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The 6-(2-nitrostyryl)-2*H*-pyran-2-ones **1** were reduced with hydrogen over Pd/C at room temperature and atmospheric pressure giving the 2-benzoylamino-4-(1,2,3,4-tetrahydro-2-quinolinylidene-2-pentenedioic acid derivatives **2** which were converted, without isolation, into the 5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-ones **4** in refluxing acetic anhydride. When α -aminoacids **2** were treated with acetic anhydride at room temperature oxazolones **3** were isolated, while by heating quinolizines **4** were found. Compounds **3** were transformed into **4** in refluxing acetic acid or anhydride.

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α -Pyranones are useful and valuable reactive synthetic intermediates for the preparation of heterocyclic compounds. As a result of our continuing research in this particular field, [1,2] we report in this paper a new and straightforward synthesis of substituted 5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-ones.

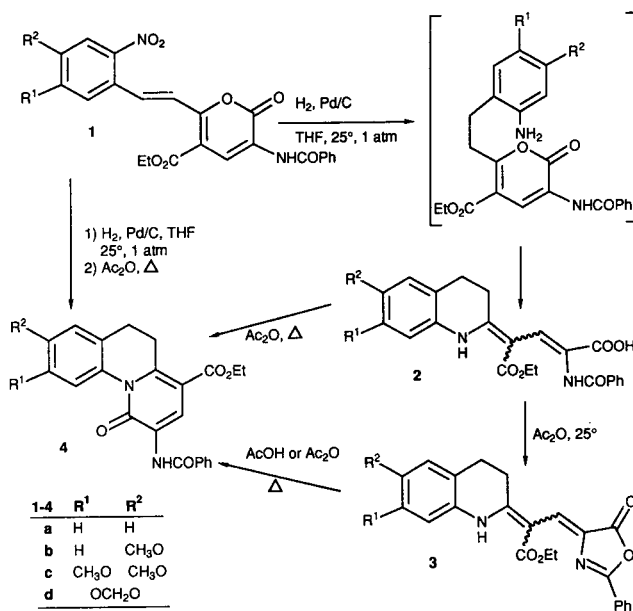
Several synthetic entries to the benzo[*c*]quinolizin-1-one ring have been reported in the literature, which share the common feature to start from 2-substituted quinolines [3-6]. All these reported methods are unsuitable for the preparation of 5,6-dihydro compounds and, to the best of our knowledge, 5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-ones are unknown until now.

Ethyl 2-benzoylamino-5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-one-4-carboxylates **4** were obtained by an one-pot reaction starting from 6-(2-nitrostyryl)-2*H*-pyran-2-ones **1** which were easily prepared by a published method [1]. Compounds **1** were reduced with hydrogen and palladium on charcoal as the catalyst in tetrahydrofuran at room temperature and under atmospheric pressure giving the tetrahydroquinolines **2**. These products were transformed, without isolation, into **4**, after filtering of the catalyst and evaporation of the solvent and on heating the crude mixture with an excess of acetic anhydride. Compounds **4** were obtained directly as a precipitate or were isolated by usual techniques. Their structure was confirmed by ir (3490-3400 cm^{-1} , NH, 1700, 1670, 1640 cm^{-1} , COOEt, CON, CONH, respectively, and ^1H nmr which shows as typical signals two multiplets (2H each) at about 2.7 and 3.4 δ associated with the hydrogens of the $-\text{CH}_2\text{CH}_2-$ bridge, a signal in the region around 7.8-8.1 δ associated with H(10), a singlet at $\delta = 9.0$ (H(3)), and an exchangeable signal at about 9.2 δ corresponding to NH.

