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Short Communications

N-Quaternary Compounds. Part. XLVII.[1] Vinylation of Pyridine-2-thiones by Base-induced Ring-opening of Intermediate Dihydrothiazolo[3,2-*a*]pyrdinium Derivatives

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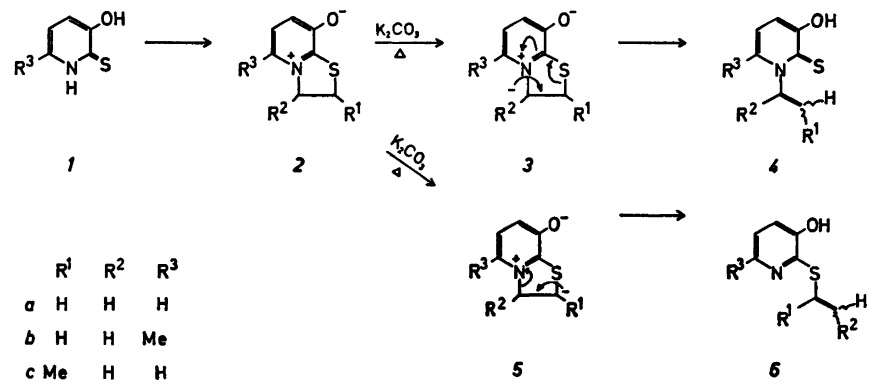
We have recently described a synthesis of *N*-vinylpyridine-2-thiones from 3-carboxydihydrothiazolo[3,2-*a*]pyridinium derivatives (*2*, $R^3 = CO_2H$) through selective carbanion formation in the 3-position by decarboxylation under aprotic conditions.[2] In dihydrothiazolo[3,2-*a*]-pyridinium derivates *2* the protons at both C-2 and C-3 are activated by the adjacent hetero atoms; the anion at C-3 is inductively stabilized by the quaternary nitrogen atom, and the anion at C-2 is stabilized by interaction with the sulfur atom,[3,4] which presumably is aided by the direct attachment of the sulfur to the electron deficient pyridine system. Hence proton abstraction by base is possible from either C-3 or C-2 leading to *N*-vinyl or *S*-vinyl pyridine derivatives respectively (Scheme 1).

The dihydrothiazolo[3,2-*a*]pyridinium derivatives which are used as starting materials in the vinylation reactions, are readily available from pyridine-2-thiones in a one-step synthesis.[5–7] A mixture of *2* and anhydrous potassium carbonate is heated under reduced pressure, and the product formed is sublimed from the reaction mixture. Generally the operating pressure is relatively high (15 Torr) in order to avoid or reduce cosublimation of the less volatile betaine *2*.

In the absence of any substituents on C-2 and C-3 in *2* the protons on C-3 are at the lower field in the NMR spectra and can be selectively exchanged with deuterium under alkaline conditions.[8] In agreement with location of the more acidic protons on C-3, the parent compound in this series *2a* yielded almost exclusively the *N*-vinyl derivative *4a*. Likewise the 2-methyl analogue *2c* furnished only the *N*-vinyl isomer *4c*. With a methyl group in the 5-position and no substituents at C-2 or C-3, however, the product is composed of the *N*-vinyl *4b* and *S*-vinyl *6b* isomers in the ratio 3:1 (chromatography, NMR); decarboxylation of the 3-carboxy derivative of *2* ($R' = H$, $R^3 = CO_2H$, $R^3 = Me$) yielded only *4b*.[2] From the



1 2 3 4 5 6

	R^1	R^2	R^3
a	H	H	H
b	H	H	Me
c	Me	H	H
d	H	Me	H
e	H	H	iPr
f	H	Ph	Me

Scheme 1.

5-isopropyl isomer *2e* the *S*-vinyl isomer was the major product component, the ratio *4e*:*6e* being 1:4. The acidity of the C-2 protons in *2b* and *2e* are presumably almost the same and hence the increase in *S*-vinyl formation with increase in the bulkiness of the 5-substituent is ascribed to steric reasons. The 3-methyl derivative *2d* yielded also both the *N*-vinyl *4d* and the *S*-vinyl *6d* isomers, the ratio being 3:1. The rate of product sublimation from *2d* is slower than from its other methyl isomers, which indicates that vinyl formation occurs less readily. Reduced acidity of H-3 because of the properties of the 3-methyl group and possibly steric effects, would act to reduce the ease of *N*-vinyl formation. On the other hand a phenyl group in the 3-position is seen to stabilise a carbanionic centre at C-3 to the extent that only the *N*-vinyl product *4f* is formed even though *2f* also carries a 5-methyl substituent.

