

AZIDO-NITRILE FORMATION IN SCHMIDT REACTION AND
ITS THERMAL CYCLISATION TO A TETRAZOLE⁽¹⁾

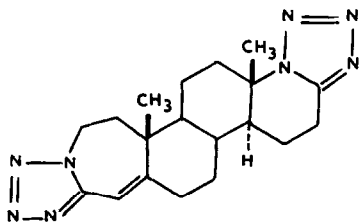
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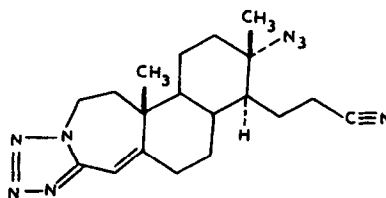
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We treated 4-androstene-3,17-dione with excess hydrazoic acid and boron trifluoride diethyl etherate in chloroform solution. The work up yielded products A and B, analysing for composition $C_{19}H_{26}N_8$, in 26.6 and 7% yields, respectively. The product A exhibited the characters: m.p. 320-322^o; λ_{\max}^{EtOH} 242 nm (log ϵ 4.25); ν_{\max}^{KBr} 1650, 1530 and 1450 cm^{-1} ; NMR($CDCl_3, \delta$) 1.34(s, 3H), 1.46(s, 3H), 3.00(m, 2H), 4.55(m, 2H) and 6.58(s, 1H); and product B: m.p. 170-172^o/~300^o; λ_{\max}^{EtOH} 242 nm (log ϵ 4.23); ν_{\max}^{KBr} 2250, 2095, 1650, 1530 and 1450 cm^{-1} ; NMR($CDCl_3, \delta$) 1.26(s, 6H), 2.49(m, 2H), 4.56(m, 2H) and 6.57(s, 1H).

The spectral data indicate the presence of 3-aza-A-homo-4a-eno[3,4-d]-tetrazole system in both the products⁽²⁾. On mechanistic consideration the 17-keto will be expected to yield 17a-aza-D-homo[17a,17-d]tetrazole entity, and presence of this in A is supported by a complex multiplet at δ 3.00(2H), which can be assigned to 16-methylene protons⁽³⁾. As such, product A has the bistetrazolosteroid structure (I). The product B shows nitrile (2250 cm^{-1}) and azide (2095 cm^{-1}) functions, which could result by cleavage of ring D. It exhibited a singlet at δ 1.26(6H), which on addition of a drop of benzene to the $CDCl_3$ solution, split into two singlets



(I)

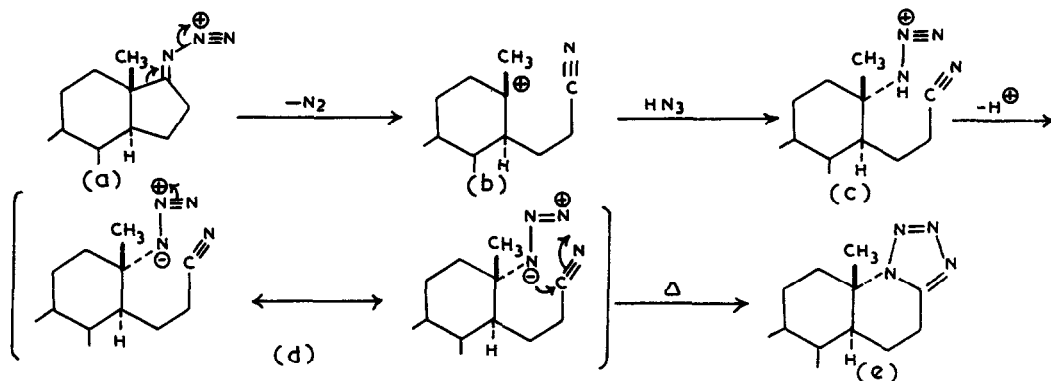


(II)

(δ 1.16, 3H; δ 1.20, 3H), accounting for the presence of two methyl groups. The signal at δ 2.49 (2H) can be assigned to $-\text{CH}_2-\text{C}\equiv\text{N}$ methylene function. This appears to be the first instance of isolation of an azido-nitrile in Schmidt reaction, though the fission of *t*-butyl alkyl ketones under the conditions and the resulting carbonium ion being involved in electrophillic aromatic substitution has been reported earlier⁽⁴⁾.

Heating product B at 250° for 10 minutes and work up yielded a product which by mixed m.p., tlc, mixed tlc, and spectral comparison was exactly identical with (I) (product A). Apparently product B has structure (II).

The following may be part of the sequence of reactions involved in the formation of product B and its cyclisation to A, the carbonium ion (b) retaining



its configuration; however, possibility of approach of azide from the rear in (a) leading to (d) cannot be excluded. The thermal cyclisation of azido-nitrile (d) to tetrazole (e) is rarely reported. The other example of intramolecular thermal cyclisation is of 2-azido-2'-cyanobiphenyl⁽⁵⁾, and for intermolecular reaction without a catalyst it seems particularly necessary that the nitrile function be sufficiently activated by electron withdrawing groups⁽⁶⁾. These may be 1,3-dipolar additions.

References

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