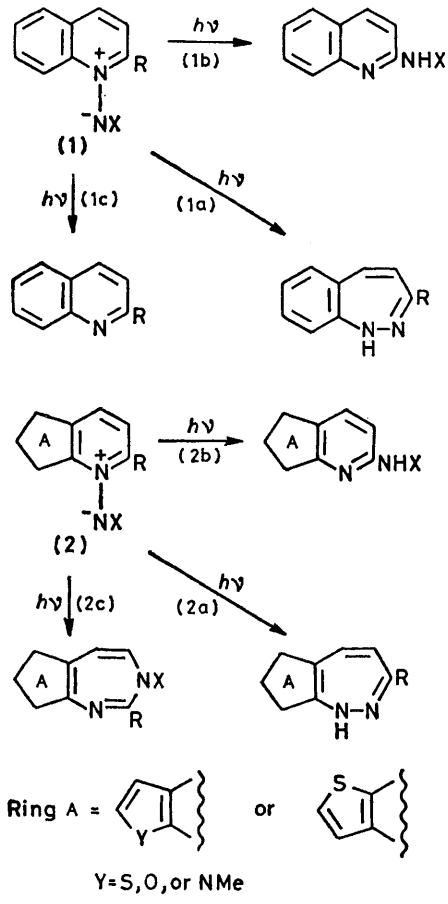
Formation of 3*H*-1,3-Benzodiazepines from Quinoline *N*-Acylimides

By TAKASHI TSUCHIYA,* SATORU OKAJIMA, MICHIKO ENKAKU, and JYOJI KURITA
(*School of Pharmacy, Hokuriku University, Kanagawa-machi, Kanazawa, 920-11, Japan*)

Summary Photolysis of the quinoline *N*-imides (**3**) having an electron-donating substituent in the 6- or 8-position affords the corresponding 3*H*-1,3-benzodiazepines (**4**), whereas quinolines having an electron-donating group in

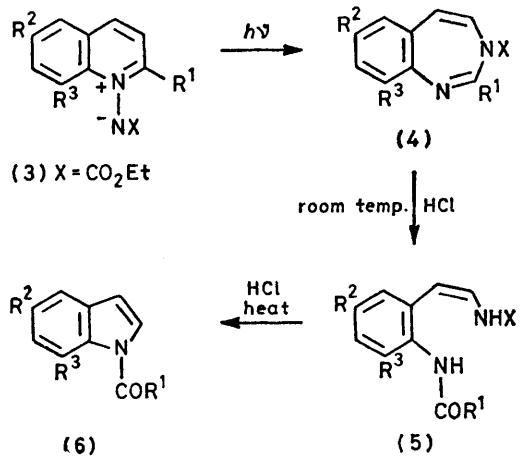
the other positions or an electron-withdrawing group give no diazepines.

IT is known that the quinoline and related fused pyridine *N*-imides (**1a**) and (**2a**) undergo photo-induced rearrangement to give the corresponding fused 1*H*-1,2-diazepines,[1,2] whereas the *N*-acylimides (**1b**) and (**2b**) (X = CO_2Et, COPh, or Ac) give only fused 2-aminopyridines and no diazepines.[3] We have recently reported that photolysis of the 2-substituted fused pyridine *N*-acylimides (**2c**) gave the corresponding fused 3*H*-1,3-diazepines.[4] However, the 2-substituted quinoline *N*-acylimides (**1c**) have been shown to undergo only N–N fragmentation to give the parent quinolines and no rearrangement products.[3,5] We have also recently reported the conversion, by heating, of 1,2-diazepines, prepared from pyridine *N*-acylimides having an electron-donating group in the 3-position, into 1,3-diazepines.[6] These results prompted us to examine the photolysis of substituted quinoline *N*-acylimides in more detail and we now report the first examples of the formation of 3*H*-1,3-benzodiazepines from quinolines.



