[CONTRIBUTION FROM THE DEPARTMENT OF BIOCHEMISTRY, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY]

Studies of Crystalline Vitamin B$_1$. XIII. Ultraviolet Absorption of Some Derivatives of the Basic Cleavage Product and their Synthetic Analogs[1]

BY A. E. RUEHLE

Similarity in absorption of an unknown and a known compound is often insufficient to establish an identification. When, however, such a similarity is found to extend to a series of derivatives of each, a high degree of certainty of identification may be achieved. These principles are well illustrated by the case of the basic cleavage product[2] of vitamin B$_1$ and certain of its derivatives. Smakula[3] pointed out a similarity which now appears fortuitous between the absorption spectrum of a cleavage product of the vitamin and the spectra of certain pyrrole derivatives. In the present study a similarity in absorption is shown between the basic cleavage product and its derivatives and a corresponding series of synthetic thiazole derivatives amounting to virtual identification of the nucleus present. This result is in accord with the structural formula for vitamin B$_1$ recently announced by Williams[4] and the further chemical evidence adduced by Clarke and Gurin.[5]

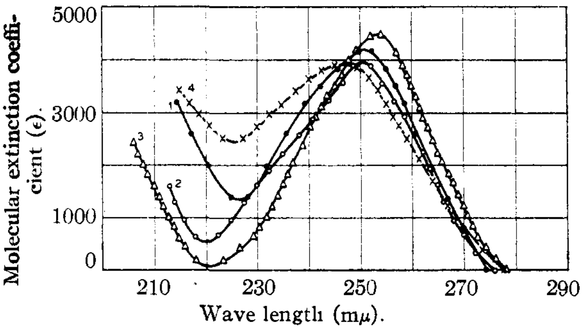

Fig. 1.—1, ●——● Basic cleavage product hydrochloride; 2, ○——○ 4-methylthiazole hydrochloride; 3, △——△ 2,4-dimethylthiazole hydrochloride; 4, ×——× 2-oxy-4-methylthiazole hydrochloride.

Experimental

The method of determining extinction coefficients was that used in obtaining the absorption curve of the vitamin,[6] namely, the use of the Hilger rotating sector photometer and E316 quartz spectrograph. The only innovation was the use of a hydrogen discharge tube as the source in rechecking most of the curves. Eastman I-O ultraviolet sensitized plates were used in exploratory work due to their greater range and latitude, while a more contrasting plate (Eastman DC Ortho) was used for final determination of the absorption spectrum.

I am indebted to my colleagues for samples of the basic cleavage product and its derivatives as well as for samples of synthetic thiazoles.[2,5,7] All samples were dissolved in distilled water and made slightly acid with sufficient hydrochloric acid to ensure the absence of excess free base.

Results and Discussion

The absorption curve of the basic cleavage product is seen in Fig. 1 to be similar to the curves of 4-methylthiazole 2,4-dimethylthiazole, and 2-oxy-4-methylthiazole. In Fig. 2 are shown the curves of the methiodide of the basic cleavage product and of 4-methylthiazole ethiodide. Again there is close correspondence, although the maximum appears at a shorter wave length when the nitrogen is quaternary. The oxidation product of the basic cleavage substance (identical with Windaus' oxidation product from the vitamin) is shown in Fig. 3. This curve agrees moderately well with that shown by Smakula.[3] In the same figure is shown the curve of synthetic 4-methylthiazole-5-carboxylic acid. The correspondence in absorption amounts to identity and the two

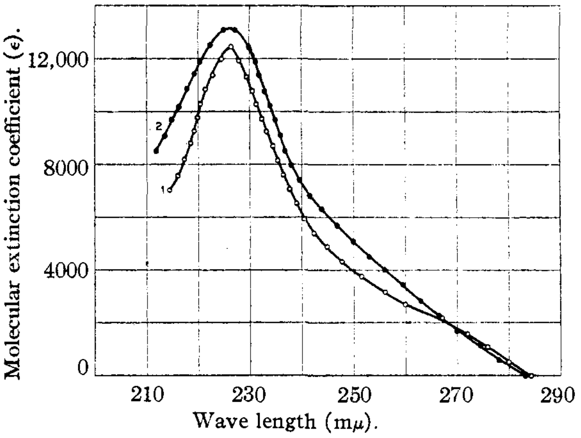

Fig. 2.—1, ○——○ Basic cleavage product methiodide; 2, ●——● 4-methylthiazole ethiodide.

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[1] Presented before the Organic Division of the American Chemical Society at the San Francisco Meeting, August 19, 1935.

[2] R. R. Williams, R. E. Waterman, J. C. Keresztesy and E. R. Buchman, THIS JOURNAL, **57**, 536 (1935).

[3] A. Smakula, *Z. physiol. Chem.*, **230**, 231 (1934).

[4] R. R. Williams, THIS JOURNAL, **57**, 229 (1935).