The *S*-propenyl derivative *6d* was stereochemically pure.[9] In contrast the corresponding *N*-vinyl isomer *4c* is obtained as a mixture of the *trans* and *cis* isomers in the ratio 2:1 which is also the isomer ratio from decarboxylation of the 3-carboxy derivative of *2* (R^1=Me, R^2=CO_2H, R^3=H).[2]

The series of *N*-vinyl and *S*-vinyl isomers display different UV spectra in ethanol solutions; the *N*-vinyl derivatives *4c*[1], *4d* and *4e* are characterised by absorption maxima in the regions 370–375, 275–280 and *ca* 260 nm whereas the maxima for the *S*-vinyl analogues *6d* and *6e* occur at *ca.* 310 and 250 nm.

Pyrolysis of dihydrothiazolo[3,2-a]pyridinium-8-olates 2 *in potassium carbonate.* The dihydrothiazolo[3,2-*a*]pyridinium-8-olate was ground well together with three times its weight of anhydrous potassium carbonate and the mixture heated at 150–180 °C/2–15 Torr for *ca.* 90 min. The vinyl derivatives are sublimed from the pyrolysis mixture as they are formed. Recrystallisation of the sublimate from an alcoholic or aqueous alcoholic solution removes any cosublimed betaine. The yields were of the order 30 %. Physical data for new compounds prepared are given below. Compounds *2a*, *2b*, *2c* yielded the *N*-vinyl derivatives *4a*, *4b*, *4c* with properties as previously described by decarboxylation of *2* (R^2=CO_2H); also the *trans*:*cis* ratio for *4c* was the same.[2]

N-*Isopropenyl-3-hydroxypyridine-2-thione* 4d *and 2-propenylthio-3-hydroxypyridine* 6d was formed from 3-methyl-8-hydroxydihydrothiazolo[3,2-*a*]pyridinium chloride [6] as above. The reaction in this case was much slower and the sublimate contained *ca.* 30 % of the unreacted betaine. The latter was removed by trituration with water. The product thus obtained consisted of the *N*-vinyl *4d* and the *S*-vinyl *6d* isomers in the ratio 3:1. The isomers were separated on a silica gel column using MePh–AcOH–MeCN (10:1:10) as eluent. The *S*-vinyl isomer is first eluted, m.p. 146 °C ($CHCl_3$). Anal. for C_6H_6NOS: C, H. ^{1}H NMR ($CDCl_3$): δ 1.8 (Me, *J* 6.5 and 1.5 Hz), overlapping of vinyl signals at 3.5–4.4. UV (EtOH, log ε) 311 (3.90), 250 (3.87) nm.

N-Vinyl isomer; m.p. 93 °C (MeOH). Anal. C_8H_9NOS: C, H. ^{1}H NMR ($CDCl_3$): δ 2.3 (Me), 5.1 and 5.2 (CH_2, *J* 1 Hz). UV (EtOH, log ε) 373 (4.06), 280 (3.75) nm.

N-*Vinyl-3-hydroxy-6-isopropylpyridine-2-thione* 4c *and 2-vinylthio-3-hydroxy-6-isopropylpyridine* 6e were formed from 5-isopropyl-8-hydroxydihydrothiazolo[3,2-*a*]pyridinium bromide [2] as above. The ratio *N*-vinyl–*S*-vinyl isomer in the sublimate was 1:4. The isomers were separated on a silica gel column using BuOH–EtOH (4:1) as eluent; the *S*-vinyl isomer *6e* is first eluted as an oily material which was purified by distillation (sublimation) at 90 °C/15 Torr. Anal. $C_{10}H_{13}NOS$: C, H. ^{1}H NMR ($CDCl_3$): δ 1.3 and 7.1 (iPr), 5.35 (*J* 9.5 Hz) and 5.4 (*J* 17 Hz) (CH_2, J_{gem} < 1 Hz), 7.1 (CH), 6.9 and 7.1 (Pyr., *J* 8 Hz). UV (EtOH, log ε): 312 (4.00), 248 (3.99) nm.

The physical properties of *4c* have previously been reported.[2]

N-α-Styryl-3-hydroxy-6-methylpyridine-2-thione 4f was formed from 3-phenyl-6-methyldihydrothiazolo[3,2-*a*]pyridinium-8-olate [7] as above: M.p. 115 °C (EtOH: H_2O). Anal. $C_{14}H_{13}NOS$: C, H. ^{1}H NMR ($CDCl_3$): 2.2 (Me), 5.3 and 6.2 (CH_2, *J* 1.5 Hz), 6.6 and 6.9 (Pyr., *J* 8 Hz), 7.2 (Ph). UV (EtOH, log ε): 366 (4.03), 246 (4.14) nm.

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