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SYDNONE AND SYDNONIMINE. A NOVEL CONVERSION TO PYRAZOLIN-5-ONE I*

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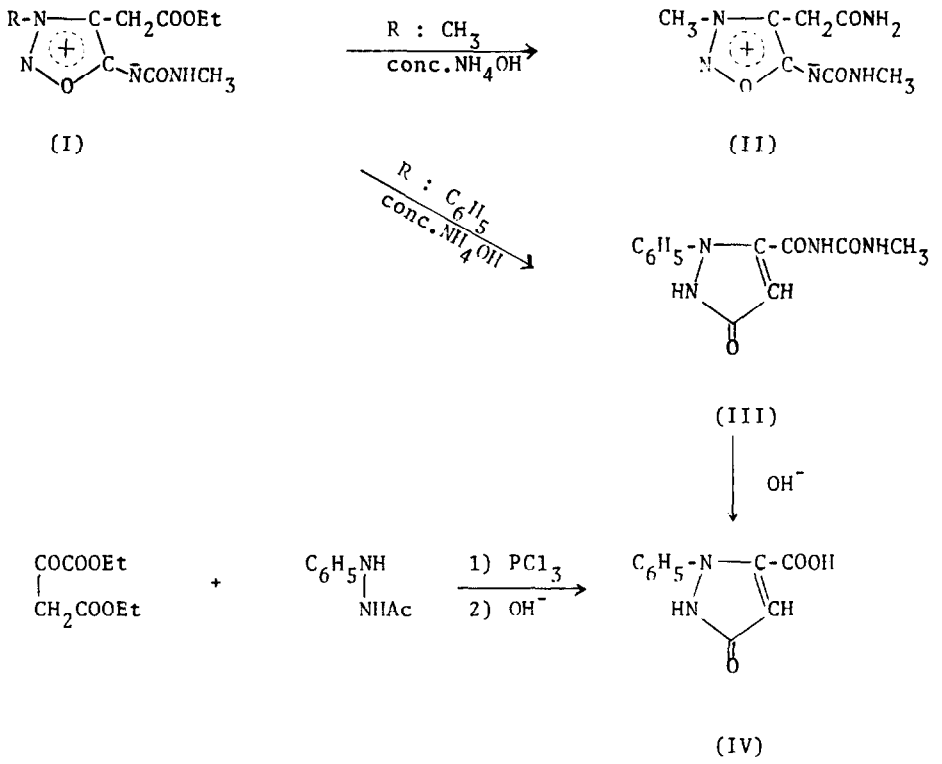
The base-catalyzed hydrolysis of sydnones and sydnonimines have been reported to give N-nitroso-aminoacid derivatives(1,2). Daeniker and Druey have reported the conversion of N-acetyl-3-phenylsydnonimine by potassium hydroxide to 1-phenyl-4-hydroxy-1,2,3-triazole(2). During our investigations on the synthesis of sydnone- and sydnonimine-4-acetic acid derivatives, we have now found that these compounds were converted into pyrazolin-5-one derivatives by the bases. In this communication we would like to report this novel conversion.

