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REACTIONS OF 4-ETHOXYCARBONYLBENZO-[c]PYRYLIUM WITH AMMONIA AND PRIMARY AMINES

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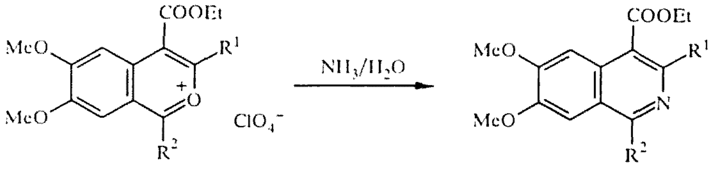
We have studied the reactions of 4-ethoxycarbonylbenzo[c]pyrylium perchlorates with ammonia and primary amines. We have obtained previously unknown derivatives of isoquinoline and 1-naphthylamine.

Earlier [1] we reported on the synthesis of benzo[c]pyrylium salts with functional substituents at the 4 position. This paper contains information about the reactions of 4-ethoxycarbonylbenzo[c]pyrylium salts with ammonia and primary amines.

Like other 1,3-dialkylbenzo[c]pyrylium salts, 1-alkyl-3-methyl-4-ethoxycarbonylbenzo[c]pyrylium perchlorates (Ia-c) are converted to the corresponding 4-ethoxycarbonylisoquinolines (IIa-c) in an aqueous alcohol solution of ammonia at room temperature.



I a–c

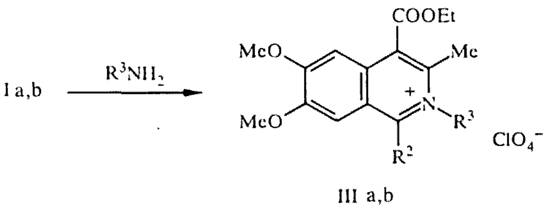
II a–c

I, II a-c R^1 – Me; d-f R^1 – Ph; a,d R^2 – Me; b,e R^2 – Et; c,f R^2 – Pr

The presence of an ester substituent in the heterocycle makes it possible under the same mild conditions to convert the perchlorides Id-f with a phenyl group in the 3 position to isoquinoline derivatives, while usually recyclization of 3-arylbenzo[c]pyrylium salts by ammonia is possible only at elevated temperatures and pressures [2, 3].

We observed a similar facile recyclization due to the presence of an acceptor substituent also in formation of 1-alkyl-3-phenyl-4-cyanoisoquinolines from the corresponding 4-cyanobenzo[c]pyrylium salts in [4].

The structure of the products of reaction of perchlorates Ia, b with primary amines depends both on the reaction conditions and on the amine used. For an equimolar ratio of reagents in alcohol at a temperature of 20-40°C, 2-R^3-4-ethoxycarbonylisoquinolium perchlorates IIIa, b are formed in high yields.



III a,b

III a R^2 – Me, R^3 – Bu; b R^2 – Et, R^3 – 4-$CH_3C_6H_4$

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TABLE 1. Characteristics of Compounds II-IV

Compound	Empirical formula	mp, °C	Yield, %
IIa	$C_{16}H_{19}NO_4$	128...130	79
IIb	$C_{17}H_{21}NO_4$	122...124	70
IIc	$C_{18}H_{23}NO_4$	117...119	78
IId	$C_{21}H_{21}NO_4$	157...159	85
IIe	$C_{22}H_{23}NO_4$	150...151	81
IIf	$C_{23}H_{25}NO_4$	145...147	82
IIIa	$C_{20}H_{28}ClNO_8$	119...121 (decomp.)	57
IIIb	$C_{24}H_{28}ClNO_8$	157...159 (decomp.)	90
IVa	$C_{20}H_{27}NO_4$	128...129	78
IVb	$C_{19}H_{25}NO_4$	132...133	73

