New Polycyclic β-Lactams. Synthesis of 2a,3-Dihydroazeto[1,2-*a*]-quinoline-1,4(2*H*)-diones, Structural Analogues of the Carbacephalosporin Antibiotics

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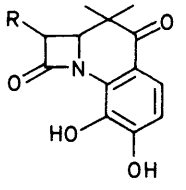
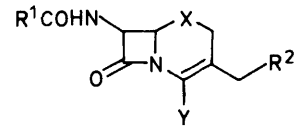
A method has been developed for the preparation of dihydroxydihydroazeto[1,2-*a*]quinoline-1,4(2*H*)-diones (1). The synthesis involved, as a key step, the completion of the polycyclic β-lactam system by a modified Bischler–Napieralski reaction. It was illustrated by the synthesis of (±)-7,8-dihydroxy-3,3-dimethyl-2-phenoxyacetamido-2a,3-dihydroazeto[1,2-*a*]quinoline-1,4(2*H*)-dione (20), which is structurally related to the carbacephalosporin antibiotics.

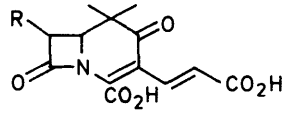
During the last decade, several new classes of antibacterial β-lactams which do not derive from the classical penicillin or cephalosporin antibiotics have been described.[1] We now report the synthesis of a new class of fused polycyclic β-lactams represented by formula (1). Taking cephalosporin (2) as a parent compound, two major changes have been introduced to give structure (1). The sulphur atom of cephalosporin has been formally substituted by a carbon unit, as in the carbacephalosporins (3),[2] and the carboxylic group has been replaced by a different acidic functionality in an analogous position to that of the tetrazolyl group in the 4-(tetrazol-5-yl)-cephems (4) and their related 3-(tetrazol-5-yl)penams.[1c] It was questioned whether, similarly to the carbacephalosporins and to the forementioned tetrazolyl derivatives, some compounds of type (1) may exhibit antibacterial activity. It was also reasoned that dihydroxyazeto[1,2-*a*]quinoline-1,4(2*H*)-diones (1) may function as precursors of potential antibiotics of structure (5), either through the chemical[3] or enzymatic[4] oxidative cleavage of their dihydric phenol system. Recently, a polycyclic β-lactam bearing, similarly to compounds (1), a phenolic 8-hydroxy group was synthesized and reported to exhibit a weak antibacterial activity.[5]



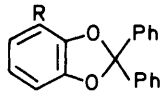
(1)



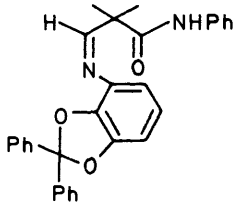
(2) X = S, Y = CO_2H
(3) X = CH_2, Y = CO_2H
(4) X = S, Y = tetrazol-5-yl



(5)



(6) R = CO_2Me
(7) R = CO_2H
(8) R = CON_3
(9) R = NH_2



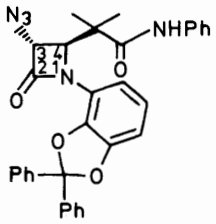
(11)

$OCHC(Me)_2CONHPh$
(10)

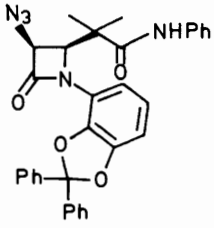
Our synthetic strategy was based, in the first stage, on the construction of an appropriately substituted non-fused β-lactam such as (12) on the nitrogen atom of 2,3-dihydroxyaniline, followed in the second stage by the completion of the fused polycyclic molecular backbone through a modified Bischler–Napieralsky reaction. The protected dihydroxyaniline (9) was prepared by the Curtius reaction of the corresponding acid (7), which was obtained by treatment of methyl 2,3-hydroxybenzoate with dichlorodiphenylmethane at 180 °C,[6] followed by selective deprotection of the resulting acetal ester (6) with LiI in 2,6-lutidine.[7] Treatment of the acid (7) with triethylamine and ethyl chloroformate, followed by tetramethylguanidinium azide and subsequent degradation of the resulting acyl azide (8), afforded the amine (9) (90%).