The steps through which the starting compounds **1** were converted into the final products **4** are represented in the Scheme. The hydrogenation of **1** results in the formation of the tetrahydroquinoline derivatives **2**. This reaction, which has been already described [1], occurs through saturation of the styryl double bond and reduction of the nitro

group. The unstable amine thus produced gives **2** by conjugate addition of the amino group to the pyranone moiety followed by ring opening. Compounds **2** were easily isolated and were converted in good yield into the corresponding 4-alkylidene-oxazol-5(4*H*)-ones **3** by reaction with acetic anhydride at room temperature. They were characterized by the typical ir absorption of the CO group (1780-1750 cm^{-1}) and by the expected signals (Table) in the ^1H nmr spectrum.

Scheme



Refluxing of oxazolones **3** in acetic acid or anhydride resulted in the formation of the quinolizine compounds **4**. This latter reaction is one more example of an intramolecular nucleophilic addition to the carbonyl group of the oxazolone ring, which appears of great usefulness for the development of synthetic strategies to nitrogen-containing heterocycles [7]. Expectedly, the direct transformation of compounds **2** into **4**, occurs by refluxing in acetic anhydride.

Table
Physical, Analytical and Spectroscopic Data for Compounds **3** and **4**

No	Mp (°C)	Formula (MW)	IR (Nujol; cm ⁻¹)		NH	¹ H NMR (δ) (deuteriochloroform), J (Hz)					Analysis		
			NH	CO		arom	OCH ₂	CH ₂ -CH ₂	CH ₃	other	Calcd./Found		
											C%	H%	N%
3a	160-161	C ₂₃ H ₂₀ N ₂ O ₄ (388)	—	1760	[a] 12.1	8.1-6.9	4.3	3.5-2.7	1.2	—	71.12 71.28	5.19 5.39	7.21 7.21
3b	140-141	C ₂₄ H ₂₂ N ₂ O ₅ (418)	3680	1760	[a] 12.1	8.1-6.7	4.3	3.5-2.7	1.3	3.8 (OCH ₃)	68.89 68.64	5.30 5.30	6.69 6.94
3c	172-173	C ₂₅ H ₂₄ N ₂ O ₆ (448)	—	1750	[a] 12.1	8.116.5	4.3	3.5-2.7	1.4	3.9 (OCH ₃)	66.95 66.94	5.37 5.29	6.25 6.24
3d	183-185	C ₂₄ H ₂₀ N ₂ O ₆ (432)	—	1780	[a] 12.1	8.1-6.5	4.3	3.5-2.7	1.3	6.0 (OCH ₂ O)	66.65 66.40	4.66 4.56	6.48 6.53
4a	155-158	C ₂₃ H ₂₀ N ₂ O ₄ (388)	3490	1700, 1670 1640	9.2	8.0-7.2	4.3	3.5-3.4 2.8-2.7	1.4	9.0 (H-3), 8.1 (d, 1H, J = 7.6, H-10)	71.12 71.37	5.19 5.08	7.21 7.39
4b	162-164	C ₂₄ H ₂₂ N ₂ O ₅ (418)	3400	1700, 1670 1640	9.2	8.0-6.8	4.3	3.5-3.4 2.8-2.7	1.4	9.0 (H-3), 8.1 (d, 1H, J = 9.0, H-10), 3.8 (OCH ₃)	68.89 68.54	5.30 5.45	6.69 6.97
4c	195-196	C ₂₅ H ₂₄ N ₂ O ₆ (448)	3400	1700, 1670 1640	9.2	8.0-6.7	4.4	3.5-3.4 2.7-2.6	1.4	9.0 (H-3), 7.8 (s, 1H, H-10), 3.9 (OCH ₃)	66.95 66.70	5.37 5.41	6.25 6.35
4d	217-218	C ₂₄ H ₂₀ N ₂ O ₆ (432)	3400	1700, 1670 1640	9.2	8.0-6.7	4.4	3.5-3.4 2.7-2.6	1.4	9.0 (H-3), 7.8 (s, 1H, H-10), 6.0 (OCH ₂ O)	66.65 66.64	4.66 4.77	6.48 6.66

[a] The signal of the CH= proton is overlapped with aromatic protons.