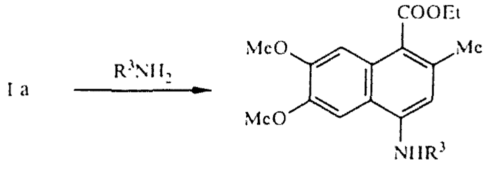
TABLE 2. Spectral Characteristics of Compounds II-IV

Compound	IR spectrum, ν, cm^{-1}	PMR spectrum, δ, ppm
IIa	1745 (CO_2Et), 1650 (—C=N—)	1,37 (3H, t, CH_3), 2.73 (3H, s, CH_3), 3,10 (3H, s, CH_3), 3,94 (3H, s, OCH_3), 4,01 (3H, C, OCH_3), 4,41 (2H, q, CH_2), 7,52 (1H, s, H arom.), 7,65 (1H, s, H arom.)
IIb	1740, 1640	1,30 (3H, t, CH_3), 1.35 (3H, t, CH_3), 2.70 (3H, s, CH_3), 3.52 (2H, q, CH_2), 3.97 (3H, s, OCH_3), 4.07 (3H, s, OCH_3), 4.49 (2H, q, CH_2), 7.70 (2H, s, H arom.)
IIc	1750, 1650	0,94 (3H, t, CH_3), 1.35 (3H, t, CH_3), 1,87 (2H, m, CH_2), 2.79 (3H, s, CH_3), 3.50 (2H, t, CH_2), 4.05 (3H, s, OCH_3), 4,15 (3H, s, OCH_3), 4,62 (2H, q, CH_2), 7,62 (1H, s, H arom.), 7,70 (1H, c, H arom.)
IId	1760, 1745	1,09 (3H, t, CH), 3.32 (3H, s, CH), 4,15 (3H, s, OCH), 4.22 (3H, s, OCH), 4.56 (2H, q, CH), 7.74...7,87 (7H, m, H arom.)
IIe	1755, 1650	1,11 (3H, t, CH_3), 1.65 (3H, t, CH_3), 3.75 (2H, q, CH_2), 4.18 (3H, s, OCH_3), 4.22 (3H, s, OCH_3), 4,48 (2H, q, CH_2), 7,70...7,84 (7H, m, H arom.)
IIf	1755, 1650	1,06 (3H, t, CH_3), 1,92...2,44 (2H, m, CH_2), 3,67 (2H, t, CH_2), 4.10 (3H, s, OCH_3), 4,22 (3H, s, OCH_3), 4,58 (2H, q, CH_2), 7,67...7,85 (7H, m, H arom.)
IIIa	1745, 1620, 1100	0,97...2,0 (10H, m, CH_2, CH_3), 3,03 (3H, s, CH_3), 3,40 (3H, s, CH_3), 4,17 (6H, s, 2 OCH_3), 4,30 (2H, t, CH_2), 4,93 (2H, q, CH_2), 7,40 (1H, s, H arom.), 7,80 (1H, c, H arom.)
IIIb	1740, 1620, 1100	1.30 (3H, t, CH_3), 1,60 (3H, t, CH_3), 2,47 (3H, s, CH_3), 2,63 (3H, s, CH_3), 3,42 (2H, q, CH_2), 4,33 (6H, s, 2 OCH_3), 4,93 (2H, q, CH_2), 7,50...7,63 (3H, m, H arom.), 7,82 (1H, s, H arom.), 8,00 (2H, d, H arom.)
IVa	3420, 1700	0,97 (3H, t, CH_3), 1,32...2,07 (7H, m, CH_3, CH_2), 2,63 (3H, s, CH_3), 3,83 (2H, t, CH_2), 4,23 (3H, s, OCH_3), 4,27 (3H, s, OCH_3), 4,87 (2H, q, CH_3), 7,53 (1H, s, H arom.), 7,60 (1H, s, H arom.), 7,73 (1H, s, H arom.)
IVb	3420, 1700	1,50...1,70 (9H, m, 3 CH_3), 2,67 (3H, s, CH_3), 3,83 (1H, m, CH), 4,09 (6H, s, 2 OCH_3), 4,90 (2H, q, CH_2), 7,56 (2H, s, H arom.), 7,73 (1H, s, H arom.)