Treatment of the imine (11) resulting from the condensation of the amine (9) and the aldehyde (10),[8] with triethylamine followed by azidoacetyl chloride, afforded the *trans*-azido-β-lactam (12) (27%). When compound (11) was added at −78 °C to a preformed mixture of azidoacetyl chloride and triethylamine, both the *trans*-β-lactam (12) (8.5%) and its *cis* isomer (13) (4%) were obtained. Annelation of the *trans*-β-lactam (12) into the polycyclic fused β-lactam (14), was performed in chloroform by addition of 2,6-lutidine and PCl_5, followed by $SnCl_4$, and eventually by aqueous work-up. This transformation evidently involves the initial formation of the imidoyl chloride A which, with the Lewis acid, generates the highly electrophilic nitrilium ion B, which in turn reacts with an aromatic carbon to give the cyclized compound C as in the Bischler–Napieralski reaction.[9] Hydrolysis of the exocyclic imine C with 3M-hydrochloric acid in dioxane afforded the fused β-lactam (14). When the annelation was performed under the conditions described in the Experimental section, compound (14) was obtained in 70% yield. However, an increase in the ratio of lutidine to $SnCl_4$ resulted in a lower yield owing to the neutralization of the Lewis acid catalyst, while a decrease in this ratio brought about a premature acid-catalyzed deprotection of the hydroxy groups. The *cis*-β-lactam (13) could not be annelated under similar conditions, probably owing to excessive steric compression between the β-azido group and one of the methyl groups. Deprotection of the lactam (14) with trifluoroacetic acid required the addition of a drop of water to give the dihydric phenol (18) and benzophenone.

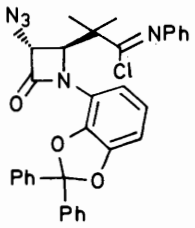
Conversion of the azide function into an acylamino group was performed by a method recently developed in this laboratory which avoids the intermediacy of a free amino group.[10] Thus, the azide (14) was converted into the corresponding iminophosphorane (15). Treatment of crude compound (15) with phenoxyacetyl chloride, followed by aqueous work-up, gave the acylamino-β-lactam (16) (80%). Deprotection of the lactam (16) with trifluoroacetic acid, as described



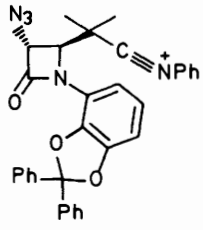
(12)



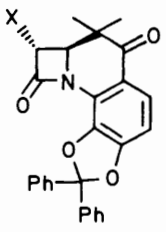
(13)



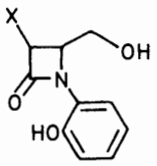
A



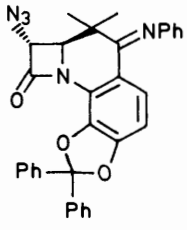
B



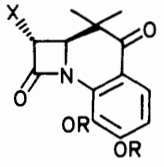
(14) X = N_3
(15) X = $Ph_3P{=}N$
(16) X = $PhOCH_2CONH$
(17) X = p -$NO_2{\cdot}C_6H_4{\cdot}CH{=}N$



(22) X = $PhCH_2CONH$



C



(18) R = H, X = N_3
(19) R = Me, X = N_3
(20) R = H, X = $PhOCH_2CONH$
(21) R = Me, X = $PhOCH_2CONH$

for compound (14), afforded (±)-7,8-dihydroxy-3,3-dimethyl-2-phenoxyacetamido-2a,3-dihydroazeto[1,2-*a*]quinoline-1,4-(2*H*)-dione (20) (quantitative). Compound (20) showed no antibacterial activity *in vitro* at a concentration of 90 μg/ml against *Staph. aureus* strain H and *E. coli* 7343. Since the known bicyclic β-lactam antibiotics bearing an acylamino side chain have the *cis*-geometry across the azetidinone ring, it was interesting to test the biological activity of the *cis* isomer of (20) as well. However, attempts to prepare this compound from (14) and (15) through the epimerization [10,11] of their *p*-nitrobenzylidene derivative (17) were unsuccessful.

