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REACTIONS OF ACYL-AMINOQUINONE TOSYLHYDRAZONES SYNTHESIS OF PYRROLO[1,2-a]INDOLOQUINONE VIA BENZOXAZOLINE BY THERMOLYSIS AND PHOTOLYSIS

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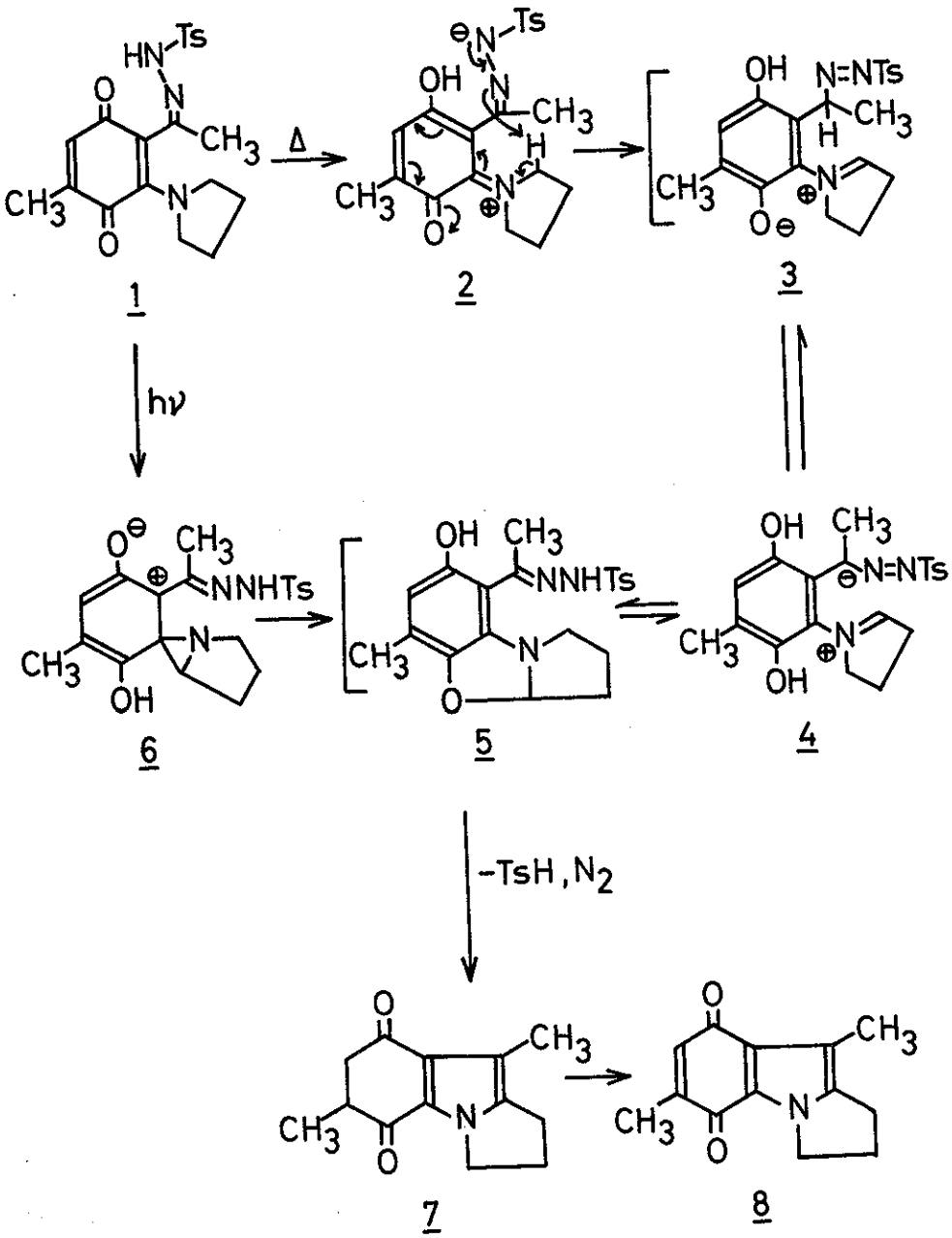
The photolysis and thermolysis of the acetyl-pyrrolidinoquinone tosylhydrazone (1) afforded the benzoxazoline (5) in a good yield, which then turned into 2,3-dihydro-6,9-dimethyl-5,8-dioxo-1H-pyrrolo[1,2-a]-indole (8) having the mother skeleton of mitomycins.

