diastereomers in this reaction was determined by analysis of the ^1H -NMR data. The following peaks were distinguishable as belonging to the minor diastereomer; ^1H NMR (400 MHz; CDCl_3) δ 4.73-4.76 (2 H, m, OCH_2), 5.20 (1H, s, CH), 7.24 (1 H, s, OH);

(9*S,9*aS**)-6-methoxy-2,3,9a-tetrahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **24** and (2*aS**,3*S**,3*aS**)-2a-hydroxy-3-methyl-2a,3,3a,4,5,6-hexahydro-2*H*,8*H*-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one **25**:**

A solution of **10** (0.209 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 50 min then concentrated *in vacuo* and purified by column chromatography [MeOH (4%) in DCM]. Two separable products were obtained from this process. The first component was title compound **24**, obtained as a brown oil (0.029 g, 14%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1645 (s), 1597 (s), 1452 (m) ; ^1H NMR (400 MHz; CDCl_3) δ 1.18 (3 H, d, J 7.5, CHCH_3), 1.82-1.98 (3 H, m, CHCHHCH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.18-2.26 (1 H, m, CHCHHCH_2), 2.47 (1 H, dq, J 11.0 and 7.5, CH_3CHCH), 3.50-3.57 (1 H, m, NCHHCH_2), 3.77 (3 H, s, OCH_3), 3.86-3.99 (2 H, m, NCHHCH_2 , $\text{CH}(\text{N})\text{CHCH}_2$), 5.67 (1 H, s, CH); ^{13}C NMR (75 MHz; CDCl_3) δ 15.3 (CH_3), 23.0 (CH_2), 30.9 (CH_2), 47.1 (CH_2), 52.4 (CH), 56.1 (CH_3), 58.7 (CH), 106.9 (CH), 158.9 (C), 160.6 (CO), 201.8 (CO); m/z (EI) 209.1044 (M^+ , 33%, requires 209.1051), 140 (31), 84 (42), 70 (100).

The second product was title compound **25** obtained as a colourless white solid (0.148 g, 76%, mp 196-198°C); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3146 (br), 1679 (s), 1584 (s), 1429 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.12 (3 H, d, J 7.0, CHCH_3) 1.76-2.11 (5 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCH_2CH_2 , $\text{C}(\text{OH})\text{CHCH}(\text{CH}_3)$), 3.40-3.56 (3 H, m, NCH_2CH_2 , $\text{CH}_2(\text{N})\text{CHCH}_2$), 4.82 (1 H, d, J 6.0, OCHH), 4.96 (1 H, d, J 6.0, OCHH), 5.08 (1H, s, CH), 6.72 (1 H, s, OH); ^{13}C NMR (100 MHz; CDCl_3) δ 15.8 (CH_3), 22.9 (CH_2), 30.5 (CH_2), 46.3 (CH_2), 49.8 (CH), 65.3 (CH), 78.9 (C) 84.3 (CH_2), 93.4 (CH), 169.4 (CO), 179.9 (C); m/z (EI) 209.1053 (M^+ , 15%, requires 209.1052), 138 (35), 70 (100). NOESY data – significant interactions shown;

(2a*S,8b*R**)-8-hydroxy-7-methoxy-1,2,2a,3,4,8b-hexahydro-5*H*-4a-azacyclopenta[*cd*]azulen-5-one 20** (number 11 in paper):

A solution of **11** (0.221 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 40 min then concentrated *in vacuo* and EtOAc (10 ml) added. The resultant precipitate was filtered off and the process repeated twice more. The solids obtained were combined to give title compound **26** (0.132 g, 60%), as a white solid, mp 180-181°C; (Found: C, 65.55; H, 7.12; N, 6.48; C₁₂H₁₅NO₃ requires C, 65.14; H, 6.83; N, 6.33%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3080, (br), 2943 (w), 1609 (s), 1562 (s), 1450 (m); ¹H NMR (400 MHz; CDCl₃) δ 1.66-1.78 (2 H, m, NCH₂CHHCH₂, CH₂CHHCH), 1.91-2.06 (2 H, m, NCH₂CHHCH₂, CH₂CHHCH), 2.51 (1 H, dt, *J* 17.0 and 7.0, CCHHCH₂), 2.69-2.78 (1 H, m, CCHHCH₂), 2.92-3.01 (1 H, m, NCHCH(CH₂)₂), 3.52-3.68 (2 H, m, NCH₂CH₂), 3.71 (3 H, s, OCH₃), 4.30 (1 H, d, *J* 7.5, NCHCH), 5.51 (1 H, s, CH), 5.92 (1 H, br s, OH); ¹³C NMR (75 MHz; CDCl₃) δ 27.4 (CH₂), 28.7 (CH₂), 29.4 (CH₂), 44.6 (CH), 45.8 (CH₂), 55.4 (CH₃), 62.7 (CH), 100.7 (CH), 123.5 (C), 139.5 (C), 159.9 (C), 164.1 (CO); *m/z* (EI) 221 (M⁺, 9%), 193 (13), 82 (100).