In conclusion, a practical synthesis of 5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-ones has been described, which can be performed advantageously as an one-pot reaction without the need to isolate the stable intermediates **2** and **3**. In this way better yields can be obtained, mainly because substantial losses are associated with the purification of compounds **2** and **3**.

EXPERIMENTAL

Melting points were detected with Büchi 510 (capillary) apparatus. The ir spectra were recorded on a PYE UNICAM SP3-200S Philips spectrophotometer. The nmr experiments were performed on a Bruker AC 200 instrument with the solvent indicated. Column chromatography was performed with silica gel eluting with *n*-hexane/ethyl acetate (1:0 to 0:1, v/v).

6-(2-Nitrostyryl)-2*H*-pyran-2-ones **1a-d** and 2-benzoylamino-4-(1,2,3,4-tetrahydro-2-quinolinylidene)-2-pentenedioic acid derivatives **2a-d** are known compounds [1].

General Procedure for the Preparation of Ethyl 3-(4,5-Dihydro-5-oxo-2-phenyl-4-oxazolyidene)-2-(1,2,3,4-tetrahydro-2-quinolinylidene)-propionates **3**.

Compound **2** (1 mmole) was suspended in acetic anhydride (4 ml, 42.3 mmoles) and stirred under nitrogen at room temperature. After 30 minutes the solid had completely dissolved and the solution turned orange. The reaction was completed in about 1 hour after which the orange compound **3** separated directly from the mother liquor. The solid was filtered and washed with *iso*-propyl ether (20 ml) giving pure **3**. The mother liquor, after elimination of the solvent, was chromatographed: a further crop of pure compound **3** was isolated after recrystallization from methylene chloride/*iso*-propyl ether, total yields were: for **3a**, 73%; **3b**,

86%; **3c**, 73%; **3d**, 73%.

General Procedure for the Preparation of Ethyl 2-Benzoylamino-5,6-dihydro-1*H*-benzo[*c*]quinolizin-1-one-4-carboxylates **4**.

Method A.

Pyrone **1** (2.3 mmoles) was suspended in anhydrous THF (70 ml) and reduced at room temperature and atmospheric pressure with hydrogen over 10% Pd/C (400 mg, 0.35 mmole). The solution became red and then, when hydrogen uptake was completed (3-7 hours), turned yellow. The hydrogen atmosphere was eliminated *in vacuo* and stirring continued for 2 hours. The catalyst was filtered and washed with methylene chloride (40 ml). After solvent evaporation the crude mixture was taken up with acetic anhydride (10 ml). By heating the solution turned orange and, after 1 hour, yellow. The reaction mixture was cooled and the solid separated was filtered giving pure **4**. The mother liquor was evaporated and the crude mixture chromatographed yielding, after crystallization from 2-propanol, pure **4**, total yields were: for **4a**, 41%; **4b**, 53%; **4c**, 48%; **4d**, 51%.

Method B.

Compound **3** (1 mmole) was refluxed in acetic acid (5 ml) and after 4 hours the orange solution turned yellow. The solvent was evaporated and the crude mixture crystallized from hot 2-propanol giving pure **4**. In the case of **3a** (390 mg, 1 mmole) the reaction was carried out in refluxing acetic anhydride (3 ml). The orange solution turned yellow after 3 hours. By cooling pure **4a**, which crystallized directly from the reaction mixture, was filtered and washed with *iso*-propyl ether (30 ml). The mother liquor, after solvent elimination, was chromatographed giving a further crop of **4a**, total yields were: for **4a**, 75%; **4b**, 80%; **4c**, 76%; **4d**, 75%.

Method C.

The acid **2b** (436 mg, 1 mmole) was refluxed in acetic anhydride (5 ml) for 5 hours. By cooling a solid precipitated, which was filtered and washed with *iso*-propyl ether (20 ml) giving pure **4b**. A further crop of this compound was obtained after chromatography of the mother liquor evaporated to dryness and recrystallization from 2-propanol, total yield of **4b** was 54%.

REFERENCES AND NOTES

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