Radiation- and Ultraviolet-induced Reactions of Caffeine with Alcohols

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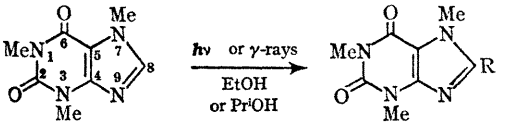
PURINES have been reported to be less reactive in photochemical reactions than pyrimidines, and it has been claimed that purine moieties in nucleic acids participate in the physical processes (*e.g.* absorption, energy transfer) of the photochemical reactions, rather than undergoing chemical changes during irradiation.[1] We report our results on the γ-ray- and u.v.-induced reactions of caffeine with alcohols. The reactions could be induced directly, or sensitized radiolytically or photochemically with a ketone, leading to substitution products at the purine 8-position in yields of up to 80%. With propan-2-ol both the γ-ray-induced and the photochemical reactions led to the dimethylcarbinol (I); with ethanol, however, the γ-ray-induced reaction led to the methylcarbinol (II) and 8-ethylcaffeine (III) in 1 : 1 ratio,

whereas the photochemical reaction led to (III) as the only product. The reactions can be summarized as follows:



(I) R=Me_2COH
(II) R=MeCH·OH
(III) R=Et

The photochemical reactions of purine and alcohols reported recently[2] have been shown to give addition products in which the carbinol groups are located at the purine 6-position.

Typically, caffeine (1·5 g.) dissolved in propan-2-ol (100 ml.) and acetone (100 ml.) was exposed to γ-rays† for 30 hr. to give the dimethylcarbinol (I) (1·3 g., 67%), m.p. 199—200°; u.v. initiation‡ gave the same product in 78% yield. In addition, some substitution at the N(7)-methyl group took place in poor yields. Longer irradiation led to higher yields of these disubstituted caffeine derivatives.

The products were isolated by chromatography on silica gel and identified by their elemental analyses, i.r., n.m.r., and mass spectra, as well as by comparison with authentic samples prepared from 8-acetylcaffeine.[3]

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† ^{60}Co γ-source Gammacell 220 (Atomic Energy of Canada Ltd., Ottawa) the dose rate being 1·27 × 10^{18}ev/ml./min.
‡ Hanovia 450w high-pressure mercury-vapour lamp.

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[2] H. Linschitz and J. S. Connolly, *J. Amer. Chem. Soc.*, 1968, **90**, 2979; J. S. Connolly and H. Linschitz, *Photochem. Photobiol.*, 1968, **7**, 791.
[3] G. Ehrhart and I. Hennig, *Arch. Pharm.*, 1965, **289**, 453.