(7a*R,10a*S**,10b*R**)-5-methoxy-1,2,7a,8,9,10,10a,10b-octahydroazepino[3,2,1-*hi*]indole-4,7-dione 27** (number 16 in paper), **(3a*S**,10a*R**,10b*S**,10c*R**)-10a-hydroxy-1,2,3,3a,4,5,10,10a,10b,10c-decahydro-7*H*-oxeto[3',2':4,5]azepino[3,2,1-*hi*]indol-7-one 28** (number 15 in paper) and **(3a*S**,10a*S**,10b*S**,10c*R**)-10a-hydroxy-1,2,3,3a,4,5,10,10a,10b,10c-decahydro-7*H*-oxeto[3',2':4,5]azepino[3,2,1-*hi*]indol-7-one 29:**

A solution of **12** (0.235 g, 1.0 mmol) in acetonitrile (100 ml) was irradiated for 2 h then concentrated *in vacuo* and purified by column chromatography [MeOH (4%) in DCM]. Three separable products were obtained from this process. The first component was title compound **27**, obtained as a brown oil (0.019 g, 8%); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 2932 (w), 1642 (s), 1593 (s), 1451 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.26-1.97 (8 H, m, $\text{NCH}_2\text{CH}_2\text{CH}$, CHCH_2CH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$, $\text{C(O)CHCH}_2\text{CH}_2$), 2.33-2.42 (1 H, m, $\text{CH}_2\text{CH}(\text{CH})\text{CH}_2$), 2.63-2.68 (1 H, m, $\text{C(O)CH}(\text{CH}_2)\text{CH}$), 3.72-3.83 (4 H, m, NCHHCH_2 , OCH_3), 3.98-4.04 (1 H, m, NCHHCH_2), 4.13-4.18 (1 H, m, CH(N)CHCH), 5.74 (1 H, s, CH); ^{13}C NMR (75 MHz; CDCl_3) δ 23.3 (CH_2), 24.5 (CH_2), 26.8 (CH_2), 29.2 (CH_2), 39.2 (CH), 48.5 (CH_2), 53.1 (CH), 56.0 (CH_3), 56.4 (CH), 107.7 (CH), 158.5 (C), 161.2 (CO), 199.4 (CO); m/z (EI) 235.1209 (M^+ , 48%, requires 235.1208), 206 (35), 69 (100).

The second product was title compound **28**, obtained as a white solid (0.058 g, 25%, mp 182-184°C); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 3281 (br), 1688 (m), 1603 (s), 1407 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.22-1.86 (8 H, m, $\text{NCH}_2\text{CH}_2\text{CH}$, CHCH_2CH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$, $\text{C(OH)CHCH}_2\text{CH}_2$), 2.38-2.46 (1 H, m, $\text{CH}_2\text{CH}(\text{CH})\text{CH}_2$), 2.47-2.54 (1 H, m, $\text{C(OH)CH}(\text{CH}_2)\text{CH}$), 3.13-3.21 (1 H, m, NCHHCH_2), 4.03 (1 H, t, J 7, CH(N)CHCH), 4.16-4.23 (1 H, m, NCHHCH_2), 4.75 (1 H, d, J 5.5, OCHH), 4.87 (1 H, d, J 5.5, OCHH), 5.08 (1H, s, CH), 5.23 (1 H, br s, OH); ^{13}C NMR (100 MHz; CDCl_3) δ 20.9 (CH_2), 21.7 (CH_2), 26.6 (CH_2), 30.9 (CH_2), 38.1 (CH), 44.5 (CH_2), 47.9 (CH), 59.9 (CH), 75.9 (C), 88.4 (CH_2), 92.9 (CH), 171.5 (CO), 179.4 (C); m/z (EI) 235.1200 (M^+ , 100%, requires 235.1208), 190 (33), 82 (91). NOESY data – significant interactions shown;

