3-Acetoxy-1-phenylpyrazoline-4,5-dione-4-Arylhydrazone and Related Compounds

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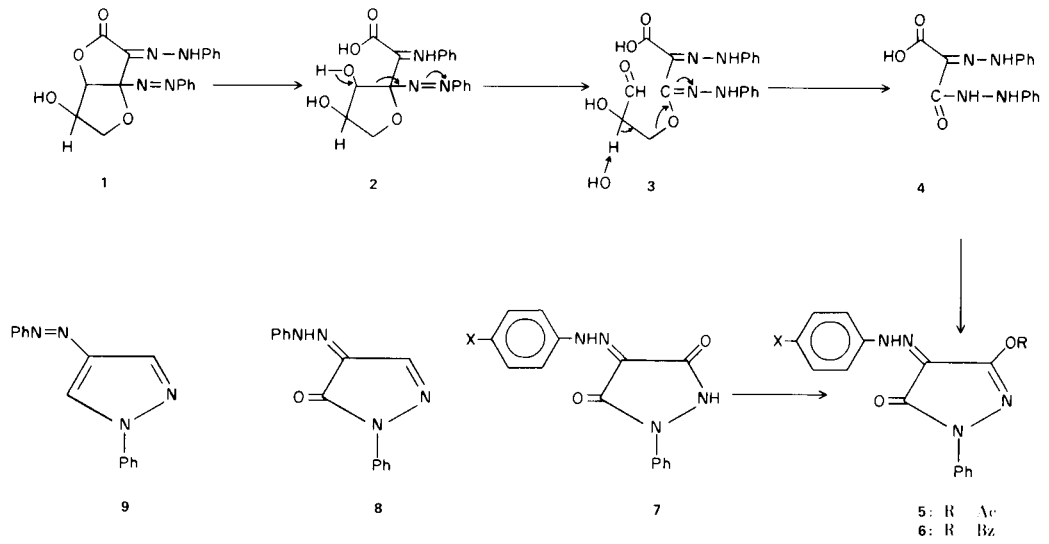
We have recently obtained (2,3) 3-acetoxy-1-phenylpyrazoline-4,5-dione 4-phenylhydrazone (**5**; X = H) by acetylating a degradation product of anhydro ascorbic acid phenyloxazone (**4**). In the present paper, we have identified this degradation product (**4**) as the monophenyl hydrazide of mesoxalic acid phenylhydrazone and have prepared a number of 3-acetoxy-1-phenylpyrazoline-4,5-dione 4-arylhydrazones to study their mass and nmr spectra and compare them with those of related 1-phenylpyrazolidine-3,4,5-trione 4-phenylhydrazone (**7**) (4), the 1-phenylpyrazoline-4,5-dione 4-phenylhydrazone (**8**) (5-7) and 4-phenylazo-1-phenylpyrazoline (**9**) (8,7).

When dehydroascorbic acid bisphenylhydrazone was oxidized with mild oxidants, it afforded a bicyclic anhydro compound (**1**) which upon treatment with alkali afforded a crystalline yellow degradation product (**4**) which analyzed for $C_{15}H_{14}N_4O_3$ (2,3). This was thought to be a hydrated form of 1-phenylpyrazolidine-3,4,5-trione 4-phenylhydrazone (**7**) since, upon acetylation, it yielded the same *O*-acetyl derivative, 3-acetoxy-1-phenylpyrazoline-4,5-dione 4-phenylhydrazone (**5**; X = H) obtained by acetylation of 1-phenylpyrazolidine-3,4,5-trione 4-phenylhydrazone (**7**). An examination of the mass spectrum of compound **4** revealed, however, that its molecular peak (see Figure 1) was at m/e 298 and not at 280, as expected for compound (**7**) and, although it showed a peak at 280 resulting from loss of water, the base peak occurred at 254, which corresponds to M-CO_2 and is characteristic of carboxylic acids, The nmr spectrum (see Table II) also revealed three imino protons instead of two expected from 1-phenylpyrazolidine-3,4,5-trione 4-phenylhydrazone (**7**). The degradation product was accordingly ascribed the structure of a monophenylhydrazide of mesoxalic acid phenylhydrazone (**4**). Its formation from the ascorbic acid derivative (**1**) by the action of alkali probably took place by opening of the γ lactone ring followed by a reverse aldol reaction to give intermediate **3**, which then underwent β-elimination to give compound **4**. This compound, under the influence of acetic anhydride, underwent cyclization and acetylation to give 3-acetoxy-1-phenylpyrazoline-4,5-dione 4-phenylhydrazone (**5**; X = H). In an effort to understand better the mass spectrum of compound **4**, we prepared a number of 3-acetoxy-1-phenylpyrazoline-4,5-dione 4-arylhydrazones (**5**; X-Cl or Br) *para*-substituted in the phenyl ring attached to the hydrazone residue by acetylation of 1-phenylpyrazoline-3,4,5-trione 4-arylhydrazones. The mass spectra of these acetates were quite similar to those of the corresponding phenylpyrazolidine trione 4-arylhydrazones, except that they possessed an additional peak 42 mass units higher, which corresponded to the molecular