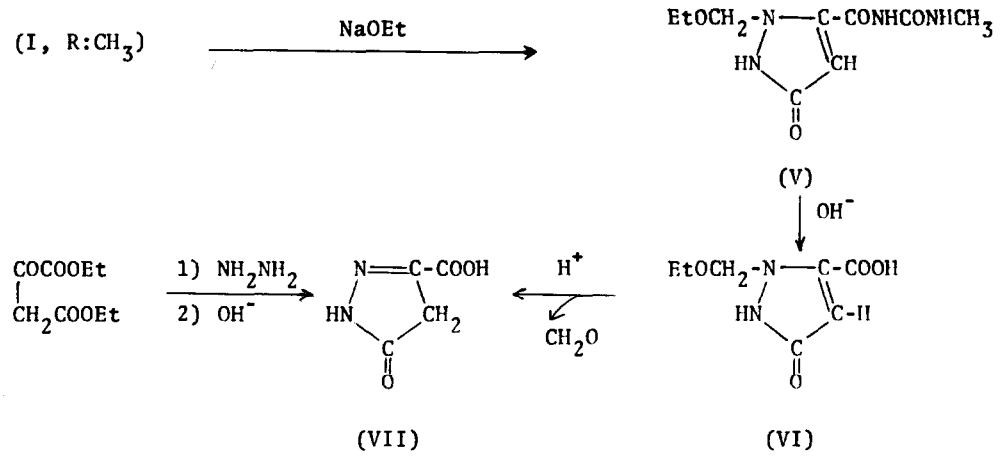
Treatment of ethyl N-methylcarbamoyl-3- methylsydnonimine-4-acetate(I, R: CH_3) with conc. NH_4OH at room temperature gave readily the corresponding amide (II). Surprisingly, however, ethyl N-methylcarbamoyl-3-phenylsydnonimine-4-acetate(I, R:C_6H_5) under the same condition as above gave a mixture of two compounds in stead of the expected amide.

One of the new products, m.p. 266°(dec.), $C_{12}H_{12}O_3N_4$ was assigned to III on the basis of its spectroscopic observations. The ir spectrum showed strong bands at 1700 and 1660 cm^{-1}(amide carbonyl). The uv spectrum(in ethanol) showed absorption maxima at 230mμ(ε,15,800) and 290mμ(ε,5,600), clearly eliminating a sydnonimine nucleus and indicating a pyrazolone nucleus. The nmr spectrum(d_6-DMSO,ppm) showed signals at 2.70(d,3H,$CONHCH_3$), 6.52(s,1H,aromatic proton) and 7.36(s,5H,phenyl protons). The mass spectrum showed a molecular ion peak at m/e 260 corresponding to a molecular formula. Fragmentations of m/e 202(M-$CONHCH_3$) and m/e 187(M-$NHCONHCH_3$) showed a presence of a methylureido group.

III was converted to acid (IV), m.p.251°(dec.), by alkaline hydrolysis. The structure(IV) was established as 2-phenyl-3-carboxy-3-pyrazolin-5-one by comparison with the authentic sample, prepared by the condensation of diethyl oxalacetate with N-acetylphenylhydrazine followed by hydrolysis.



This result suggested us that the compound(I,R:CH_3) could be transformed to the pyrazolone derivative by stronger base such as NaOEt. Actually, reaction of this compound with NaOEt in EtOH afforded a pyrazolone derivative(V), different from the type of III, in moderate yield. The nmr spectrum (d_6-DMSO, ppm) of V, m.p. 205-207°(dec.), $C_9H_{14}O_4N_4$(M^+242) have signals at 0.95(t,3H,OCH_2CH_3), 2.65 (d,3H,$CONHCH_3$), 3.40(q,2H,OCH_2CH_3), 5.43(s,2H, N-CH_2O) and 6.45(s,1H,aromatic proton). The uv spectrum (in ethanol) showed a maximum at 242mμ(ε, 13,300) and a shoulder at 275mμ(ε, 3,800) indicating a pyrazolone nucleus. From these spectral results, the product was assigned to the structure(V).



Further confirmation of this structure was provided by the following chemical ways. The alkaline hydrolysis of V yielded acid(VI), m.p. 148-150°, $C_7H_{10}O_4N_2$. The hydrolysis of VI with dil. HCl gave 3-carboxy-2-pyrazolin-5-one (VII) which was identical to the authentic sample (3) and formaldehyde, indicating the presence of a ethoxymethyl moiety. But the above results did not allow us to determine the position of the ethoxymethyl moiety. The uv spectrum is most informative for this determination. 1-Methyl-3-carboxy-2-pyrazolin-5-one and 2-methyl-3-carboxy-3-pyrazolin-5-one were prepared respectively and compared their uv spectra with that of V. The spectrum of V is consistent with that of the latter. These results provided conclusive evidence for the structure of V.

Further studies on this novel conversion of sydnones and sydnonimines will be reported in following papers.

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