We studied recyclization of the salts Ia, b with an excess of primary amine under identical conditions, boiling the pyrylium salt with a five-fold excess of ammonia in isopropanol for 4 h. Upon heating salt Ib with p-toluidine, we obtained only the perchlorate IIIb.

The use of n-butylamine and isopropylamine for recyclization of the salt Ia leads to another type of product: the naphthylamines IVa, b. Upon reaction of equimolar amounts of the salt Ia and isopropylamine, a mixture of products is formed, from which after heating in isopropanol we isolated the naphthylamine IVb. (see scheme in the next page)

The studied conversions show that 4-ethoxycarbonylbenzo[c]pyrylium perchlorates in reactions with ammonia and primary amines behave like other 1,3-dialkyl-substituted benzo[c]pyrylium salts. The presence of an ester substituent at the 4 position of the benzo[c]pyrylium cation facilitates conversion of the latter to naphthylamine derivatives, occurring according to the Kost–Sagitullin reaction [5].



IV a,b

IV a R^3 = Bu; b R^3 = *i*-Pr

EXPERIMENTAL

The IR spectra were recorded in Vaseline oil on the UR-20 spectrophotometer. The PMR spectra were recorded on the Tesla BS-467 spectrometer (operating frequency, 60 MHz); internal standard, TMS. The spectra of the napthylamines IVa, b were recorded in $CDCl_3$; the spectra of the rest of the compounds were recorded in trifluoracetic acid.

The characteristics and spectral data for the synthesized compounds are presented in Tables 1 and 2.

The elemental analysis data for C, H, Cl, N correspond to the calculated values.

4-Ethoxycarbonylisoquinones IIa-f. Perchlorate I (5 mmoles) was added to a mixture of 5 ml 25% aqueous solution of ammonia and 5 ml isopropanol. The reaction mixture was stirred for 1-1.5 h. The isoquinoline II was filtered off, washed with water, and crystallized from ethanol.

1,3-Dialkyl-2-R-4-ethoxycarbonyl-6,7-dimethoxyisoquinolinium Perchlorates III. Perchlorate IIa (5 mmoles) or IIb were added to a solution of 5 millimoles primary amine in 10 ml isopropanol and stirred for several hours at a temperature of 20-40°C. The reaction mixture was diluted with ether and then the perchlorates III were filtered off and washed with ether, and then dried.

1-Alkyl-3-methyl-4-ethoxycarbonyl-6,7-dimethoxynaphthalines (IV). Salt I (5 mmoles) was added to a solution of 25 millimoles amine and 50 ml ethanol and boiled for 6-7 h. The reaction mixture was poured into 100 ml ether. The filtrate was washed with 25 ml water, dried over anhydrous magnesium sulfate, and then evaporated. The residue was crystallized from isopropanol.

REFERENCES

1. Yu. A. Nikolyukin, S. L. Bogza, and V. I. Dulenko, Khim. Geterotsikl. Soedin., No. 4, 465 (1990).
2. G. N. Dorofeenko and E. V. Kuznetsov, Oxygen-Containing Heterocycles: Book 2 [in Russian], Zinatne, Riga (1970), p. 207.
3. G. N. Dorofeenko, E. V. Kuznetsov, and S. V. Krivun, Zh. Org. Khim., **2**, 1499 (1966).
4. Yu. A. Nikolyukin, S. L. Bogza, T. A. Zaritovskaya, and V. I. Dulenko, InFOU Akad. Nauk Ukr. SSR, Donetsk (1986); Dep. VINITI 17.04.1986, No. 2800, V 86.
5. V. I. Terenin, L. G. Yudin, and R. S. Sagitullin, Khim. Geterotsikl. Soedin., No. 1, 73 (1983).