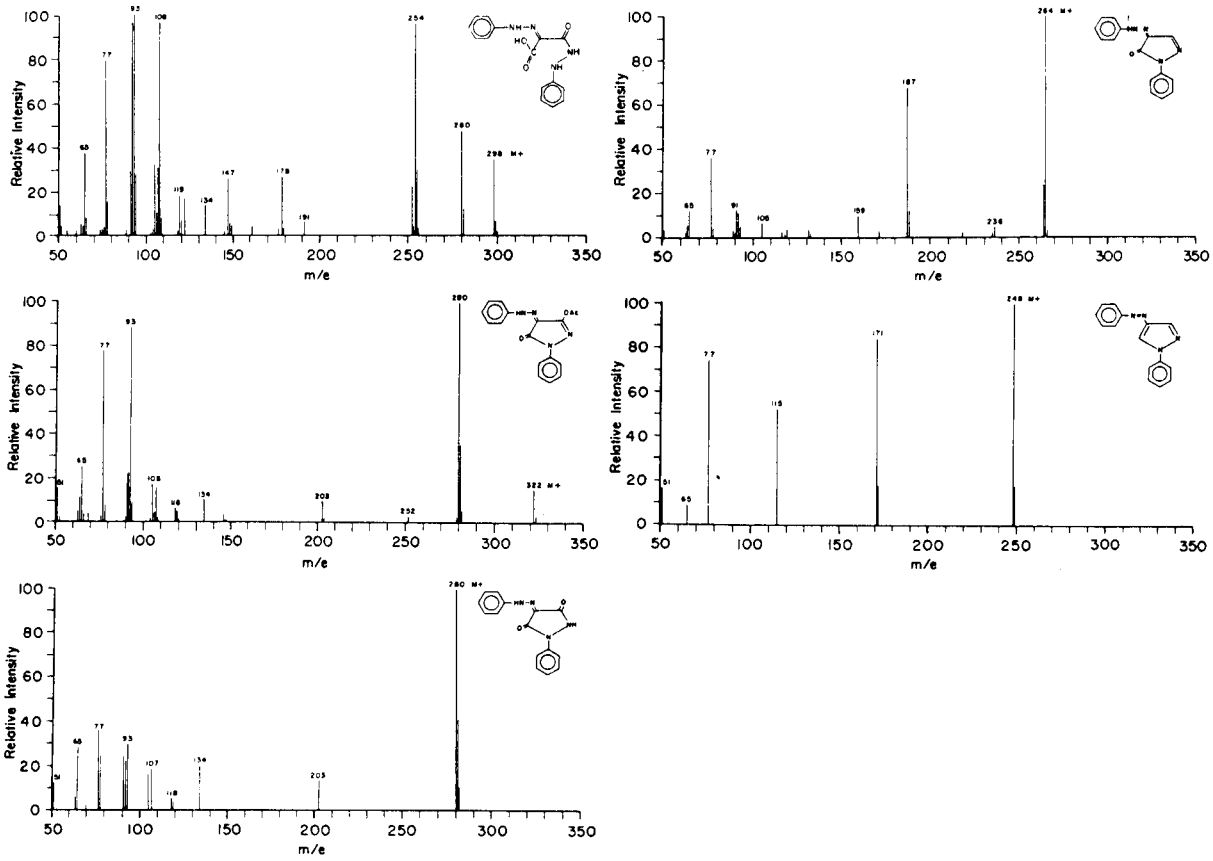


Fig. 1. Mass Spectrum of *N*-Phenylpyrazole Derivatives.

TABLE I

Compound No.	Subst(X)	Yield %	M.p.	Formula	Calcd. C	Calcd. H	Calcd. N	Found C	Found H	Found N
5	Cl	85	172	$C_{17}H_{13}N_4O_3Cl$	57.2	3.6	15.7	57.6	4.0	15.5
5	Br	87	214	$C_{17}H_{13}N_4O_3Br$	50.9	3.3	14.0	50.5	3.4	14.1
6	H	92	228	$C_{22}H_{16}N_4O_3$	68.7	4.2	14.6	68.6	3.8	14.6
6	Cl	90	186	$C_{22}H_{15}N_4O_3Cl$	63.1	3.6	13.4	63.1	3.4	13.6

TABLE II

(Nmr Data)

Compound	δ NH	δ *p*H	δ others
1-Phenylpyrazolidine-3,5-dione	11.5	7.0-8.2	3.66 (CH_2)
7	10.9-11.8	6.9-8.1	
5; X = H	8.91	6.9-7.9	2.71 (Ac)
8	10.4	7.0-8.6 (a)	
4	9.5	6.8-7.6	

(a) CH of the heterocyclic ring appeared under the phenyl peak.

peak of the acetyl derivative. The base peak in these acetates corresponded to the loss of the acetyl groups. The next strong peak occurred 77 mass units lower for the phenyl derivative, 111 units lower for the *p*-chlorophenyl, and 155 units lower for the *p*-bromophenyl derivative. This indicated that a loss of the aryl group occurred at the aryl linked to the hydrazone residue and not to the pyrazole ring. This was verified by the fact that 1-phenylpyrazolidine-3,5-dione does not show a significant peak corresponding to M-phenyl. On the other hand, loss of a phenyl group was a significant peak in the mass spectrum of 1-phenylpyrazoline dione 4-phenylhydrazone and of 4-phenylazo-1-phenylpyrazole, which show strong molecular peaks which are themselves the base peaks and are followed by strong peaks corresponding to M-Ph.

