HETEROCYCLES, Vol 22, No 4, 1984

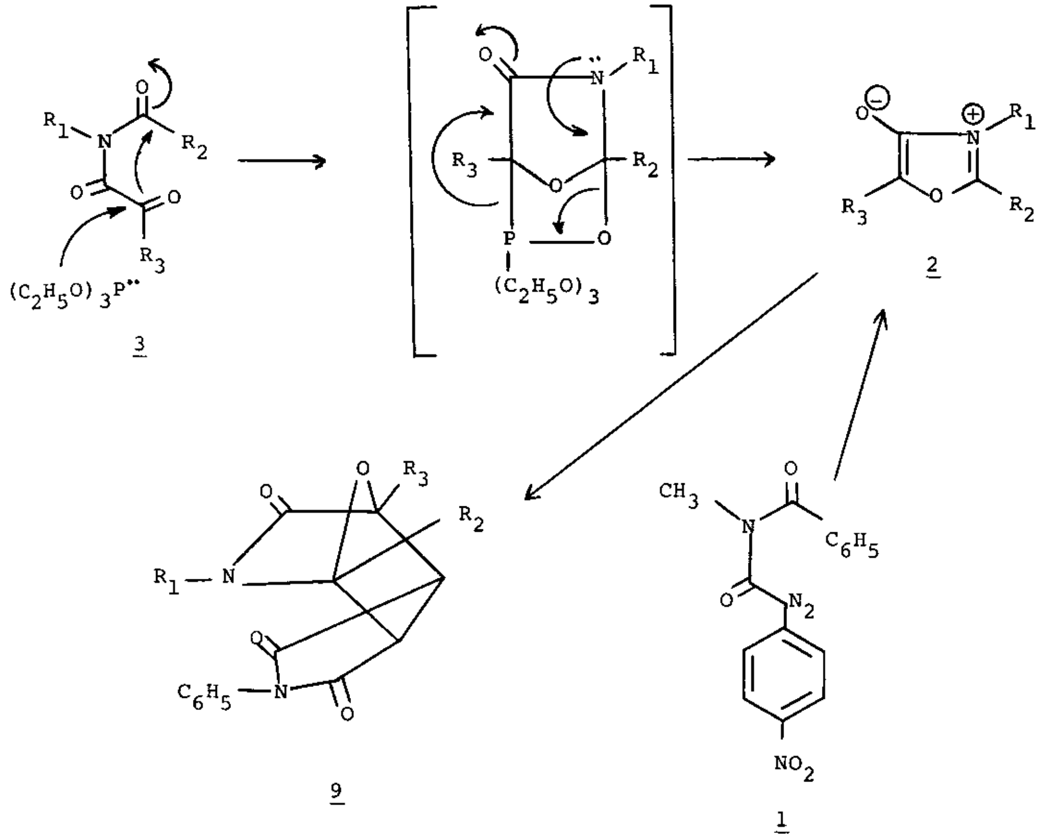
PREPARATION OF SOME STABLE AND TRANSIENT 1,3-OXAZOLIUM-4-OLATES[1]

Makhluf J. Haddadin* and Hana T. Tannus

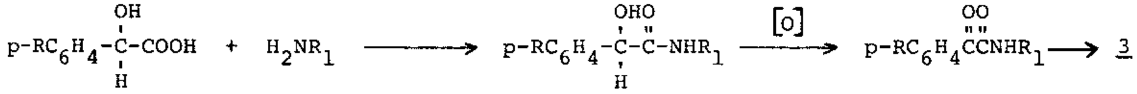
Department of Chemistry, American University of Beirut, Beirut,
Lebanon

Abstract - A number of mandelanilides (6) were prepared and oxidized with barium manganate to phenylglyoxanilides (7). The latter were converted to N-benzoylphenylglyoxanilides which, upon heating with triethyl phosphite, gave the corresponding 1,3-oxazolium-4-olates (2). 1,3-Oxazolium-4-olates 2f,g,o were isolated as colored solids whereas the rest of these mesoionic compounds (Table II) showed transitory existence in solution.

Recent progress in the chemistry of mesoionic heterocycles has appeared in two reviews[2]. Whereas 1,3-oxazolium-5-olates (Munchnones) have been studied considerably[2], little is known about their isomeric 1,3-oxazolium-4-olates (2). The first example of 1,3-oxazolium-4-olates was reported by Hamaguchi and Ibata[3] in 1974 in which diazoimide 1 was heated in the presence of cupric acetylacetonate, to give 2 ($R_1 = CH_3$, $R_2 = C_6H_5$, $R_3 = p\text{-}O_2NC_6H_4$).
A new method for the preparation of 1,3-oxazolium-4-olates was described recently[4]. Treatment of N-benzoylphenylglyoxanilide 3a with triethyl phosphite yielded 2,3,5-triphenyl-1,3-oxazolium-4-olates (3, $R_1 = R_2 = R_3 = C_6H_5$) as an orange-red solid. The purpose of this investigation was to explore the generality of this reaction as a method for synthesis of 1,3-oxazolium-4-olates. Starting materials 3 are not known in the literature and two methods were used to prepare them. The first method[5] consisted in the direct heating of mandelic acid 4 with the corresponding primary amines 5 to yield mandelamides 6 (Table I). Oxidation of 6 with barium manganate[6] gave glyoxamides 7 (Table I) in fairly good yields. Barium manganate was found to be more effective than manganese dioxide or nickel peroxide in this reaction. Mandelic acids 4c,d were prepared by hydrolysis of their corresponding cyanohydrins. Attempts to prepare p-nitromandelic acid