Recently we reported[1] the results of the thermolysis of the acyl-aminoquinone tosylhydrazone (1). These investigations pointed to the formation of the carbene intermediate which yielded the pyrrolo[1,2-a]indoloquinone (8). This paper describes the formation of the intermediate, a benzoxazoline (5), which then turns into (8), in the photolysis and the thermolysis of (1).

The photolysis of (1) in benzene solution using a high pressure mercury lamp through Pyrex glass gave a new compound in a high yield. The same product (70%) was also obtained from a refluxed solution of (1) in benzene or ethanol. The product, a yellow crystalline material, has been assigned as a structure (5) [decomp. 129°; ir 3430 (OH), 3100 (NH), 1640 (C=N), 1600, 1410, and 1170 (SO_2) cm^{-1}; nmr ($CDCl_3$) δ 10.36 (1H, s, OH), 9.40 (1H, broad, NH), 7.70 (2H, d, J = 8Hz, Ar-H), 7.30 (2H, d, J = 8Hz, Ar-H), 6.12 (1H, s, Ar-H), 5.70 (1H, t, J = 3Hz, oxazoline proton), 3.2-1.6 (6H, m, CH_2), 2.46 (3H, s, CH_3), 2.38 (3H, s, CH_3), and 2.04 (3H, s, CH_3); UV λ_{max}^{EtOH} (ε) 238 (1.98×10^4), 337 (1.10×10^4), and 413 (2.57×10^3)]. The product (5) is unstable for refluxing in chlor-


HN-Ts
N
O
CH3
CH3
O
Δ
⊖N-Ts
OH
N
CH3
H
CH3
O
N=NTs
CH3
H
CH3
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1
2
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NNHTs
CH3
N
OH
OH
CH3
NNHTs
CH3
N
O
OH
CH3
⊖N=NTs
CH3
N
OH
6
5
4
-TsH, N2
O
CH3
CH3
N
O
7
8

Scheme I

obenzene or dimethylformamide.

Heating (5) in chlorobenzene solution, (7) (19%) and (8) (23%) were obtained as major products. Ditolyl disulfide and ditolyl thiolsulfonate were also isolated in small amounts. The structure of (7) was confirmed by the following spectral data and the chemical methods [mp 130-131°; ir 1660 (CO), 1470, 1210, and 1120 cm^{-1}; UV λ_{max}^{EtOH} (ε) 222 (1.17×10^4), 236 (1.21×10^4), 282 (8.03×10^3), and 333 (1.07×10^4); nmr ($CDCl_3$) δ 4.34 (2H, t, J = 6Hz, NCH_2), 2.6-3.2 (7H, m, $3CH_2$ and CH), 2.30 (3H, s, CH_3), and 1.32 (3H, d, J = 6Hz, CH_3); ms. m/e 217 (M^+)].

When refluxed in dimethylformamide, (7) was converted into (8) in a quantitative yield. Reduction of (8) with sodium hydrosulfite in water-chloroform afforded (7), in which the keto form[2] usually appears to favor.

From these experiments, the following mechanism seems to be reasonable for the formation of (8) from (1). The reaction probably proceeds through a spiroaziridine intermediate (6) formed by γ-hydrogen abstraction[3] on photo-excitation of (1) (presumably the hydrogen of NCH_2 favored over that of CH_3), which undergoes cleavage leading to the formation of an equilibrium mixture of (3), (4), and (5). On the other hand, in case of the thermolysis the present reaction is basically analogous to that proposed by J. Lynch et al.[4] as shown in Scheme I.

The formation of (7) and (8) may be explained as occurring from the intramolecular cyclization of the zwitter ion (4) to (5) together with the elimination of nitrogen and toluenesulfinic acid. Further (7) undergoes the dehydrogenation to form (8). In fact, (1) was directly converted to (8) by refluxing in dimethylformamide in a good yield.

This step-wise procedure via the benzoxazoline appears to be distinctly more versatile than the original procedure[1], which also afforded indazoloquinones, for the synthesis of pyrrolo[1,2-a]indoloquinones and related compounds.

Further observation on the photolysis and the thermolysis of substituted aminoquinones other than tosylhydrazone function will be the subject of future communications.

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