HETEROCYCLES, *Vol.* 2, *No.* 4, 1974

PHOTO-FRIES REARRANGEMENT OF HETEROAROMATIC ACID PHENYL ESTERS[1,2]

Yuichi Kanaoka* and Yasumaru Hatanaka

Faculty of Pharmaceutical Sciences, Hokkaido University, Sapporo, 060 Japan

Photolysis of the phenyl esters of pyridine-carboxylic acids 1a-b and furan-2-4a, thiophene-2-4b, and N-methylpyrrole-2-carboxylic acids 4c afforded the corresponding o- and p-hydroxyketones 2,3,5,6.

The photo-Fries rearrangement has been the subject of considerable study in the last decade.[3-5] However, little attention has been given to the reactions of heterocyclic aryl esters except some examples of pyridine-containing esters[6,7] and p-t-butylphenyl furoate[8] with divergent results. In the course of our synthetic photochemical study in the heterocyclic series,[9] we wish to report the photolysis of the phenyl esters of pyridine-carboxylic acids 1a-b and furan-2-4a, thiophene-2-4b and N-methylpyrrole-2-carboxylic acids 4c.[10]

Although it has been generally recognized that both o- and p-rearranged products are formed from esters of unsubstituted phenol,[3-5] photolysis of aryl nicotinates and isonicotinates was reported to give either the o- or the p-products.[6] Therefore, the photoreactions of 1a-b were first examined to

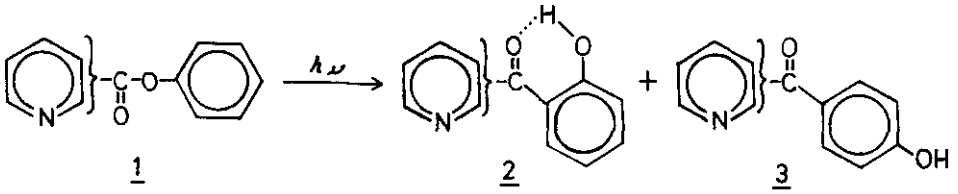
determine the general photochemical behavior of such typical heteroaromatic esters. The reactions were run in hexane (500 ml; 10 mM) using three 10-W low-pressure mercury lamps. As expected, both the o-hydroxy- 2a-b and the p-hydroxy-ketones 3a-b were obtained (Table). The structural assignment of 2-3 was mainly based on their nmr spectra (comparison of the p-, and o-disubstituted benzene protons). Further, phenyl esters of five-membered electron-rich heteroaromatic carboxylic acids 4a-c were irradiated in acetonitrile (500 ml; 10 mM) with a 500-W high-pressure mercury lamp. The table compiles the results which are again in agreement with the general pattern of the photo-Fries rearrangement. The structures of 5-6 were similarly confirmed by their nmr spectra.

TABLE Photorearrangement of the Heteroaromatic Phenyl Esters

Ester	Reaction time (hr)	Recovered (%)	Hydroxyphenone (% yield)	mp° C (or bp)
1a	48	1a (25)	2a (25)	63-4
			3a (11)	196-6.5[a]
1b	66	1b (8)	2b (15)	74-5
			3b (6)	257-8.5
4a	1	4a (9)	5a (31)	bp_3 125-30[b]
			6a (14)	163-4
4b	2.5	4b (14)	5b (33)	bp_3 140-5[c]
			6b (22)	103.5-4.5
4c	1.5	4c (13)	5c (28)	bp_2 135-40[d]
			6c (24)	136-6.5

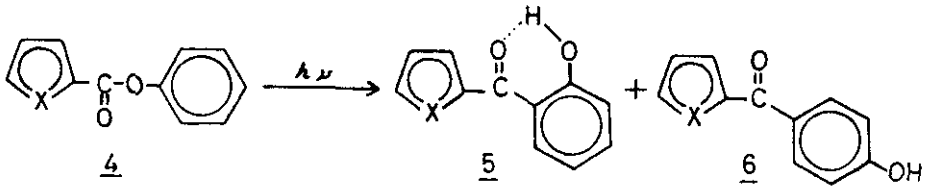
a) lit.[6], mp 192 . Oximes, mp: b) 130-1° c) 128-9° d) 100-1°.

The mechanism of this rearrangement is not yet well understood and conflicting interpretations have been advanced in the literature.[5,11,12] Regardless of the detailed mechanism, however, it is worth noting that phenyl esters of the representative heteroaromatic acids as above undergo such a typical photo-rearrangement. In the conventional acid-catalyzed Fries reaction, the product distribution mostly favors p-hydroxyketones[13] and, in addition, very little has been known of examples in heterocyclic systems. Thus by the procedure described in the present work a variety of heterocyclic ketones will be readily accessible as a pair of the o- and p-hydroxy derivatives under neutral conditions without substantial side reactions. Scope and limitation of these reactions are under investigation.



1 2 3

a : b :



4 5 6

a : X=O b : X=S c : X=NMe

REFERENCES

1 Photochemistry of the Ester System. I.

2 Photoinduced Reactions. XIX. For Part XVIII: Y.Kanaoka, K.Itoh, J.L.Flippen, I.L.Karle and B.Witkop, in preparation.

3 D.Belluš and P.Hrdlovič, Chem.Rev., 1967, 67, 599.

4 V.I.Stenberg, " Organic Photochemistry ", ed. by O.L.Chapman, vol. 1, p. 127, Marcel Dekker, New York, 1967.

5 D.Belluš, " Advances in Photochemistry ", eds. by J.N.Pitts, jr., G.S.Hammond and W.A.Noyes, jr., vol. 8, p. 109, Wiley-Interscience, New York, 1971.

6 M.T.LeGoff and R.Beugelmans, Bull.Chim.Soc.France, 1972, 1106 ; 1972, 1115.

7 G.M.Coppinger and E.R.Bell, J.Phys.Chem., 1966, 70, 3479.

8 H.Kobsa, J.Org.Chem., 1962, 27, 2293.

9 K.Itoh and Y.Kanaoka, Chem.Pharm.Bull., 1974, 22, in press.

10 All new compounds gave satisfactory analyses and their structures were supported by spectral (uv, ir, nmr, mass) data.

11 J.W.Meyer and G.S.Hammond, J.Am.Chem.Soc., 1972, 94, 2219.

12 C.E.Kalmus and D.M.Hercules, J.Am.Chem.Soc., 1974, 96, 449.

13 A.H.Blatt. " Organic Reactions," ed. by R.Adams, vol. 1, p. 342, J.Wiley, New York, 1942.

Received, 27th April, 1974