The third product was title compound **29** (0.063 g, 27%), obtained as a white solid; $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3310 (br), 1714 (m), 1629 (s), 1445 (m); ^1H NMR (300 MHz; CD_3OD) δ 0.90-2.05 (10 H, m, $\text{NCH}_2\text{CH}_2\text{CH}$, CHCH_2CH_2 , $\text{CH}_2\text{CH}_2\text{CH}_2$, $\text{C}(\text{OH})\text{CHCH}_2\text{CH}_2$, $\text{CH}_2\text{CH}(\text{CH})\text{CH}_2$, $\text{C}(\text{OH})\text{CH}(\text{CH}_2)\text{CH}$), 3.37-3.67 (2 H, m, NCH_2CH_2), 4.03-4.07 (1 H, m, CHCHCH), 4.49 (1 H, d, J 6.0, OCHH), 4.93 (1 H, d, J 6.0, OCHH), 5.04 (1H, s, CH); ^{13}C NMR (75 MHz; CD_3OD) δ 23.6 (CH_2), 25.5 (CH_2), 27.1 (CH_2), 27.7 (CH_2), 40.4 (CH), 41.9 (CH), 48.4 (CH_2), 60.3 (CH), 78.5 (C), 82.3 (CH_2), 96.1 (CH), 159.2 (CO), 177.7 (C); m/z (EI) 235.1206 (M^+ , 97%, requires 235.1208), 190 (70), 82 (100).

(2aS*,3aS*)-9-chloro-2a-hydroxy-2,2-dimethyl-2a,3,3a,4,5,6-hexahydro-2H,8H-oxeto[3,2-*d*]pyrrolo[1,2-*a*]azepin-8-one 33 and 6-chloro-2,3,9a-tetrahydro-1H-pyrrolo[1,2-*a*]azepine-5,8-dione 34 (number 18 in paper):

A solution of **32** (0.15 g, 0.58 mmol) in acetonitrile (100 ml) was irradiated for 10 min, then concentrated *in vacuo* and purified by column chromatography [MeOH (2%) in DCM]. Two products were obtained from this process. The minor component was title compound **33** as a white crystalline solid (0.019g, 13%, mp 205-207°C); (Found: C, 55.63; H, 6.44; N, 5.24; Cl, 13.93 $\text{C}_{12}\text{H}_{16}\text{ClNO}_3$ requires C, 55.93; H, 6.26; N, 5.44; Cl, 13.76%); $\nu_{\max}(\text{film})/\text{cm}^{-1}$ 3189 (br), 1677 (m), 1607 (s), 1418 (s); ^1H NMR (400 MHz; CDCl_3) δ 1.58 (s, 3H, CH_3), 1.69 (s, 3H, CH_3), 1.69-1.75 (1 H, m, CHCHHCH_2), 1.86-2.07 (4 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$, CHCHHCH_2 , $\text{C}(\text{OH})\text{CHHCH}$), 2.51 (1 H, dd, J 14.5 and 5.5, $\text{C}(\text{OH})\text{CHHCH}$), 3.50-3.59 (2 H, m, NCH_2CH_2), 4.04-4.41 (1 H, m, CH_2CHCH_2); ^{13}C NMR (100 MHz; CDCl_3) δ 22.4 (CH_3), 22.7 (CH_3), 24.7 (CH_2), 31.0 (CH_2), 43.9 (CH_2), 47.0 (CH_2), 59.1 (CH), 77.8 (C), 96.1 (C), 99.9 (C), 165.2 (CO), 172.6 (C); m/z (EI) 257 (M^+ , 20%), 259 (6), 172 (100), 174 (34), 70 (93).