Benzoylation of 1-phenylpyrazolidine trione 4-arylhydrazones (**7**) afforded the *O*-benzoyl derivatives (**6**; R H and Cl) as evidenced by their ir spectra, which showed ester bands at 1745 in addition to the amide band at 1660 cm^{-1} present in the starting trione arylhydrazones (**7**).

The nmr spectra of compounds **7** and **8** (see Table II) show low field imino protons around δ 11-12. It should be noted that the imino proton of the pyrazole ring is also located in this region, and both types of NH protons appear as a single broad peak. The number of imino protons in this broad peak was determined by integration and comparison of the areas of the amino and the phenyl peaks. The monophenyl hydrazide of mesoxalic acid phenylhydrazone (**4**) showed three imino protons, 1-phenylpyrazolidine trione 4-phenylhydrazone (**7**) showed two imino protons, its acetate (**5**; X = H) and 1-phenylpyrazolin-4,5-dione 4-phenylhydrazone (**8**) possessed one imino proton (**9**), and 4-phenylazo-1-phenylpyrazole (9) showed no imino protons.

EXPERIMENTAL

Melting points were determined on a Kofler block and are uncorrected. Infrared absorption spectra were measured on a Unicam SP 200 and Perkin Elmer 620, and ultraviolet absorption spectra with a Unicam SP 800 spectrometers. Nmr and mass spectra were determined in pyridine-d5 by M. Gilles, using a Varian HA-100 spectrometer and a Varian M66 instrument, respectively.

Mesoxalic Acid Phenylhydrazone Monophenylhydrazide (**4**).

The 3,6-anhydro-3-phenylazo-2-oxo-L-gulono-γ-lactone phenylhydrazone (**1**) needed was prepared as described earlier (3) by heating a suspension of dehydro-L-ascorbic acid phenyloxazone (1.2 g.) with cupric chloride (3 g.) in ethanol (50 ml.) for 15 minutes. The solution was concentrated and hot water was added until it became turbid. The product that separated was filtered and crystallized from ethanol to give yellow needles, m.p. 177-179 (yield 1 g.). It was suspended in water (5 ml.) and was heated with 2 *N* sodium hydroxide solution (20 ml.) at 70-80° for three minutes. The solution was then acidified with glacial acetic acid and the crystals that separated (0.5 g.) were filtered off and crystallized from chloroform-ethanol in needles, m.p. 185-188°, (2,3).

3-Acetoxy-1-phenylpyrazoline-4,5-dione 4-Arylhydrazones (**5**).

The required 1-phenylpyrazolidinetrione 4-arylhydrazones (**7**) were prepared by treating a solution of 1-phenylpyrazolidine-3,5-dione (4) (0.6 g.) in 2 *N* sodium hydroxide (20 ml.) with the required *p*-substituted aryl diazonium chloride and acidifying the mixture with dilute hydrochloric acid. The products that separated were filtered off, recrystallized from chloroform and dried. A solution of this 1-phenylpyrazolidinetrione 4-arylhydrazone (**7**) (0.5 g.) in dry pyridine (10 ml.) was then treated with acetic anhydride (8 ml.) and left overnight at room temperature. The mixture was poured on crushed ice and the product filtered off, washed with water, and recrystallized from chloroform-ethanol to give yellow needles (see Table I). Spectral data: compound **5**; X-Cl ν (Nujol): 1590, 1660, 1770 cm^{-1}, λ max (ethanol): 206, 250, 396 nm (log ε 4.15, 4.25, 4.34), λ min 218, 306 nm (log ε 3.79, 2.99). For compound **5**; X = Br ν (Nujol) 1595, 1660, 1760 cm^{-1}.

3-Benzoyloxy-1-phenylpyrazoline-4,5-dione 4-Arylhydrazones (**6**).

A solution of 1-phenylpyrazolidine trione 4-arylhydrazones (**7**) (0.5 g.) in dry pyridine (10 ml.) was treated with benzoyl chloride (3 ml.) and left overnight at room temperature. The mixture was poured on crushed ice and the benzoate was filtered off and washed separately with water. It crystallized from chloroform-ethanol to give yellow needles. Spectral data: compound **6**: X = H ν max (Nujol): 1590, 1660, 1745 cm^{-1}; λ max (ethanol): 207, 235, 248 sh, 255 sh, 296 nm (log ε 4.41, 4.26, 4.43, 4.23, 4.17), λ min 246, 297 nm (log ε 4.13, 2.81); compound **6**; X = Cl ν max (Nujol) 1590, 1660, 1740 cm^{-1}; λ max (ethanol): 206, 243, 397 nm (log ε 4.24, 4.37, 4.29), λ min 216, 308 (log ε 3.96, 2.97).

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