BULLETIN OF THE CHEMICAL SOCIETY OF JAPAN VOL. 43 3941—3942 (1970)

The Reaction of 3-Methyl-5-methylmercapto-2,4-diphenylthiazolium Iodide with Bases. Preparation of Mesoionic Imidazoles

Toshie SHIBA and Hiroshi KATO*[1]

Department of Chemistry, Faculty of Science, Shinshu University, Asahi, Matsumoto

(Received June 23, 1970)

In connection with our interest in photolyses and pyrolyses of mesoionic compounds in general,[1] we needed a convenient synthetic approach for various mesoionic ring systems. For this purpose, mesoionic oxazol-5-one derivatives, first prepared by Huisgen and his collaborators[2], are ideal starting materials. The preparation of several mesoionic compounds by the reaction of 3-methyl-2,4-diphenyloxazol-5-one (I) and a few hetero-cumulenes has previously been described.[3] Further, the phenyl isothiocyanate adduct, mesoionic 1-methyl-2,3,5-triphenylimidazole-4-thione (II, R=Ph), has been reported to isomerize to mesoionic *N*-phenyl-3-methyl-2,4-diphenyl-thiazol-5-imine (III, R=Ph) by hydrogen chloride.[3] Since we were unable to reproduce this rearrangement under various conditions, we attempted to prepare this compound *via* methylmercaptothiazolium salt.

The treatment with methyl iodide of mesoionic 3-methyl-2,4-diphenylthiazole-5-thione (IV), prepared by the reaction of I and carbon disulfide,[3] gave the corresponding *S*-methyl salt, 3-methyl-5-methylmercapto-2,4-diphenylthiazolium iodide (V). It was anticipated that the methylmercaptothiazolium salt V would give the corresponding imines, III, by the reaction with amines.[4]

The treatment of V with methylamine gave a product with a composition in agreement with the expected mesoionic imine (III. R=Me), but the NMR methyl signals (τ 6.33 and 6.55) suggested that the two methyl groups are substituted on aromatic-ring nitrogen atoms. Further, its infrared spectrum showed no absorption in the region expected for an imine group, but, instead, absorptions at 1310 and 1071 cm^{-1}, regions earlier assigned to an azole-thione structure.[5] These spectral data strongly suggest that the product is 1,3-dimethyl-2,5-diphenylimidazole-4-thione (II, R=Me). To support further this structural assignment, it was treated with methyl iodide to give methiodide VI (R=Me), the NMR spectrum of which, showing a new methyl signal at τ 7.55 (*S*-Me), is thus wholly consistent with the proposed structure. This is the first example of a mesoionic imidazole-4-thione with an aliphatic substituent on the 3-position; thus, this reaction sequence may be regarded as an attractive synthetic route for this type of compounds.[6]

The reaction of V and aniline took a different course, and gave another quaternary salt, the NMR spectrum of which exhibits the presence of two types of methyl groups by signals at τ 6.33 and 7.85. This suggests that the product is 1-methyl-4-methylmercapto-2,5-diphenylimidazolium iodide (VI, R=Ph); it was identified as such by comparison with a specimen prepared by the methylation of II (R=Ph)[3] by methyl iodide. The two iodides VI (R=Me and Ph) were no longer reactive to aniline or methylamine, even under forcing conditions.

The reaction of imidazolium iodides, VI, with alkali may be expected to give mesoionic imidazol-4-ones, VII, but this reaction only gave resinous products. The expected imidazolone (VII, R=Ph), however, could be prepared by the cycloaddition reaction of I with phenyl isocyanate. In this case, in contrast to the reactions with other hetero-cumulenes, the corresponding cycloadduct, VIIIa or VIIIb, was isolated; this was converted to the imidazolone VII by the elimination of carbon dioxide only after heating in xylene. To date, this compound is the only example of a non-fused

*1 To whom inquires should be addressed.

1) For a review of mesoionic compounds, see, M. Ohta and H. Kato, "Nonbenzonoid Aromatics," ed. by J. P. Snyder, Academic Press, New York (1970), p. 117.

2) R. Huisgen, H. Gotthardt, H. O. Bayer and F. C. Schaefer, *Angew. Chem.*, **76**, 185 (1964).

