X-Ray Structure Studies in Some Flavin Derivatives

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RIBOFLAVIN [vitamin B_2, 7,8-dimethyl-10-(D-1′-ribityl)isoalloxazine] was one of the first vitamins for which the chemical structure was determined. Flavin is found in Nature in the form of riboflavin-5′ phosphates as the prosthetic group or part of the prosthetic group of a number of enzymes with redox activity. During the redox process of a flavoenzyme the oxidation state of flavin is changed in steps of one or two equivalents. The physical and chemical properties of flavin derivatives in all the three different states of oxidation have in the last few years been intensively investigated. Special attention has been paid to the properties of light absorption, electron spin resonance, and binding of metal ions.[1]

Although other vitamins and coenzymes (vitamin B_{12} and hæmin) have been investigated by the method of *X*-ray analysis, in the case of flavin coenzymes only the adenine part[2] of FAD (flavin adenosine dinucleotide) has thus far been studied by this method. The present investigation was undertaken to provide accurate three-dimensional structural data.

Crystals of 1,3,10-trimethylisoalloxazinium iodide, $C_{13}H_{13}N_4O_2I$, were investigated first. The compound crystallises in space group $P2_1/n$ with

$a = 12{\cdot}905$, $b = 16{\cdot}091$, $c = 6{\cdot}832$ Å, $\beta = 94{\cdot}04°$, and $Z = 4$.

By using an automatic General Electric single-crystal orienter XRD6, 932 significant reflexions were recorded. Cu-K_α radiation was used. The structure was solved by the heavy-atom method and refined by full-matrix least-squares analysis to a present R-value of 0·054. So far, anisotropic temperature factors have been used for iodine only and no hydrogen positions have been included.

The structure of the cation is shown in the Figure. The ring skeleton is nearly planar but ring (I) is slightly bent out of this plane through the bonds C(4)–C(12) and N(1)–C(11). Least-squares planes calculated for each of the rings, with substituted groups excluded, show that no significant deviation from a plane exists in ring (III). No atom within the two other rings deviates more than 0·1 Å from the corresponding planes. The two carbon atoms C(15) and C(16) deviate most from the planar ring system and are located approximately 0·8 Å on either side of a least-squares plane through the ring skeleton.

The calculated C(7)–C(8) distance is as short as 1·32 Å, but this may be considered somewhat uncertain and related to the unusually high "temperature factors" obtained for these atoms.

Within the present research programme, full three-dimensional X-ray diffractometer data have also been collected for 1,3,7,8,10-pentamethylisoalloxazinium iodide, 5-acetyl-1,3,7,8,10-pentamethylisoalloxazine, and a silver salt of riboflavin.[3] The structure determinations of these compounds are in progress.

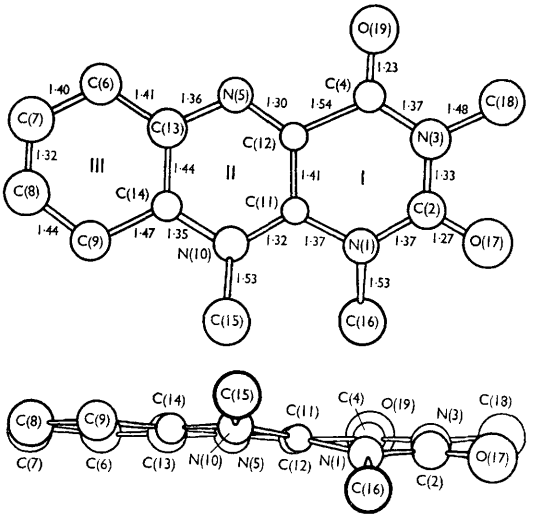

FIGURE. *The structure of the cation in* 1,3,10-*trimethylisoalloxazinium iodide*, $C_{13}H_{13}N_4O_2I$.

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[1] See Papers in "Flavin and Flavoproteins", ed. C. E. Slater, B.B.A. Library, 8, Elsevier, Amsterdam, 1966.
[2] D. G. Watson, D. J. Sutor, and P. Tollin, *Acta Cryst.*, 1965, **19**, 111.
[3] We thank Dr. P. Hemmerich, Institut für Anorganische Chemie, Universität, Basel, Switzerland, for providing some of these compounds.