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MESOMERIC BETAINES OF AZOLIUM AZOLATE: SYNTHESIS AND PROPERTIES

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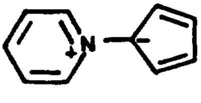
A facile entry into the almost unknown azolium azolate inner salts is described, and the structure of these highly dipolar compounds is well reflected by their spectroscopic properties and reactivity towards electrophiles (MeI) and dipolarophiles (DMAD) under mild conditions.

Among the many fascinating types of heterocyclic mesomeric betaines conjugated heterocyclic N-ylides isoconjugated with non-alternant hydrocarbon anions are sparsely populated and no cycloaddition reactions of any members of this type of compounds have been reported,[1] even though the reaction with dienophiles can give access to a variety of heterocyclic structures and also entry into novel polycyclic ring systems.

Remarkably little is known about this class of mesomeric betaines and only few aza-analogues of 1 have been synthesized,[2] the inner salts of pyridinium azolate 2 and pyridinium benzimidazolate 3. In this connection, the azolium azolate inner salts 4 and 5 have received little attention, and only the tetrazolium tetrazolate betaines 6 have been so far reported in the context of an investigation on the chemistry of tetrazoles and properties of formazans.[3a,4]



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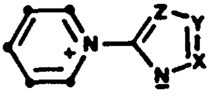

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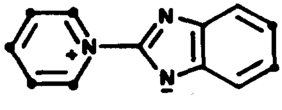

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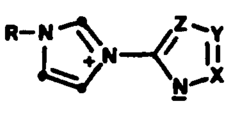

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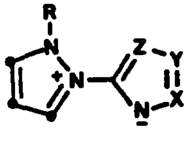

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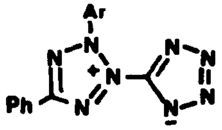
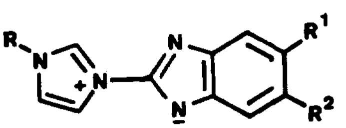


6

• = CR
X,Y,Z = CR or N

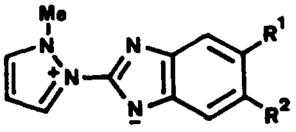
Following our research work on mesomeric betaines related with the N-ylide 1, we describe the first synthesis and spectroscopic properties of simple azolium azolate inner salts 7-12. Thus, reaction of an activated chloroazole (e.g. 2-chlorobenzimidazole) with a 1-alkylazole (e.g. 1-methylimidazole) afforded the N-azolylazolium salt, whose deprotonation has been achieved using an anionic (OH^- form) ion-exchange resin. The new betaines 7-12 were obtained (overall yields were for 7-11 >70%, and 22% of 12), they gave satisfactory elemental analysis and their electron mass spectra showed an intensive molecular peak: for betaines 7-9, 12 they were the base peaks and for compounds 10, 11 the relative abundance was c.a. 65%.



7 $R^1 = R^2 = H$, R= Me

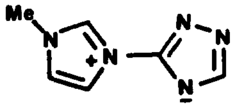
8 $R^1 = R^2 = H$, R= nBut

9 $R^1 = R^2 = Me$, R= nBut



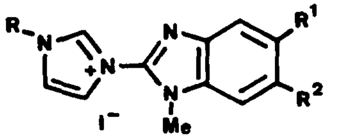
10 $R^1 = R^2 = H$

11 $R^1 = R^2 = Me$



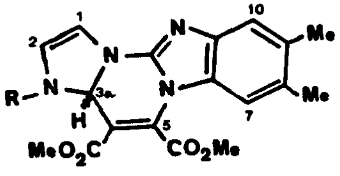
12

In the IR spectra, absorbtions in the range of 3400-3200 cm^{-1} (ν_{NH}) and 2790-2500 cm^{-1} (hydrochlorides) were absent. The highly dipolar structure of 7-12 is well reflected by their ^1H and ^{13}C-NMR spectra. The chemical shifts of the azolate ring protons were shifted to lower frequencies compared with the protons of the corresponding N-azolylazolium salts and the δ_C values of the carbon atoms were in excellent agreement with data reported for anionic species in the azole series and the useful comparative data from pyridinium azolate inner salts.[2] Both the ^1H and ^{13}C-NMR chemical shifts of the quaternary azolium ring accord very well with data reported for pyrazolium derivatives[3b] and the scarcely reported imidazolium salts.[5] These spectral properties indicate the high electron density on the azolate ring of 7-12. Indeed, these betaines protonated in CF_3COOH to give the corresponding conjugated acid (the N-azolylazolium trifluoroacetates), which reversibly regenerated the betaine on treatment with 25% ammonium hydroxide.



13 $R^1 = R^2 = H$, R= nBut

14 $R^1 = R^2 = Me$, R= nBut



15 R = nBut

Furthermore, electrophilic attack at 1-position of the benzimidazolate nucleus has been done under neutral and mild conditions.[6] Thus, the betaines 8, 9 reacted with methyl iodide/acetone at room temperature to afford compounds 13 and 14 in high yields (>81%). On the other hand, the imidazolium benzimidazolate 9 underwent ready dipolar cycloaddition with an equimolecular amount of dimethylacetylenedicarboxilate (DMAD) in dichloromethane at room temperature. The stable 1:1 cycloadduct 15 was obtained as the major product, m.p. 182°C, which could be isolated in fair yield (51%) by flash column chromatography. The novel 3aH-imidazo[1′,2′:3,4]pyrimido[1,2-a]benzimidazole 15 was unambiguosly established by its analytical and spectral data.[8]

The azolium azolate mesomeric betaines are undoubtedly interesting compounds due to their clearly highly dipolar structure whose prospective values bear an interest worthy to be explored.

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