

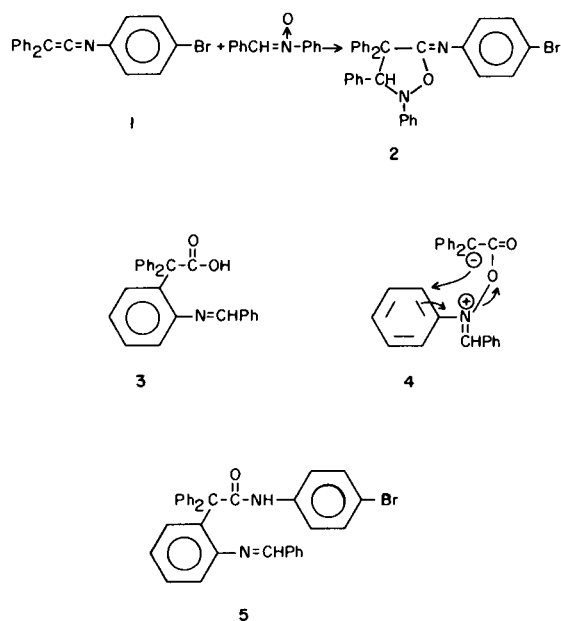
Heterocycles from Ketenimines. II (1). Imino-substituted Isoxazolidines

Marvin W. Barker and James H. Gardner

Department of Chemistry, Mississippi State University

In continuing our study (1,2) of the utility of the ketenimine moiety as a precursor for a series of heterocycles with exocyclic unsaturation, we have investigated the reaction of nitrones with diphenylketene-*N*-(*p*-bromophenyl)imine (**1**). When an ether solution of **1** and α ,*N*-diphenylnitrone is heated, precipitation occurs. The collected solid exhibits its strongest infrared absorption at 1680 cm^{-1} indicative of the imine function and suggesting addition of the 1,3-dipole across the carbon-carbon double bond. The absorption, of course, is one of unsaturation, but its strength is too great for a tetrasubstituted olefin (**3**), the product which would result from addition to the carbon-nitrogen double bond. No absorptions characteristic of the ketenimine or nitrone moieties were present. On the basis of known nitrone reactions (**4**) and the manner in which nucleophiles add to ketenimines (**5**), we postulated structure **2** for the adduct.

One other possible structure for the adduct is the amide (**5**). Hassall and Lippman who studied the reaction of diphenylketene with this same nitrone found that the product was not the corresponding isoxazolidinone but rather the triphenylacetic acid (**3**) formed through intermediate **4** (**6**). If nitrone addition to **1** occurs in the same manner, the product would be **5**.



No satisfactory nmr data could be obtained for the adduct because of its insolubility in the normal nmr solvents. The mass spectrum contained the strong parent ion peaks at m/e 544 and 546, and although the spectrum is quite complex, several conclusions can be drawn. If the structure is **5**, cleavage α to the carbonyl group and β to the amide nitrogen should occur (**7**) to give a fragment with m/e of 346. If the structure is **2**, one might expect a fragmentation that is the reverse cycloaddition to give peaks for the ketenimine moiety at m/e 347 and 349. The mass spectrum exhibits peaks at m/e 347 and 349 but none at 346. Thus, the mass spectrum excludes **5** and agrees with **2**.

Several 5-iminoisoxazolidines were prepared by adding nitrones to **1** to establish the generality of the reaction. Except for the adduct from α -phenyl-*N*-methylnitrone and **1**, the iminoisoxazolidines are high melting solids which do not decompose below 300° . The fact that α -phenyl-*N*-benzyl nitrone and α -phenyl-*N*-methylnitrone give adducts which are similar in spectral, chemical, and physical behavior to **2** supports the heterocyclic structure since no intermediate like **4** is possible in these systems.

EXPERIMENTAL

All nitrones were prepared by the condensation of the appropriate aldehyde with a hydroxylamine (**8**). Melting points were determined on a Fisher-Johns apparatus and are uncorrected. The spectra were obtained on Perkin-Elmer Model 137 and 137G Infracords, a Varian A-60 nmr, and a Perkin-Elmer Model 270 mass spectrometer. Analyses were performed by Galbraith Laboratories, Inc., Knoxville, Tennessee.

2,3,4,4-Tetraphenyl-5-*p*-bromophenyliminoisoxazolidine (**2**).