The β-lactam carbonyl group exhibits in the i.r. spectrum of compound (18) an absorption band at 1 725 cm^{-1}, and in the spectrum of (20) a peak at 1 730 cm^{-1}. These remarkably low frequencies are attributed to hydrogen bonding with the 8-OH group. Indeed, the β-lactam carbonyls of the dimethyl ethers (19) and (21), obtained respectively from (18) and (20) with diazomethane, absorb at 1 770 cm^{-1}. This frequency is within the expected range for the carbonyl group of fused β-lactams.[12] A low frequency of 1 720 cm^{-1} has been recently reported for the carbonyl absorption band of the *N*-hydroxyphenyl-β-lactam (22).[5]

Experimental

I.r. spectra were recorded with a Perkin-Elmer 237 spectrophotometer. When not otherwise specified, the ^1H n.m.r. data were determined on a 90 MHz Bruker RF-HFX-10 spectrometer. The 80 MHz spectra were recorded on a Varian FT-80A instrument. Mass spectra were recorded on a Varian MAT-731 (double focusing) spectrometer. Ether refers to diethyl ether.

Methyl 2,3-*Diphenylmethylenedioxybenzoate* (6).—Methyl 2,3-dihydroxybenzoate (24 g, 0.14 mol) was heated under a stream of argon to 180 °C and Ph_2CCl_2 (99.5 g, 0.42 mol) was added with vigorous stirring. When all the starting material had reacted (t.l.c.), the reaction mixture was brought to room temperature and methanol (50 ml) was added followed, dropwise by an excess of 10% aqueous $NaHCO_3$. The reaction mixture was stirred for 16 h and the precipitate was collected. The crude product was recrystallized from methanol to give a first crop of pure compound (6) and a methanolic solution of (6) and benzophenone. The latter was removed at 140 °C/0.5 mmHg and the residue was recrystallized from methanol to give a second crop of the *ester* (6) (total 40 g, 84%), m.p. 92—94 °C (Found: C, 75.9; H, 4.8. $C_{21}H_{16}O_4$ requires C, 75.9; H, 4.85%).

2,3-*Diphenylmethylenedioxybenzoic Acid* (7).—A mixture of the ester (6) (21.6 g, 0.065 mol), dry LiI (33.5 g, 0.25 mol) and dry 2,6-lutidine (1 l) was boiled under reflux for 3 h. Most of the lutidine was evaporated, the residue was diluted with water, acidified with conc. hydrochloric acid and extracted with EtOAc. The residue obtained after drying and evaporation of the solvent was recrystallized from $CHCl_3$–hexane to give the *acid* (7) (17 g), m.p. 188—190 °C [an additional 2.7 g of (7) were obtained on chromatography of the mother-liquor from the recrystallization] (Found: C, 75.3; H, 4.55. $C_{20}H_{14}O_4$ requires C, 75.5; H, 4.4%).

2,3-*Diphenylmethylenedioxyaniline* (9).—To a stirred mixture of the acid (7) (10 g, 0.031 mol) and triethylamine (3.44 g, 0.034 mol) in dry tetrahydrofuran (THF) (400 ml) at 0 °C was added ethyl chloroformate (3.2 g, 0.034 mol) and stirring was continued for 1 h. A solution of tetramethylguanidinium azide (7 g, 0.034 mol) in dry chloroform (100 ml) was added to the reaction mixture and stirring at 0 °C was continued for an additional 2.5 h. The precipitate was filtered off and the filtrate was evaporated. The residue was dissolved in CH_2Cl_2, washed with dilute hydrochloric acid and with water, dried and evaporated. The residue, which consisted of the azide (8), was dried in a vacuum desiccator over P_2O_5 for 16 h. The dried compound was dissolved in dry benzene (200 ml) and boiled under reflux until no 2 100 cm^{-1} absorption band could be detected in the i.r. spectrum (*ca.* 90 min). Benzene was