The major component was title compound **34** as a brown oil (0.047 g, 31%); ^1H NMR (400 MHz; CDCl_3) δ 1.78-1.88 (1 H, m, CHCHHCH_2), 1.91-2.07 (2 H, m, $\text{CH}_2\text{CH}_2\text{CH}_2$), 2.30-2.40 (1 H, m, CHCHHCH_2), 2.74-2.80 (2 H, m, COCH_2CH), 3.67-3.84 (2 H, m, NCH_2CH_2), 4.26-4.34 (1 H, m, CH_2CHCH_2), 6.75 (1H, s, CH); ^{13}C NMR (100 MHz; CDCl_3) δ 23.5 (CH_2), 32.5 (CH_2), 47.9 (CH_2), 49.7 (CH_2), 53.6 (CH), 132.8 (CH), 144.0 (C), 158.4 (CO), 196.0 (CO); m/z (EI) 199.0404 (M^+ , 34%, requires 199.0400), 201 (11), 164 (25), 83 (100).

Oxetane cleavage

8-hydroxy-8-(hydroxymethyl)octahydro-5H-pyrrolo[1,2-*a*]azepin-5-one 30 (number **23** in paper):

A solution of **23** (0.130 g, 0.67 mmol) in EtOH (5 ml) was flushed with N_2 , then 5% Pt/C (0.03 g) was added. The reaction mixture was placed under a slight positive pressure of nitrogen, which was then released, and the procedure repeated 3 times. The same process was then carried out using hydrogen, this time finishing by leaving the reaction vessel under the slight positive pressure of hydrogen. After 52 h the platinum was filtered off through celite, and the crude product purified by column chromatography [MeOH (5 $\rightarrow$ 10%) in DCM] to give **30** (0.107 g, 83%), obtained as a white solid, mp (EtOAc) 150-152 $^\circ\text{C}$; ν_{max} (film)/ cm^{-1} 3267 (br), 1595 (s), 1452 (m); ^1H NMR (400 MHz; CDCl_3) δ 1.50-1.72 (4 H, m, $\text{CH}_2\text{CHHCH}_2$, CHCHHCH_2 , $\text{CH}_2\text{CHHC(OH)}$, C(OH)CHHCH), 1.79-1.87 (1 H, m, $\text{CH}_2\text{CHHCH}_2$), 1.89-2.01 (2 H, m, $\text{CH}_2\text{CHHC(OH)}$, C(OH)CHHCH), 2.10-2.17 (1 H, m, CHCHHCH_2), 2.27-2.33 (1 H, m, $\text{CH}_2\text{CHHC(O)}$), 2.41-2.47 (1 H, m, $\text{CH}_2\text{CHHC(O)}$), 3.20 (2 H, s, OH), 3.32-3.38 (1 H, m, NCHHCH_2), 3.52-3.59 (4 H, m, NCHHCH_2 , $\text{CH}_2(\text{N})\text{CHCH}_2$, HOCH_2); ^{13}C NMR (100 MHz; CDCl_3) δ 23.5 (CH_2), 31.8 (CH_2), 32.4 (CH_2), 35.2 (CH_2), 43.6 (CH_2), 47.6 (CH_2), 54.6 (CH), 66.6 (CH_2), 73.5 (C), 173.3 (CO); m/z (CI) 200.1253 ($(\text{M}+\text{H})^+$, requires 200.1287). m/z (EI) 199 (M^+ , 12%), 168 (16), 70 (100).

Hexahydro-1*H*-pyrrolo[1,2-*a*]azepine-5,8-dione **31** (number **24** in paper):

Sodium periodate (0.086, 0.40 mmol) was added to a solution of **30** (0.072 g, 0.36 mmol) in a mixture of EtOH (2 ml) and water (0.5 ml). After 2 h the reaction mixture was filtered through celite. Concentration *in vacuo*, followed by removal of any traces of water by trituration with toluene (3 X 5 ml), then EtOH (3 X 5 ml) gave **31** (0.060 g, 100%), obtained as a white solid, mp (EtOAc) 89-91°C (Lit¹, oil); $\nu_{\text{max}}(\text{film})/\text{cm}^{-1}$ 1611 (s), 1453 (m); ¹H NMR (400 MHz; CDCl₃) δ 1.63-1.93 (3 H, m, CH₂CH₂CH₂, CHCHHCH₂), 2.21-2.28 (1 H, m, CHCHHCH₂), 2.50-2.65 (6 H, m, CH₂CH₂CO(N), CH₂CH₂CO, COCH₂CH), 3.48-3.52 (1 H, m, NCHHCH₂), 3.60-3.65 (1 H, m, NCHHCH₂), 3.91-3.97 (1 H, m, CH₂(N)CHCH₂); ¹³C NMR (100 MHz; CDCl₃) δ 23.5 (CH₂), 32.8 (CH₂), 34.7 (CH₂), 39.8 (CH₂), 47.4 (CH₂), 51.2 (CH₂), 54.7 (CH), 171.7 (CO), 207.9 (CO); *m/z* (EI) 167 (M⁺, 22%), 149 (15), 70 (100).