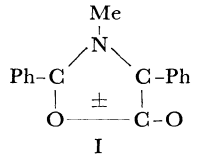
3) R. Huisgen, E. Funke, F. C. Schaeffer, H. Gotthardt and E. Brunn, *Tetrahedron Lett.*, **1967**, 1809.

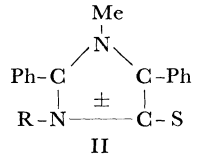
4) For a similar type of reactions, see, K. Ichimura and M. Ohta, This Bulletin, **38**, 707 (1965).

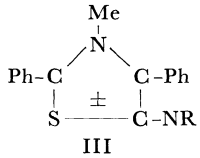
5) M. Ohta, H. Kato and T. Kaneko, *ibid.*, **40**, 579 (1967), and references cited therein. See also, S. Sato and M. Ohta, *ibid.*, **42**, 2054 (1969); F. Kröhnke and H. H. Steuernagel, *Chem. Ber.*, **97**, 1118 (1964); L. B. Kier and M. K. Scott, *J. Heterocycl. Chem.*, **5**, 277 (1968); T. G. Stewart and L. B. Kier, *J. Pharm. Sci.*, **54**, 731 (1965).

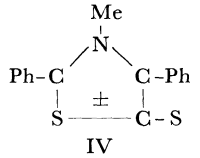
6) The preparation of compounds of this type by the reaction of I and aliphatic isothiocyanate was unsuccessful: T. Shiba and H. Kato, unpublished results.

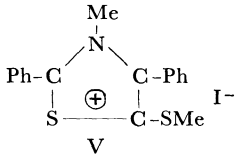
mesoionic imidazol-4-one with no acyl substituents.[7]

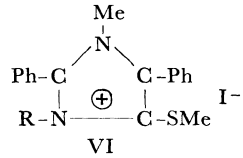

I

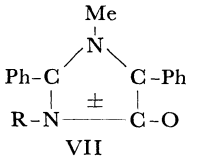

II

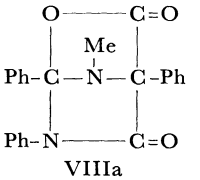

III

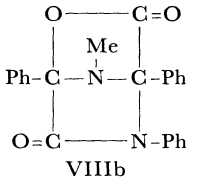

IV


V


VI


VII


VIIIa


VIIIb

Experimental[8]

3-Methyl-5-methylmercapto-2,4-diphenylthiazolium Iodide (V). A mixture of 1 g of IV[3] and 0.6 g of methyl iodide in 10 m*l* of ethanol was stirred at room temperature for two hours. Ether was then added to the mixture, and the precipitate was recrystallized from ethanol to give 1.06 g (70% yield) of pale yellow prisms melting at 133—134°C. NMR: 1.84—2.50 (m, 10H, Ph), 6.12 (s, 3H, *N*-Me), 7.46 τ (s, 3H, *S*-Me).

Found: C, 48.26; H, 3.80; N, 3.19%. Calcd for $C_{17}H_{16}NS_2I$: C, 48.00; H, 3.76; N, 3.29%.

Mesoionic 1,3-Dimethyl-2,5-diphenylimidazole-4-thione (II, R=Me). A mixture of 1 g of V, 3 m*l* of 30% aqueous methylamine, and 10 m*l* of ethanol was stirred at room temperature for ten hours. The mixture was then concentrated, and the crystals which seperated out were recrystallized from ethanol to give 0.6 g (90% yield) of pale yellow needles melting at 191—192°C. IR (cm^{-1}): 1310, 1071. NMR: 2.20—2.72 (m, 10H, Ph), 6.33 τ (s, 3H, Me), 6.55 τ (s, 3H, Me).

Found: C, 72.36; H, 5.70; N, 9.67%. Calcd for $C_{17}H_{16}N_2S$: C, 72.83; H, 5.75; N, 9.99%.