a; X = H
b; X = CO_2Et, COPh, Ac; R = H
c; X = CO_2Et, COPh, Ac; R ≠ H

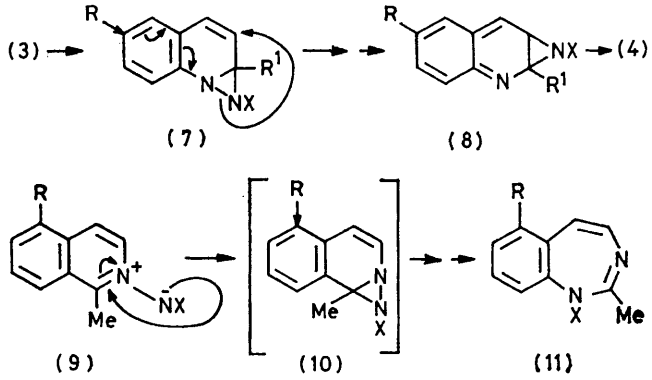
SCHEME 1



a; R^1 = Me, R^2 = OMe, R^3 = H
b; R^1 = Me, R^2 = NMe_2, R^3 = H
c; R^1 = Me, R^2 = Me, R^3 = H
d; R^1 = Me, R^2 = H, R^3 = Me
e; R^1 = H, R^2 = OMe, R^3 = H

SCHEME 2

Irradiation (400 W, high-pressure Hg lamp; Pyrex filter) of the quinoline *N*-ethoxycarbonylimides (**3a**—**e**) having an electron-donating group in the 6- or 8-position resulted in the formation of the corresponding novel 3*H*-1,3-benzodiazepines (**4a**—**e**).† Treatment of the resulting diazepines (**4**) with 10% aqueous HCl at room temperature gave the ring-opened products (**5**), which were converted into the indoles (**6**) by further treatment with HCl at 70—80 °C; these results are analogous to those observed for fused 3*H*-1,3-diazepines obtained from (**2c**).[4]



X = CO_2Et
a; R = H, **b**; R = OMe, **c**; R = NMe_2

SCHEME 3

† Satisfactory elemental analyses and spectral data were obtained for the 1,3-diazepines (**4**), *e.g.*, (**4a**): *ca.* 50% yield; m.p. 62—64 °C; $\lambda_{max}(\epsilon)$ (EtOH) 219 (18,000) and 256 nm (14,000); δ ($CDCl_3$) 2·44 (3H, s, 2-Me), 3·78 (3H, s, 7-OMe), 6·13 (1H, d, 5-H), 6·27 (1H, d, 4-H), 6·62 (1H, d, 6-H), 6·82 (1H, dd, 8-H), 7·16 (1H, d, 9-H), and 1·30 and 3·78 (3H, t, and 2H, q, CO_2Et), $J_{5,4}$ = 7, $J_{6,8}$ = 3, $J_{8,9}$ = 9 Hz; (**4b**): 25%, m.p. 115·5—117 °C; (**4c**): 8—10%, m.p. 110—111·5 °C; (**4d**): 8—10%, oil. The diazepine (**4e**) decomposed during separation to give the ring-opened product (**5e**): 5%, m.p. 106—107 °C.

However, quinoline *N*-acylimides having an electron-withdrawing group (Ac, CO_2Me, NO_2, or Cl) in the 6- or 8-position gave the parent quinolines, but no diazepines, on irradiation. Similarly, quinolines with an electron-donating or withdrawing group in the other ring positions also gave no diazepines. These results clearly indicate that the presence of an electron-donating substituent in either the 6- or the 8-position is essential for the rearrangement of (**3**) to (**4**).

The formation of the 1,3-diazepines (**4**) from (**3**) may involve the diaziridine intermediate (**7**), which then rearranges to the aziridine (**8**) followed by ring-expansion to (**4**), analogous to the photolyses of (**2c**) and 1-substituted isoquinoline *N*-imides.[7] The electron-donating groups may assist both the cleavage of the N–N bond in (**7**) and the cyclization of the resulting dipolar intermediate to give (**8**). Although electron-donating substituents at C-3 in the pyridine ring give no such assistance, this substituent effect is analogous to that observed for the thermal conversion of monocyclic 1,2-diazepines into 1,3-diazepines.[6]

In addition, a similar substituent effect was observed for the photo-induced rearrangement of the isoquinoline *N*-imides (**9**) into the 1*H*-1,3-benzodiazepines (**11**), for which the yields of (**11b**) (40%) and (**11c**) (35—40%) were higher than that of (**11a**) (15—20%).

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