Crystal structure for 14

Empirical formula	C ₁₀ H ₁₂ Cl N O ₃	
Formula weight	229.66	
Temperature	173(2) K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P2(1)/c	
Unit cell dimensions	a = 11.6273(57) Å	α = 90°
	b = 9.6181(38) Å	β = 93.407(47)°
	c = 9.1912(38) Å	γ = 90°
Volume	1026.1(8) Å ³	
Z	4	
Density (calculated)	1.487 Mg/m ³	
Absorption coefficient	0.358 mm ⁻¹	
F(000)	480	
Crystal size	0.3 x 0.3 x 0.1 mm	
θ range for data collection	1.75 to 27.51°	
Index ranges	-15 ≤ h ≤ 15, -12 ≤ k ≤ 12, -11 ≤ l ≤ 11	
Reflections collected	10449	
Independent reflections	2352 [R _{int} = 0.0285]	
Completeness to θ = 27.51°	99.6 %	
Absorption correction	Semi-empirical from equivalents	

Max. and min. transmission	0.960 and 0.823
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	2352 / 0 / 141
Goodness-of-fit on F^2	$S = 1.070$
R indices [for 2044 reflections with $I > 2\sigma(I)$]	$R_1 = 0.0300$, $wR_2 = 0.0791$
R indices (for all 2352 data)	$R_1 = 0.0362$, $wR_2 = 0.0835$
Weighting scheme	$w^{-1} = \sigma^2(F_o^2) + (aP)^2 + (bP)$, where $P = [\max(F_o^2, 0) + 2F_c^2]/3$ $a = 0.0418$, $b = 0.3945$
Largest diff. peak and hole	0.320 and -0.209 $e\text{\AA}^{-3}$

Crystal structure for 17

Empirical formula	C ₁₂ H ₁₄ Cl N O ₃
Formula weight	255.69
Temperature	100(2) K
Wavelength	0.71073 Å
Crystal system	Monoclinic
Space group	P2(1)/n
Unit cell dimensions	$a = 9.2325(18)$ Å $\alpha = 90^\circ$ $b = 10.771(2)$ Å $\beta = 106.74(3)^\circ$ $c = 12.724(3)$ Å $\gamma = 90^\circ$
Volume	1211.7(4) Å ³

Z	4
Density (calculated)	1.402 Mg/m ³
Absorption coefficient	0.311 mm ⁻¹
F(000)	536
Crystal size	0.3 x 0.2 x 0.05 mm
θ range for data collection	2.43 to 27.48°
Index ranges	-11 ≤ h ≤ 11, -12 ≤ k ≤ 11, -5 ≤ l ≤ 16
Reflections collected	4499
Independent reflections	2556 [R _{int} = 0.0369]
Completeness to θ = 27.48°	92.0 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.000 and 0.808
Refinement method	Full-matrix least-squares on F ²
Data / restraints / parameters	2556 / 0 / 155
Goodness-of-fit on F ²	S = 1.078
R indices [for 2079 reflections with I > 2σ(I)]	R ₁ = 0.0546, wR ₂ = 0.1182
R indices (for all 2556 data)	R ₁ = 0.0721, wR ₂ = 0.1253
Weighting scheme	w ⁻¹ = σ ² (F _o ²) + (aP) ² + (bP), where P = [max(F _o ² , 0) + 2F _c ²]/3 a = 0.0455, b = 0.981
Largest diff. peak and hole	0.362 and -0.335 eÅ ⁻³

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