evaporated and the residue was dissolved in dioxane (100 ml). To this a 2.5M-NaOH solution (200 ml) was added with stirring, followed, dropwise, by 6M-hydrochloric acid, until pH 8 was reached. Most of the solvent was removed under reduced pressure and the residue was extracted with CH_2Cl_2, dried and evaporated. The residue was taken up with ether, and filtered. A saturated solution of oxalic acid in ether was added until precipitation was complete. The precipitated salt was filtered, suspended in EtOAc and treated with a 3M-NaOH solution until all the solid dissolved. The layers were separated and the aqueous phase extracted with EtOAc (× 3). The combined organic fractions were washed with water, dried and evaporated to give the *amine* (9) (8.2 g, 90%), m.p. 117—119 °C (MeOH) (Found: C, 78.75; H, 5.3; N, 4.9. $C_{19}H_{15}O_2N$ requires C, 78.9; H, 5.2; N, 4.8%).

β-*Lactams* (12) *and* (13).—(*a*) A mixture of the amine (9) (656 mg, 2.27 mmol), the aldehyde (10) [8] (440 mg, 2.3 mmol), and anhydrous magnesium sulphate (600 mg) in dry ether (20 ml) was stirred for 20 h and then filtered and evaporated. The residue was dissolved in dry benzene (70 ml), boiled in a Dean–Stark separator for 1 h, and then cooled to room temperature. Triethylamine (0.46 g, 4.6 mmol) was added to the reaction mixture which contained the imine (11). This was followed by the dropwise addition (1 h) of azidoacetyl chloride (0.56 g, 4.67 mmol) in benzene (25 ml). The reaction mixture was stirred for an additional 1 h and then a second portion of triethylamine (0.46 g, 4.6 mmol) was added, followed (1 h) by more azidoacetyl chloride (0.56 g) in portions in benzene (25 ml). The reaction mixture was stirred for 1 h, more triethylamine (0.80 g, 7.9 mmol) was added and stirring was continued for 16 h, when an additional portion of azidoacetyl chloride (0.28 g, 2.33 mmol) was added, followed after 30 min by more triethylamine (0.36 g, 3.6 mmol). The reaction mixture was stirred for 20 h and then filtered through Celite, evaporated, and chromatographed on a silica-gel column (CH_2Cl_2). The β-lactam-containing fractions were combined and chromatographed again on a Florisil column using CH_2Cl_2–hexane as eluant to give trans-3-*azido*-1-(3,4-*diphenylmethylenedioxyphenyl*)-4-(1-*methyl*-1-*phenylcarbamoylethyl*)-*azetidin*-2-*one* (12) (340 mg, 27%); $\nu_{max.}$ ($CHCl_3$) 2 100, 1 765, and 1 670 cm^{-1}; δ ($CDCl_3$) 1.2 (3 H, s, CMe), 1.23 (3 H, s, CMe), 4.38 (1 H, d, *J* 2 Hz, 4-H), 4.78 (1 H, d, *J* 2 Hz, 3-H), 6.74 (s), and 6.9—7.6 (m, ArH and NH) (Found: M^+ 545.2069. $C_{32}H_{27}N_5O_4$ requires M^+ 545.2063); *m/e* 545 (M^+), 489 ($M^+ - CO - N_2$).