by this method failed. In the second method glyoxamide 7e (Table I) was prepared by the reaction of benzoylformic acid chloride (8) with 2-naphthylamine. The former was satisfactorily prepared by the reaction of benzoylformic acid with 1,1-dichlorodimethyl ether[7] which was found to be superior to thionyl chloride



$$p\text{-}RC_6H_4\text{-}\overset{OH}{\underset{H}{C}}\text{-}COOH + H_2NR_1 \longrightarrow p\text{-}RC_6H_4\text{-}\overset{OH}{\underset{H}{C}}\text{-}\overset{O}{C}\text{-}NHR_1 \xrightarrow{[O]} p\text{-}RC_6H_4\overset{O}{C}\overset{O}{C}NHR_1 \longrightarrow 3$$

4 5 6 7

a, R = H, $R_1 = C_6H_5$

b, R = H, $R_1 = 2,5\text{-}(CH_3)_2C_6H_3$

c, R = Br, $R_1 = C_6H_5$

d, R = CH_3, $R_1 = C_6H_5$

e, R = H, R_1 = 2-Naphthyl

in the preparation of α-ketoacid chlorides where decarbonylation of α-ketoacid chloride is invariably a serious drawback. The conversion of glyoxamides 7 into glyoximides 3 was achieved through the generation of the amidate anion of 7 by the action of either sodium wire, sodium hydride, or a phase transfer reaction (40% sodium hydroxide, toluene, benzyltriethylammonium chloride as a catalyst) followed by addition of the appropriate acid chloride. A third route to the preparation of 3 was to treat amidate anion $R_1\text{-}\bar{N}\text{-}\overset{\overset{O}{\|}}{C}C_6H_5$ with benzoylformic acid chloride. This procedure was least satisfactory because glyoximides 3 were obtained in a highly impure form and therefore in low yield. By varying the nature of the acid chloride in the conversion of 7 to 3, fifteen glyoximides 3 were obtained in fairly good yields (Table II). All glyoximides 3, with the exception of 3k,t, showed two carbonyl bands at 1715-1700 and 1680-1650 cm^{-1}. Compounds 3k,t showed one band at 1670 cm^{-1}. Each of glyoximides 3 was heated with triethyl phosphite, which acted as a solvent also, to produce the corresponding 1,3-oxazolium-4-olate 2 (Table II). It was found that unless the product precipitated out of the reaction mixture, as in cases 2f,g,o, it eventually decomposed in solution as evidenced by the gradual loss of color in the span of minutes at room temperature. Attempts to induce products to crystallize out by using the usual organic solvents were fruitless. 1,3-Oxazolium-4-olates 2f,g,o which were isolated in the solid state were found to decompose readily in solution. Indeed, the instability of these compounds is not surprising in the light of their rapid reactivity with moisture and oxygen[8]. The high reactivity of 2 as a 4π electron-rich system was demonstrated in their fast reaction with N-phenylmaleimide. Compounds 2f,g,o reacted instantaneously with the latter, at room temperature to give the expected cycloaddition products. Although 2f gave a mixture of the endo and exo adducts[4], 2g,o gave predominently endo adducts 2g,o (yield: 36%, 46%, mp 210-212°C, 302-303°C respectively) which were purified by TLC. The infrared spectra of endo adducts 2g,o showed carbonyl bands at 1720 cm^{-1}, and NMR signals at δ 8.2, 7.5 (m, 17H), 6.8 (m, 2H), two doublets at δ 4.4 (1H) and 4.0 (1H). The endo assignment was made on the basis of the two-proton multiplet in the NMR of both 9g and 9o at δ 6.8 due to the ortho protons of the phenyl group of the N-phenylmaleimide. It is noteworthy that endo adducts 9f,g,o melted with decomposition exhibiting the color of the 1,3-oxazolium-4-olate from which they were derived. Attempts to isolate the cycloaddition products of the rest of 1,3-oxazolium-4-olates (Table II) with N-phenylmaleimide were fruitless. Although the latter decolorized the color of 2 rapidly, it reacted readily with triethyl phosphite, which was present in relatively high concentration, to give a complex mixture[9] of products in which the sought after cycloadducts 9 were formed in traces.

