Urine of 3 rats given DMSO-S^{35} (0.5 ml/kg i.p.) was collected for 24 h and assayed for DMSO and $DMSO_2$ by this method with the following results (expressed as a ratio of $DMSO_2$ to DMSO content): rat 1, 0.23; rat 2, 0.30; rat 3, 0.25. Quantitative gas chromatographic assay (HUCKER and MILLER[8]) gave the following ratios: rat 1, 0.25; rat 2, 0.35; rat 3, 0.24.

The present method appears to be a quick, accurate way to estimate DMSO and $DMSO_2$ content of solutions containing these compounds. It seems possible that the technique may also be applicable to the analysis of radioactive DMSO in mixtures containing other labeled compounds, provided the latter are not precipitated by $SnCl_4$.

Zusammenfassung. Es wird eine rasch arbeitende Methode für die quantitative Bestimmung von radioaktivem Dimethylsulfoxid und seinem Metaboliten Dimethylsulfon in Lösung beschrieben. Diese Methode beruht auf der selektiven Ausfällung von DMSO als Komplexverbindung mit Stannichloriden.

H. B. HUCKER and E. A. HOFFMAN

Merck Institute for Therapeutic Research, West Point (Pennsylvania, USA), July 18, 1966.

8 H. B. HUCKER and J. K. MILLER, unpublished results.

THEORIA

Theoretical Interpretation of the Saturation Effect in Irradiated Substances

The object of this investigation is the theoretical calculation of the dose-saturation effect by irradiation of a compound. In general, saturation effect means that the number of damaged molecules of a certain compound caused by irradiation (X-rays, γ-rays or fast electrons) does not increase steadily until all molecules are damaged, but reaches a constant value which will not be overstepped by further irradiation. This fact depends on the recombination of the radicals.

The mathematical description of this effect is based on the following model: During the irradiation the radical concentration increases and therefore the average distance between 2 neighbouring radicals becomes shorter. If the distance between 2 neighbouring radicals is small enough, these 2 radicals can recombine. This recombination depends also on temperature, so that recombination increases with mounting temperature.

The mathematical formulation is as follows: Let n be the number of molecules the sample contains. Then after irradiation, with the sample during the time t a constant dose rate, there are n_R radicals and $n - n_R$ undamaged molecules. Now we define

p_G: the expectation for generating radicals, and

p_V: the expectation for vanishing radicals.

The probability W_G for generating a radical with the next incident $h\nu$ is:

$$W_G = \frac{n - n_R}{n}\, p_G \cdot \qquad (1)$$

The probability W_V for a vanishing (recombination) radical is:

$$W_V = \frac{n_R}{n}\, p_V. \qquad (2)$$

The increase dn_R of the radicals per time dt is given by

$$\frac{dn_R}{dt} = A\,(W_G - W_V) = A\left(\frac{n - n_R}{n}\, p_G - \frac{n_R}{n}\, p_V\right) \qquad (3)$$

under the condition of constant dose rate. This differential equation (3) has the solution:

$$n_R = n\,\frac{p_G}{p_G + p_V}\left(1 - e^{-(p_G + p_V)\frac{A}{n}t}\right) \qquad (4)$$

with the initial condition $t = 0$, $n_R = 0$. Here A is a proportional factor including the dose rate. The equilibrium between the generating and vanishing of radicals is reached if $W_G = W_V$. This yields:

$$n_{R\,max} = n\,\frac{p_G}{p_V + p_G}.$$

Eq. (4) is in accordance with the empirically found function of CONGER and RANDOLPH[1] for the dose-dependent radical yields in X-irradiated germ:

$$n_R = n_0\,(1 - e^{-\alpha D}).$$

Also many other investigators have observed an exponential dose-effect curve in irradiated substances. The recent literature is summarized in [2].

Zusammenfassung. Der bei der Bestrahlung mit ionisierenden Strahlen auftretende Sättigungseffekt, d.h. die Abweichung von der Linearität des Verhältnisses zwischen der Strahlendosis und der Zahl der geschädigten Molekeln bei höheren Dosisleistungen, wird unter Zugrundelegung eines einfachen Modells, welches sowohl die Erzeugung als auch die Rekombination der Strahlenschäden berücksichtigt, mathematisch beschrieben.

G. SCHOFFA and G. K. BÜRK

Department of Physics, Technische Hochschule, Karlsruhe (Germany), June 29, 1966.

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2 G. SCHOFFA, *Elektronenspinresonanz in der Biologie* (Verlag G. Braun, Karlsruhe 1964).

CORRIGENDUM

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