

mission with the Physiology Department, Tufts University School of Medicine. I wish to thank M. Apicella and B. R. Stone for their able assistance.

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Degradation of Thiotaurine by Ionizing Radiations

THE degradation of sulphur-containing compounds by ionizing radiation has been extensively studied¹⁻³ in view of the protective action of those compounds against radiation damage in animals. Recently, thiotaurine (aminoethylthiosulphonate) has become available for chemical and biological investigation^{4,5}. Since thiotaurine was discovered as a metabolic product of cystine⁶ and cystamine⁷ in the rat, and since it is chemically related to cysteamine, it seemed of interest to study its reactivity towards irradiation with X-rays and γ -rays.

30 μ moles of pure thiotaurine dissolved in 3 ml. of water were placed in a glass vessel 2.5 cm. diameter. The solution was irradiated for a suitable length of time with a Philips 50 kV. X-ray source having a beryllium window. The shorter distance from the window to the centre of the solution was 1 cm. The intensity of irradiation was determined with a ferrous sulphate dosimeter⁸. 0.15 ml. of the solution was withdrawn for analysis at intervals.

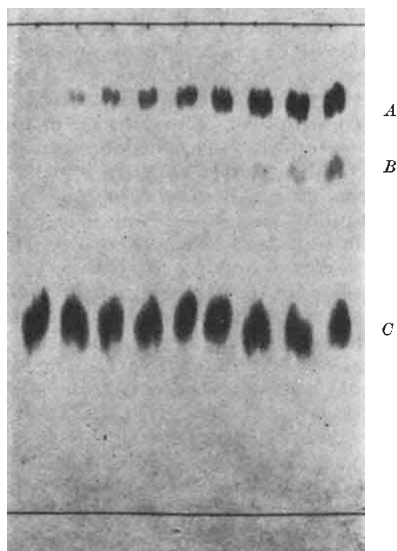


Fig. 1. Progressive chromatogram of the irradiated solution of thiotaurine with X-rays. Dose (r.), left to right, 0, 12,000, 36,000, 60,000, 84,000, 120,000, 240,000, 360,000, 480,000. Descending chromatogram in collidine-lutidine, developed with ninhydrin. 0.5 μ mole of initial thiotaurine spotted at the starting line. A, hypotaurine; B, taurine; C, thiotaurine

As soon as irradiation started it became apparent that some reaction was taking place: the solution became more and more turbid. The degree of turbidity increased with the time of irradiation. The unirradiated control remained clear for a long time.

The material which caused turbidity was identified as colloidal sulphur by sedimentation in a 'Spinco' model L preparative ultracentrifuge at 125,000g, followed by conversion of the washed residue to thiocyanate by the procedure of Bartlett and Skoog⁹.

Some of the compounds produced by the radiochemical degradation of thiotaurine have been detected by paper chromatography. At intervals a sample of the irradiated solution was spotted on a Whatman No. 4 filter paper and the chromatogram was run in collidine/lutidine/water (1:1:1 v/v) and developed with ninhydrin. Apart from a residue of unchanged thiotaurine, two main compounds reacting with ninhydrin appeared on the chromatogram. These have been identified, by careful comparison with the synthetic products and by specific reactions⁶, as hypotaurine and taurine. Hypotaurine is the first degradation product to appear; its spot appears after a dose of 12,000 r. Taurine appears later and only in small amounts.

The production of hypotaurine and colloidal sulphur is consistent with the following overall reaction:



which represents the reversal of the reaction used for the synthesis of thiotaurine from hypotaurine and sulphur⁴.

Essentially the same results have been obtained by irradiating a solution of thiotaurine with a comparable dose of γ -rays from a radium source immersed in the solution. The irradiation of a solution of thiotaurine buffered with phosphate pH 7.4 also gave identical results.

It is of interest that cystamine, one of the best known protective agents against radiation damage, under the same conditions and using the same procedure to detect degradation products, gave only a faint trace of taurine even with the higher doses of X-rays. In the light of these results the comparative effect of cystamine and thiotaurine in the radio-protection of animals is being studied.

This work has been assisted by a grant of the Comitato Nazionale Ricerche Nucleari.

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March 31.

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