Table I

Compound	R	R_1	Mp (°C)	% Yield	IR (cm^{-1})
6a	H-	C_6H_5	Ref. 4	Ref. 4	Ref. 4
6b	H-	$2,5-(CH_3)_2C_6H_3$	112-113	39	3210, 1640
6c	Br	C_6H_5	127-129	71	3250, 1640
6d	CH_3	C_6H_5	106-110	79	3300, 1660
7a	H-	C_6H_5	62-63	73	3330, 1690, 1660
7b	H-	$2,5-(CH_3)_2C_6H_3$	98-99	81	3250, 1670, 1650
7c	Br	C_6H_5	128-129	47	3345, 1680, 1660
7d	CH_3	C_6H_5	114-115	50	3320, 1685, 1650
7e	H-	2-Naphthyl	145-146	39	3340, 1690

Table II

Compound	R_1	R_2	R_3	Mp (°C)	% Yield	Compound	Stability of compound 2
3f	C_6H_5	C_6H_5	C_6H_5	131	30	2f	Red crystals: several weeks
3g	C_6H_5	p-$O_2NC_6H_4$	C_6H_5	152-153	24	2g	Blue crystals: several weeks
3h	C_6H_5	p-$CH_3OC_6H_4$	C_6H_5	136-137	45	2h	Red solution: 10 minutes
3i	C_6H_5	$C(CH_3)_3$	C_6H_5	126-127	37	2i	Red solution: 4 minutes
3j	C_6H_5	$HC{=}CHC_6H_5$	C_6H_5	162-164	31	2j	Violet solution: 2 minutes
3k	$2,5(CH_3)_2$-C_6H_3	C_6H_5	C_6H_5	151-153	70	2k	Blue solution: 9 minutes
3l	$2,5(CH_3)_2$-C_6H_3	p-$O_2NC_6H_4$	C_6H_5	150-152	32	2l	Blue solution: 9 minutes
3m	2-naphthyl	C_6H_5	C_6H_5	163-164	24	2m	Red solution: 9 minutes
3n	2-naphthyl	p-$O_2NC_6H_4$	C_6H_5	187-189	38	2n	Blue solution: 15 minutes
3o	C_6H_5	p-$O_2NC_6H_4$	p-BrC_6H_4	145-147	53	2o	Violet crystals: few weeks
3p	C_6H_5	p-$CH_3C_6H_4$	p-BrC_6H_4	104-106	49	2p	Red solution: 6 minutes
3q	C_6H_5	$HC{=}CHC_6H_5$	p-BrC_6H_4	185-186	23	2q	Violet solution: 4 minutes
3r	C_6H_5	C_6H_5	p-$CH_3C_6H_4$	147-148	56	2r	Red solution: 4 minutes
3s	C_6H_5	CH_3	C_6H_5	173-175	39	2s	Orange solution: immediate decolorization
3t	C_6H_5	1-naphthyl	C_6H_5	163-165	21	2t	Red solution: 3 minutes

NMR showed aromatic protons plus: δ 3.7 (s, 3H) for 3h; δ 1.95 (s, 3H) for 3s; δ 1.0 (s, 9H) for 3i; δ 2.35 (s, 3H), 2.25 (s, 3H) for 3k.

ACKNOWLEDGEMENT We thank Professor Costas H. Issidorides for many stimulating discussions.

REFERENCES

1. Presented at the 9th International Congress of Heterocyclic Chemistry, August 21-26, 1983, Tokyo, Japan.
2. C.G. Newton and C.A. Ramsden, *Tetrahedron*, 1982, **38**, 2965; C.A. Ramsden, *Adv. Heterocycl. Chem.*, 1976, **19**, 1.
3. M. Hamaguchi and T. Ibata, *Tetrahedron Lett.*, 1974, 4475; T. Ibata, M. Hamaguchi, and H. Kiyohara, *Chem. Lett.*, 1975, 21.
4. M.J. Haddadin, A.M. Kattan, and J.P. Freeman, *J. Org. Chem.*, 1982, 723.
5. C.A. Bischoff and P. Walden, *Justus Liebigs Ann. Chem.*, 1894, **279**, 128.
6. H. Firouzabadi and E. Ghaderi, *Tetrahedron Lett.*, 1976, 839.
7. H. Gross, A. Rieche, E. Hoft, and E. Beyer, *Org. Synth.*, 1973, Coll. Vol. 5, 365; H.C.J. Ottenheijm and J.H.M. de Man, *Synthesis*, 1975, 163.
8. T. Sheradsky and D. Djaida, *J. Org. Chem.*, 1980, **45**, 4850.
9. Triethyl phosphite reacts with N-phenylmaleimide to give an ylide and other unidentified products (see M.J. Haddadin, B.J. Agha, and R.F. Tabri, *J. Org. Chem.*, 1980, **44**, 494 and references cited therein).

Received, 28th November, 1983