(*b*) A mixture of the amine (9) (2.5 g, 8.64 mmol), the aldehyde (10) (1.72 g, 9 mmol), and anhydrous $MgSO_4$ (2.5 g) in dry CH_2Cl_2 (50 ml) was stirred for 20 h. The $MgSO_4$ was filtered off and the filtrate was concentrated to 20 ml. This solution, which contained the imine (11), was added at −78 °C, during 2 h, to a reaction mixture prepared beforehand by the addition (30 min) in portions of a solution of azidoacetyl chloride (1.71 g, 14.34 mmol) in dry CH_2Cl_2 (10 ml) to a stirred solution of triethylamine (1.45 g, 14.34 mmol) in CH_2Cl_2 (25 ml) at −78 °C. The reaction mixture was allowed to reach ambient temperature, and after 20 h it was washed with water, dried and evaporated. The residue was chromatographed on a silica-gel column (CH_2Cl_2–hexane) and the fractions containing the β-lactams (12) and (13) along with some aldehyde (10) were dissolved in CH_2Cl_2 and stirred with 40% aqueous $NaHSO_3$ for 3 h. The residue obtained after filtration and evaporation of the organic layer was chromatographed on silica-gel plates (EtOAc–CCl_4) to give the *trans*-β-lactam (12) (0.4 g, 8.5%) and its cis-*isomer* (13) (0.2 g, 4%); $\nu_{max.}$ ($CHCl_3$) 2 100, 1 770, and 1 670 cm^{-1}; δ ($CDCl_3$) 1.09 (3 H, s, CMe), 1.37 (3 H, s, CMe), 5.04 (1 H, d, *J* 5.5 Hz, 4-H), 5.12 (1 H, d, *J* 5.5 Hz, 3-H) and 6.77—7.58 (m, ArH) (Found: M^+ 545.2069. $C_{32}H_{27}N_5O_4$ requires M^+ 545.2063); *m/e* 545 (M^+), 517 ($M^+ - CO$), and 489 ($M^+ - CO - N_2$) (Found: C, 70.2; H, 4.9; N, 13.3. $C_{32}H_{27}N_5O_4$ requires C, 70.4; H, 5.0; N, 12.8%).

(±)-2-*Azido*-7,8-*diphenylmethylenedioxy*-3,3-*dimethyl*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (14).—A mixture of the β-lactam (12) (200 mg, 0.37 mmol), 2,6-lutidine (0.5 ml, 4.33 mmol), and PCl_5 (80 mg, 0.38 mmol) in dry chloroform (10 ml) was stirred for 2 h at 20 °C and then boiled under reflux for 30 min. The reaction mixture was brought to room temperature and $SnCl_4$ (211 mg, 0.81 mmol) was added. After being stirred for 16 h, a second portion of $SnCl_4$ (211 mg) was added, followed after 2 h by a third portion of $SnCl_4$ (90 mg, 0.35 mmol). The reaction mixture was stirred for an additional 1 h and then poured into a mixture of EtOAc and a pH 7 phosphate buffer. After filtration through Celite the organic layer was washed with water, dried, and evaporated. The residue was dissolved in dioxane (10 ml) and 3M-hydrochloric acid (3 ml) was added. After 1 h the solution was diluted with water and extracted with EtOAc. The organic phase was dried, evaporated and the residue was chromatographed on a silica-gel column (EtOAc–light petroleum) to give the *fused* β-*lactam* (14) (117 mg, 70%); $\nu_{max.}$ ($CHCl_3$) 2 100, 1 775, and 1 680 cm^{-1}; δ ($CDCl_3$) 1.11 (3 H, s, CMe), 1.30 (3 H, s, CMe), 3.81 (1 H, d, *J* 2.5 Hz, 2a-H), 4.29 (1 H, d, *J* 2.5 Hz, 2-H), 6.75 (1 H, d, *J* 8 Hz, 6-H), and 7.24—7.83 (11 H, m, 2 Ph and 5-H); *m/e* 452 (M^+), 424 ($M^+ - H_2$ and/or $M^+ - CO$), and 396 ($M^+ - H_2 - CO$).