1,3-Dimethyl-4-methylmercapto-2,5-diphenylimidazolium Iodide (VI. R=Me). A mixture of 0.5 g of II (R=Me) and 0.3 g of methyl iodide in 3 m*l* of ethanol was stirred at room temperature for two hours; the crystals which separated out were recrystallized from ethanol to give 0.6 g (80% yield) of colorless prisms melting at 175.8—176.7°C. NMR: 1.90—2.45 (m, 10H, Ph), 6.20 (s, 3H, *N*-Me), 6.50 (s, 3H, *N*-Me), 7.55 τ (s, 3H, *S*-Me).

Found: C, 51.20; H, 4.54; N, 6.60%. Calcd for $C_{18}H_{19}N_2SI$: C, 51.16; H, 4.50; N, 6.63%.

1-Methyl-4-methylmercapto-2,3,5-triphenylimidazolium Iodide (VI, R=Ph). a) A mixture of 0.7 g of V, 0.5 g of aniline, and 10 m*l* of *n*-butanol was refluxed for ten hours. Ether was added to the concentrated mixture, and the precipitate was crystallized from ethanol to give 0.5 g (60% yield) of colorless prisms melting at 236—237°C. NMR: 1.41—2.20 (m, 5H, Ph), 2.40—2.70 (m, 10H, Ph), 6.33 (s, 3H, *N*-Me), 7.85 τ (3H, *S*-Me).

Found: C, 56.66; H, 4.33; N, 5.24%. Calcd for $C_{23}H_{21}N_2SI$: C, 57.03; H, 4.37; N, 5.78%.

b) A solution of 1 g of II (R=Ph)[3] and 0.53 g of methyl iodide in 10 m*l* of acetone was stirred for two hours at room temperature. The solution was then concentrated, and the precipitate was recrystallized from ethanol to give 1.0 g (70% yield) of colorless prisms melting at 236—237°C, identical with the specimen prepared by Procedure **a**.

Phenyl Isocyanate Adduct of I (VIII). A solution of 5 g of I and 4.5 g of phenyl isocyanate in 100 m*l* of xylene was stirred at 70°C for four hours. The mixture was then concentrated, and ether was added; the precipitate was recrystallized from benzene to give 5.5 g (90% yield) of colorless prisms melting at 160—161°C. IR (cm^{-1}): 1735 (lactone C=O), 1640 (lactam C=O). NMR: 2.08—2.29 (m, 5H, Ph), 2.40—2.80 (m, 10H, Ph), 7.28 τ (s, 3H, Me).

Found: C, 74.50; H, 4.70; N, 7.50%. Calcd for $C_{23}H_{18}N_2O_3$: C, 74.59; H, 4.86; N, 7.46%.

Mesoionic 1-Methyl-2,3,5-triphenylimidazol-4-one (VII, R=Ph). A solution of 1 g of the adduct VIII in 30 m*l* of xylene was heated under reflux for thirty minutes. The solution was concentrated and then petroleum ether was added; the precipitate which separated out was recrystallized from acetone to give 0.2 g (23% yield) of pale yellow prisms melting at 190—192°C. IR (cm^{-1}): 1650 (C=O). NMR: 2.50—3.05 (m, 15H, Ph), 6.97 τ (s, 3H, Me).

Found: C, 81.75; H, 5.87; N, 9.14%. Calcd for $C_{22}H_{18}N_2O$: C, 82.21; H, 5.52; N, 8.59%.

We are indebted to Professor Masaki Ohta of Tokyo Institute of Technology and to Professor Kameji Yamane of this Department for discussion and encouragement.

7) The preparation of mesoionic 5-acylimidazol-4-ones by way of a different route has been reported: A. Lawson and D. H. Miles, *J. Chem. Soc.*, **1959**, 2865. After the completion of this work, a report on the preparation of a mesoionic imidazol-4-one which also has an acetyl substituent on the 5-position has appeared: E. B. Roche and D. W. Stansloski, *J. Heterocycl. Chem.*, **7**, 139 (1970).

8) All melting points were determined on a micro hot stage, and are uncorrected. The infrared spectra were recorded as KBr disks on a Hitachi model EPI-SII Spectrophotometer. The NMR spectra were measured using a JEOLCO JNM-4H-100 (100 MHz) Spectrometer in deuteriochloroform solutions containing tetramethylsilane as internal standard, and the chemical shifts are given in τ values.