The Tautomerism of *N*-Methyl-2-phenacylthioimidazoline

By **R. S. Shadbolt,*** Twyford Laboratories, 309 Elveden Road, London N.W.10

N-Methyl-2-phenacylthioimidazoline (2) and the corresponding hydrobromide (1) exist largely in bicyclic forms owing to interactions between the carbonyl group and a ring nitrogen atom.

THE tautomerism of 2-phenacylthioimidazolinium bromides has been discussed.[1] It was thought that compounds of this class with substituents on the ring nitrogen atom would not exhibit amino-carbinol–keto-imine tautomerism,[2] and consequently 1-methyl-2-phenacylthioimidazolinium bromide (1) was prepared. This compound showed i.r. carbonyl absorption, but ^{1}H n.m.r. spectroscopy showed that only 25% existed as the keto-form (1B) and that the remainder probably exists as a cyclic form (1A or C). Treatment of the hydrobromide (1) with ammonia gave a base (2) with analytical figures corresponding to $C_{12}H_{14}N_2OS$ but its i.r. spectrum did not show a carbonyl band. Treatment of the base (2) with hydrobromic acid gave a salt which differed from the original hydrobromide, and analysis showed that loss of a molecule of water had occurred. By analogy with the formation of 3-phenyl-5,6-dihydrothiazolo[2,3-*d*]thiazolium bromide from 2-phenacylthiothiazolinium bromide,[3,4] this hydrobromide should be 4 (or 7)-methyl-3-phenyl-5,6-dihydroimidazo[2,1-*b*]thiazolium bromide [(3) or (4)]. Bredt's bridgehead double-bond rule[5] indicates structure (4) to be more probable, and comparison of the u.v. spectrum of the product [$\lambda_{max.}$ 269 nm. (ε 11,940)] with those of 3-phenyl-5,6-dihydroimidazo[2,1-*b*]thiazolium bromide ($\lambda_{max.}$ 269 nm. in acid) and related thiazoles[6] supports this assignment. The position of the methyl signal (τ 8·42 and 8·52) in the ^{1}H n.m.r. spectrum of the bromide (4) indicated that the methyl group was not attached to a quaternary nitrogen atom[7] (the appearance of the methyl signal as two peaks may be due to *N*-methyl inversion).

The base (2) gave a neutral reaction in water, and its u.v. spectrum ($\lambda_{max.}$ 222 nm.) eliminated the possibility that it was 7-methyl-3-phenyl-5,6-dihydroimidazo[2,1-*b*]thiazolium hydroxide, as this compound would be expected to have a spectrum resembling that of the corresponding bromide (4). The ^{1}H n.m.r. spectrum indicated that the methyl group was attached to a charged nitrogen atom[7] (τ 6·37), and the protons at position 2 gave rise to doublets at τ 8·78 and 8·85, so

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* *Present address*, Ward Blenkinsop and Co. Ltd., Halebank Laboratories, Lower Road, Widnes, Lancs.

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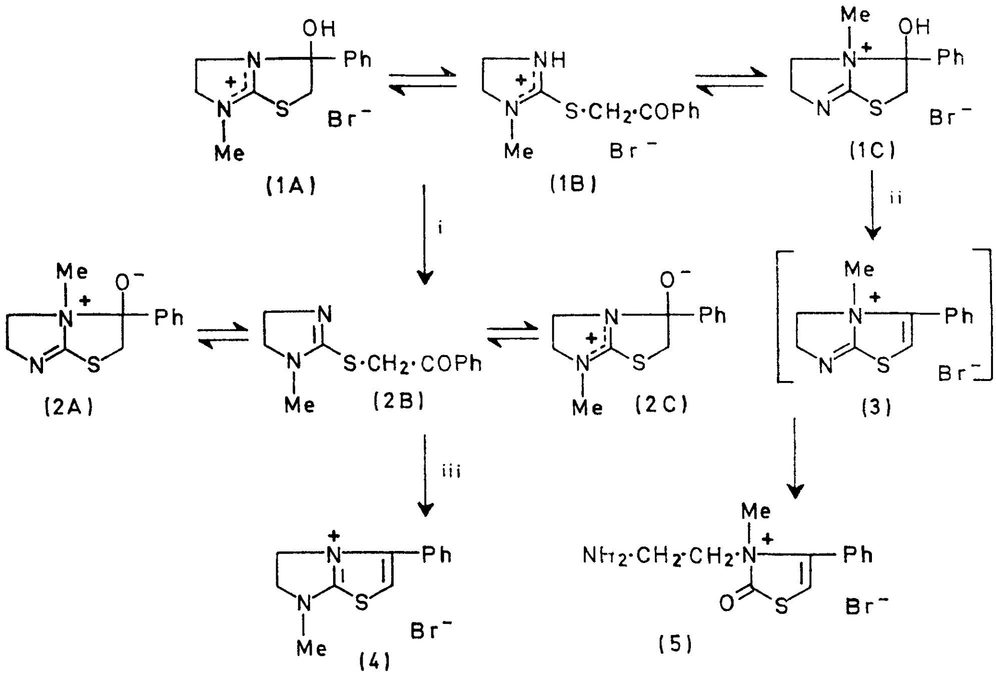
that structure (2C) appears the most likely. Similar interactions between tertiary nitrogen groups and carbonyl groups have been reported.[8] 2-Phenacylthio-2-thiazoline[3] does not exhibit this phenomenon to the same degree; a strong band is found in the i.r. spectrum at 1690 cm.$^{-1}$.