(±)-2-*Azido*-7,8-*dihydroxy*-3,3-*dimethyl*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (18) *and* (±)-2-*Azido*-7,8-*dimethoxy*-3,3-*dimethyl*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (19).—A solution of compound (14) (50 mg, 0.11 mmol) in F_3CCO_2H (1 ml) containing 1 drop of water was kept for 1 h at room temperature. The residue obtained after the evaporation of F_3CCO_2H was triturated with light petroleum to give the *dihydric phenol* (18) (25 mg, 78%); $\nu_{max.}$ (KBr) 2 100, 1 725, and 1 670 cm^{-1}; δ [$(CD_3)_2CO$] 1.18 (3 H, s, CMe), 1.32 (3 H, s, CMe), 4.19 (1 H, d, *J* 2.5 Hz, 2a-H), 5.53 (1 H, d, *J* 2.5 Hz, 2-H), 6.78 (1 H, d, *J* 8.5 Hz, 6-H), 7.38 (1 H, d, *J* 8.5 Hz, 5-H) (Found: M^+ 288.0862. $C_{13}H_{12}N_4O_4$ requires M^+ 288.0818); *m/e* 288 (M^+), 260 ($M^+ - N_2$), 205 ($M^+ - N_3CHCO$), and 178 ($M^+ - N_3CHCHCMe_2$).

To a solution of the dihydroxy compound (18) in EtOAc was added an excess of diazomethane in ether. Evaporation of the organic solvents afforded the *dimethyl ether* (19) (quantitative), $\nu_{max.}$ ($CHCl_3$) 2 100, 1 770, and 1 680 cm^{-1}; δ (80 MHz, $CDCl_3$), 1.12 (3 H, s, CMe), 1.30 (3 H, s, CMe), 3.78 (1 H, d, *J* 2 Hz, 2a-H), 3.94 (3 H, s, OMe), 3.97 (3 H, s, OMe), 4.70 (1 H, d, *J* 2 Hz, 2-H), 6.79 (1 H, d, *J* 8.8 Hz, 6-H), and 7.74 (1 H, d, *J* 8.8 Hz, 5-H) (Found: M^+ 316.1110. $C_{15}H_{16}N_4O_4$ requires M^+ 316.1171); *m/e* 316 (M^+), 288 ($M^+ - N_2$), and 206 ($M^+ - N_3CHCHCMe_2$).

(±)-7,8-*Diphenylmethylenedioxy*-3,3-*dimethyl*-2-*phenoxyacetamido*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (16).—(*a*) To a solution of the azide (14) (50 mg, 0.11 mmol) in dry CH_2Cl_2 (10 ml) was added triphenylphosphine (100 mg, 0.38 mmol). After being stirred for 1 h under argon, the solvent was evaporated and the residue was triturated with light petroleum to give quantitatively the phosphinimine (15), amorphous solid; $\nu_{max.}$ ($CHCl_3$) 1 760, 1 680 cm^{-1}; δ (80 MHz, $CDCl_3$) 0.77 (3 H, s, CMe), 0.88 (3 H, s, CMe), 3.86 (1 H apparent br s, 2a-H), 5.56 (1 H, dd, *J* 2.5, 28 Hz, 2-H), 6.63 (1 H, d, *J* 8.5 Hz, 6-H), 6.58—7.91 (26 H, m, 5 Ph and 5-H).

To a stirred solution of (15) (50 mg, 0.073 mmol) in dry CH_2Cl_2 (2 ml), at 0 °C under argon, was added a solution of phenoxyacetyl chloride (12.4 mg, 0.073 mmol) in CH_2Cl_2 (2 ml) during 15 min. After 50 min at 0 °C and an additional 1 h at 25 °C, the reaction mixture was cooled again to 0 °C and a solution of 4% aqueous $KHCO_3$ (3 ml) was added. Stirring was continued for an additional 5 min, the organic phase was then washed with water, dried, and evaporated. Chromatography of the residue on a silica-gel plate afforded the *amide* (16) (30 mg, 73%).