[5] H. T. Clarke and S. Gurin, *ibid.*, **57**, 1876 (1935).

[6] O. Wintersteiner, R. R. Williams and A. E. Ruehle, *ibid.*, **57**, 517 (1935). Nomenclature of V. Henri, "International Critical Tables," 1929, Vol. V, p. 359.

[7] E. R. Buchman, R. R. Williams and J. C. Keresztesy, THIS JOURNAL, **57**, 1849 (1935).

compounds have in fact been shown by chemical methods to be identical.[5] Absorption curves obtained subsequently on synthetic 4-methyl-5-β-hydroxyethylthiazole and its methiodide show equally close correspondence to the curves of the basic cleavage product and its methiodide, respectively, but are omitted from Figs. 1 and 2 for purposes of clarity. A case in which substitution produced little change in absorption is shown in Fig. 4, where the curves of the basic cleavage product and its chloro derivative (V)[7] are compared. The replacement of the β-hydroxyl group by chlorine apparently does not involve the portion of the molecule associated with the observed absorption.

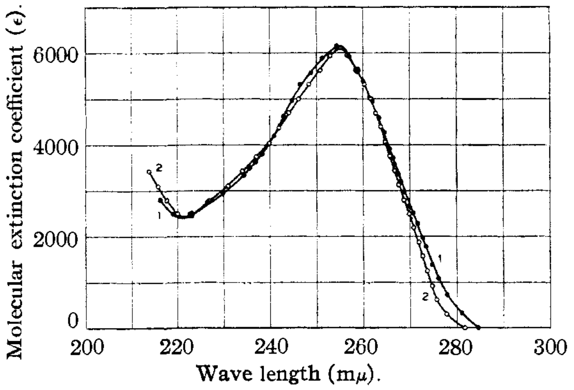

Fig. 3.—1, ●——● Oxidation product of basic cleavage product; 2, ○——○ 4-methylthiazole, 5-carboxylic acid.

I wish to thank Dr. R. R. Williams for suggesting this problem to me and for helpful criticism and advice. I am indebted to Drs. H. T. Clarke, E. R. Buchman and S. Gurin for generously supplying me with the samples used, and especially to Dr. Clarke for the use of the spectrographic facilities in his laboratory. I am further indebted to the Carnegie Corporation of New York through the Carnegie Institution of Washington for financial support in the purchase of materials necessary in the work.

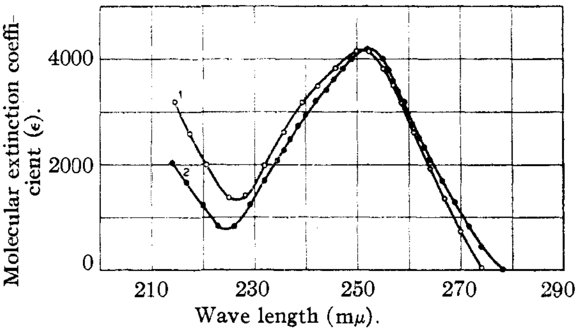

Fig. 4.—1, ○——○ Basic cleavage product hydrochloride; 2, ●——● chloro derivative of basic cleavage product hydrochloride.

Summary

The ultraviolet absorption of the basic cleavage product of vitamin B_1 is not only similar to that of the thiazoles but its derivatives exhibit absorption similar to that of corresponding thiazole derivatives.

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[CONTRIBUTION FROM THE SCHOOL OF CHEMISTRY AND PHYSICS OF THE PENNSYLVANIA STATE COLLEGE]

Nitroso Compounds. IV. Reaction of Ethyl Nitrite with Certain Isopropyl and Cyclohexyl Ketones

BY JOHN G. ASTON AND M. GLENN MAYBERRY

In the present paper further[1] experiments with a variety of ketones and catalysts are described. It was found that when ethyl nitrite reacts with certain isopropyl or cyclohexyl ketones in the presence of concentrated aqueous hydrogen chloride as catalyst, substitution usually occurs both on the branched alpha carbon atom to yield the true nitroso compound and on the primary alkyl group to yield the α isonitroso compound.

$$2(CH_3)_2CHCOCH_2R + 2HNO_2 \longrightarrow 2H_2O + (CH_3)_2C(NO)COCH_2R$$

$$(CH_3)_2CHCOCH_2R + HNO_2 \longrightarrow H_2O + (CH_3)_2CHCOC(NOH)R$$

However, better yields of both products are obtained if acetyl chloride or dry hydrogen chloride is used as catalyst.[2]

The numerical results appear in Tables I, II and III.

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[1] See Aston, Menard and Mayberry, THIS JOURNAL, **54**, 1530 (1932).

[2] In nitrosating menthone to the bisnitroso compound acetyl chloride gave better yields than aqueous hydrochloric acid. (a) Baeyer and Manasse, *Ber.*, **27**, 1912 (1894); (b) Baeyer, *ibid.*, **28**, 1586 (1895).