N-Methyl-2-phenacylthioimidazolinium bromide (1) was unchanged when heated in ethanol, but when heated in acetic acid gave a product whose i.r. spectrum contained bands at 3405 and 3305 cm.$^{-1}$ (NH_2), which did not react with sodium nitrite, and which did react with nitrous acid with evolution of nitrogen. This was identified as 3-(2-aminoethyl)-3-methyl-2-oxo-5-phenyl-4-thiazolinium bromide (5). This compound (5) was also obtained by treatment of 3-phenyl-5,6-dihydroimidazo[2,1-*b*]thiazole with methyl toluene-*p*-sulphonate, followed by conversion of the product into the corresponding bromide, thus showing that the 4-methylimidazothiazolium bromide (3) is unstable. This contrasts with the fact that the 7-methylimidazothiazolium bromide (4) is unchanged when a solution in acetic acid is heated under reflux for 16 hr. Related degradations of the imidazo[2,1-*b*]thiazole ring have been reported.[9]



Reagents: i, NH_4OH; ii, AcOH; iii, HBr.

EXPERIMENTAL

I.r. spectra were determined for Nujol mulls with a Perkin-Elmer 237 instrument. U.v. spectra were determined for solutions in 95% ethanol (*ca.* 3·5 mg. in 100 ml.) with a Hilger–Watts Ultrascan; ε values were obtained with a Uvispek. ^1H N.m.r. spectra were recorded with a Varian A60 instrument. The percentage of keto-isomer in compound (2) was estimated by comparison of the integral of the CH_2·CO group with that of the aromatic protons.

N-*Methyl-2-phenacylthioimidazolinium Bromide* (1).—Phenacyl bromide (1·99 g.) in acetone (20 ml.) was added to a solution of 2-mercapto-*N*-methylimidazoline[10] (1·16 g.) in acetone (30 ml.). After 20 min. the *hydrobromide* (2·53 g.) was collected; m.p. 158—159°, $\nu_{max.}$ 1690 cm.$^{-1}$, τ [$(CD_3)_2SO$] 1·63—2·55 (5H, m, Ph), 4·45 (0·5H, s, CH_2·CO), 5·22—6·42 (5·5H, m, imidazoline CH_2 and CH_2·C·OH), and 6·65 (3H, s, NMe) (Found: C, 45·7; H, 4·8; N, 8·9. $C_{12}H_{15}BrN_2OS$ requires C, 45·7; H, 4·8; N, 8·9%).

7-*Methyl-3-oxido-3-phenyl-3,4,5,6-tetrahydroimidazo-*[2,1-b]*thiazolium* (2C).—Aqueous ammonia was added to a solution of 1-methyl-2-phenacylthioimidazolinium bromide (17·3 g.) in water (500 ml.) (to pH 9). The solid gave the *anhydro-base* (6·2 g.), m.p. 134—135° (from ethanol), τ [$(CD_3)_2SO$] 2·22—2·75 (5H, m, Ph), 5·33—7·37 (4H, m, imidazoline CH_2), 6·37 (3H, s, NMe), and 8·78 and 8·85 (both 1H, d, CH_2, $J_{2,2}$ 6 Hz) (Found: C, 61·6; H, 6·0; N, 11·9. $C_{12}H_{14}N_2OS$ requires C, 61·5; H, 6·0; N, 12·0%).

7-*Methyl-3-phenyl-5,6-dihydroimidazo*[2,1-b]*thiazolium Bromide* (4).—Excess of ether was added to a solution of the anhydro-base (2C) (0·24 g.) in 48% hydrobromic acid (0·2 ml.). The oil solidified (0·27 g.; m.p. 186—189°) and was recrystallised from methanol–ether to give the *bromide* (0·19 g.), m.p. 191—192°, $\lambda_{max.}$ 275 (ε 12,340) and 269 nm. (11,940), τ (CD_3·OD) 2·25—2·65 (5H, m, Ph), 3·05 (1H, s, CH), 4·97—5·92 (4H, m, imidazoline CH_2), and 8·42 and 8·52 (both s, total 3H, NMe) (Found: C, 48·6; H, 4·5; N, 9·4. $C_{12}H_{13}BrN_2S$ requires C, 48·5; H, 4·4; N, 9·4%).

3-(2-*Aminoethyl*)-3-*methyl-2-oxo-5-phenyl-4-thiazolinium Bromide* (5).—(*a*) 1-Methyl-2-phenacylthioimidazolinium bromide (1·75 g.) and acetic acid (10 ml.) were heated under

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reflux for 16 hr. The solution was evaporated and the residue was crystallised from propan-2-ol to give material (1·44 g.), m.p. 171—172°. Recrystallisation from methanol–ether gave the *bromide*, m.p. 184—185°, $\lambda_{max.}$ 225 (ε 13,720) and 277 nm. (13,610), τ ($CD_3 \cdot OD$) 2·23—2·58 (5H, m, Ph), 3·03 (1H, s, CH), 5·38 (2H, s, NH_2), 5·42—5·63 (4H, m, imidazoline CH_2), and 6·78 (3H, s, NMe) (Found: C, 46·0; H, 4·6; N, 8·9. $C_{12}H_{15}BrN_2OS$ requires C, 45·7; H, 4·8; N, 8·9%).

(*b*) 3-Phenyl-5,6-dihydroimidazo[2,1-*b*]thiazole [1] (0·5 g.), methyl toluene-*p*-sulphonate (0·5 g.), and methanol (5 ml.) were heated under reflux for 3 hr. The solution was evaporated and the residue was washed by decantation with ether. The residue was dissolved in water and passed through a column of Amberlite IRA 400 resin (Br^-). Evaporation of the eluate and crystallisation from methanol–ether gave material (0·5 g.), m.p. 178—180°, with u.v. and i.r. spectra identical with those of the compound prepared by method (*a*).

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