A solution of 3.48 g. (0.01 mole) of **1** (**9**) and 1.97 g. (0.01 mole) of α ,*N*-diphenylnitrone in 30 ml. of anhydrous ether was refluxed for five hours. Collection of the precipitate gave 1.8 g. (33%) of a white powder, m.p. $213-215^\circ$. The product exhibited a strong infrared absorption at 1680 cm^{-1} attributable to the imine function and nmr absorptions centering on $6.8\ \delta$ and $7.4\ \delta$ due to the aromatic protons. A good integration of the nmr spectrum could not be obtained on the instrument available. The mass spectrum indicated the parent ion at m/e 544 and 546 and the ketenimine moiety at m/e 347 and 349. Recrystallization of the product from acetone afforded an analytically pure sample as white needles, m.p. $216-218^\circ$.

Anal. Calcd. for $\text{C}_{33}\text{H}_{25}\text{BrON}_2$: C, 72.71; H, 4.59; N, 5.14. Found: C, 72.90; H, 4.45; N, 5.31.

2,4,4-Triphenyl-3-(3,4-methylenedioxyphenyl)-5-*p*-bromophenyliminoisoxazolidine.

A solution of 3.48 g. (0.01 mole) of **1** and 2.6 g. (0.01 mole) of α -3,4-methylenedioxyphenyl)-*N*-phenylnitrone in 150 ml. of anhydrous ether was refluxed for 48 hours. Collection of the precipitate gave 3.1 g. (53%) of white solid, m.p. 253-255°. Recrystallization of the product from acetone gave an analytically pure sample as white needles, m.p. 255-256°.

Anal. Calcd. for $C_{34}H_{25}BrO_3N_2$: C, 69.29; H, 4.24; N, 4.75. Found: C, 69.05; H, 4.25; N, 4.69.

2,4,4-Triphenyl-3-(*p*-methoxyphenyl)-5-*p*-bromophenyliminoisoxazolidine.

A solution of 3.48 g. (0.01 mole) of **1** and 2.27 g. (0.01 mole) of α -(*p*-methoxyphenyl)-*N*-phenylnitrone in 35 ml. of anhydrous ether was refluxed for 24 hours. Collection of the precipitate gave 2.5 g. (43.5%) of white powder, m.p. 194-196°. Recrystallization of the product from acetone gave an analytically pure sample as a white powder, m.p. 194-196°.

Anal. Calcd. for $C_{34}H_{27}BrO_2N_2$: C, 70.98; H, 4.69; N, 4.87. Found: C, 71.19; H, 4.87; N, 4.78.

2,4,4-Triphenyl-3-(2,3-dimethoxyphenyl)-5-*p*-bromophenyliminoisoxazolidine.

A solution of 3.48 g. (0.01 mole) of **1** and 2.57 g. (0.01 mole) of α -(2,3-dimethoxyphenyl)-*N*-phenylnitrone in 35 ml. of anhydrous ether was refluxed for 48 hours. Decantation of the ether left 3.8 g. (63%) of white solid, m.p. 196-198°. Recrystallization of the product from acetone gave an analytically pure sample as a white powder, m.p. 223-225°.

Anal. Calcd. for $C_{35}H_{29}BrO_3N_2$: C, 69.45; H, 4.79; N, 4.63. Found: C, 69.46; H, 4.95; N, 4.52.

2-Benzyl-3,4,4-triphenyl-5-*p*-bromophenyliminoisoxazolidine.

A solution of 3.48 g. (0.01 mole) of **1** and 2.11 g. (0.01 mole) of α -phenyl-*N*-benzyl-nitrone in 25 ml. of ether was refluxed for 18 hours. Cooling of the solution to 0° resulted in the precipitation of 0.9 g. (16.1%) of white solid, m.p. 226-228°. Recrystallization of the product from acetone gave an analytically pure sample as a white powder, m.p. 229-231°.

Anal. Calcd. for $C_{34}H_{27}BrON_2$: C, 73.01; H, 4.83; N, 5.01. Found: C, 73.52; H, 5.18; N, 5.12.

2-Methyl-3,4,4-triphenyl-5-*p*-bromophenyliminoisoxazolidine.

A solution of 3.48 g. (0.01 mole) of **1** and 1.35 g. (0.01 mole) of α -phenyl-*N*-methyl-nitrone in 20 ml. of anhydrous ether was

refluxed for 36 hours. The ether was removed under reduced pressure leaving a yellow oil which solidified when triturated with 15 ml. of hexane. The product appeared to undergo decomposition upon standing. Recrystallization of the solid from acetone gave 1.4 g. (29%) of an analytically pure sample as a white powder, m.p. 110-112°.

Anal. Calcd. for $C_{28}H_{23}BrON_2$: C, 69.59; H, 4.76; N, 5.80. Found: C, 69.27; H, 5.19; N, 5.36.

Attempted Reactions of **2**.

Compound **2** was found to be inert towards boiling 50% sulfuric acid, lithium aluminum hydride in refluxing ether or tetrahydrofuran, and chromic acid oxidation.

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State College, Mississippi 39762