(*b*) The azide (14) (35 mg, 0.074 mmol) and triphenylphosphine (30 mg, 0.11 mmol) in dry chloroform (40 ml) were stirred for 3 h. The reaction mixture was cooled to 0 °C and phenoxyacetyl chloride (62.7 mg, 0.37 mmol) was added. After being stirred for 1 h at 0 °C and 90 min at 25 °C, the mixture was cooled again to 0 °C and a solution of 4% aqueous $KHCO_3$ (3 ml) was added. The mixture was stirred for 5 min at 0 °C and 15 min at 25 °C to give, after work-up as in (*a*), the *title compound* (16) (35 mg, 80%, two steps); $\nu_{max.}$ ($CHCl_3$) 1 774, 1 685 cm^{-1}; δ ($CDCl_3$) 1.19 (3 H, s, CMe), 1.31 (3 H, s, CMe), 3.81 (1 H, d, *J* 2.5 Hz, 2a-H), 4.56 (2 H, s, PhCH_2CO), 5.38 (1 H, dd, *J* 2.5, 8.5 Hz, 2-H), and 6.69—7.83 (18 H, m, 3 Ph, 5-, 6-H, and NH) (Found: M^+ 560.1960. $C_{34}H_{28}N_2O_6$ requires M^+ 560.1947); *m/e*, 560 (M^+), 425 (M^+ − $PhOCH_2CO$), 370 (M^+ − $PhOCH_2CONH{-}C{=}CO$), 342 (M^+ − $PhOCH_2CONHCHCHCMe_2$), and 218 ($PhOCH_2$-$CONHCHCHCMe_2$).

(±)-7,8-*Dihydroxy*-3,3-*dimethyl*-2-*phenoxyacetamido*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (20).—A solution of (16) (65 mg, 0.12 mmol) in F_3CCO_2H (3 ml), containing one drop of water, was kept for 20 min at 0 °C. The residue, obtained after the removal of F_3CCO_2H under reduced pressure, was chromatographed on silica gel (toluene–ethyl acetate) to give benzophenone and the *title compound* (20) (45 mg, quantitative), amorphous solid (after trituration with light petroleum); $\nu_{max.}$ (KBr) 1 730, 1 700—1 650 cm^{-1}; δ [$(CD_3)_2CO$–D_2O] 1.17 (s, CH_3), 1.22 (3 H, s, CMe), 4.27 (1 H, d, *J* 2.5 Hz, 2a-H), 4.63 (2 H, s, PhCH_2CO), 5.41 (1 H, d, *J* 2.5 Hz, 2-H), and 7.42—6.71 (m, Ph, 5- and 6-H) (Found: M^+ 396.1284. $C_{21}H_{20}N_2O_6$ requires M^+ 396.1321); *m/e* 396 (M^+), 302 (M^+ PhOH), 261 (M^+ − $PhOCH_2CO$), 218 ($PhOCH_2CONHCHCHCMe_2$), and 205 (M^+ − $PhOCH_2$-$CONHCHCO$).

To a solution of the dihydroxy compound (20) in EtOAc was added an excess of diazomethane in ether. Evaporation of the solvents afforded 7,8-*dimethoxy*-3,3-*dimethyl*-2-*phenoxyacetamido*-2a,3-*dihydroazeto*[1,2-a]*quinoline*-1,4(2H)-*dione* (21); $\nu_{max.}$ ($CHCl_3$) 1 770, 1 690—1 670 cm^{-1}; δ (80 MHz, $CDCl_3$), 1.21 (3 H, s, CMe), 1.32 (3 H, s, CMe), 3.83 (1 H, d, *J* 2.5 Hz, 2a-H), 3.94 (3 H, s, OMe), 4.00 (3 H, s, OMe), 4.56 (2 H, s, PhOCH_2CO), 5.28 (1 H, dd, *J* 2.5, 8 Hz, 2-H), and 6.99—7.68 (m, ArH) (Found: M^+ 424.1623. $C_{23}H_{24}N_2O_6$ requires M^+ 424.1634); *m/e* 424 (M^+), 234 (M^+ − $PhOCH_2$-$CONH{-}C{=}C{=}O$), and 206 (M^+ − $PhOCH_2CONHCH$-$CHCMe_2$).

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