THE SENSITIZATION OF MAMMALIAN CELLS TO NEAR ULTRAVIOLET RADIATION KILLING BY THE SUNSCREEN AGENT P-AMINO BENZOIC ACID

P.J. Osgood, S.H. Moss, D.J.G. Davies, School of Pharmacy and Pharmacology, University of Bath, Claverton Down, Bath BA2 7AY.

The acute responses of intact human skin to sunlight are erythema and oedema. The chronic responses include premature ageing of skin and skin cancer formation. The wavelengths largely responsible for these effects are in the range 290-340nm. Formulated sunscreens usually contain an agent which preferentially absorbs in this wavelength range and one of the most widely used is p-amino benzoic acid (PABA). We have previously shown with a model bacterial system that PABA penetrates cells, associates itself to DNA, and sensitises the cell to the lethal effects of ultraviolet radiation of 313nm wavelength, (near UV), Hodges (1977). In order to determine whether these results might indicate a hazard in the use of PABA as a sunscreen agent, more direct evidence was sought by investigating whether PABA sensitised near UV-induced damage in mammalian cells. Mouse lymphoma cells L5178Y were chosen as a convenient mammalian cell line easily grown and irradiated in suspension. The source of near UV was a 200W super pressure mercury lamp, in conjunction with a monochromator and a Mylar filter, the latter effectively cutting out wavelengths below 300nm. The L5178Y cells were irradiated at $0^{\circ}C$ at 10^5 cells per ml in the absence or in the presence of PABA at 0.01 - 0.2%. and of PABA plus 5% dimethyl sulphoxide (DMSO) at 0.01 - 0.5%. The DMSO was used to increase the solubility of PABA at high concentrations, so a parallel set of experiments at low PABA concentrations, with and without DMSO were carried out, to determine the effect if any, of DMSO on PABA sensitisation. Survival data were obtained by plating cells in Fischers medium containing 20% horse serum, solidified with 0.25% Noble agar.

Survival curves in all cases exhibited an initial shoulder at high survival levels, followed by an exponential loss of survival with increase in UV dose. The absorbance of 313nm UV by PABA in phosphate buffer, with and without DMSO was determined for the PABA range examined. From this a modified Morowitz correction, Morowitz (1950), for absorbed UV was made, and the survival curves replotted against corrected dose. From these data the sensitisation ratio, defined as the ratio of dose for 10% survival in the absence and presence of PABA was calculated for each concentration of PABA. The table gives the sensitisation ratios obtained for PABA at 0.01 - 0.2% in the absence and presence of 5% DMSO.

PABA	Sensitisation ratio	PABA/DMSO	Sensitisation ratio
0.01%	0.99	0.01%	1.12
0.02%	1.63	0.02%	1.84
0.05%	2.41	0.05%	3.01
0.10%	3.73	0.10%	5.60
0.20%	6.36	0.20%	10.77

Within the above concentration range, the relationship between sensitisation and concentration of PABA is linear in both cases. Above this concentration the results were less reproducible but the general trend was for the sensitisation ratio to plateau. The slope of the plot of sensitisation ratio against PABA concentration was steeper in the presence of DMSO than that for PABA alone. These results indicate an increased sensitivity of a mammalian cell system to near UV radiation in the presence of the sunscreen agent PABA. We feel these results emphasise the need for screening cosmetic and topical pharmaceutical preparations in particular, sunscreen agents, for the sensitisation of near UV radiation effects.

Hodges, N.D.M., Moss, S.H., Davies, D.J.G. (1977) Photochem. Photobiol. 26, 493-498.

Morowitz, J.M. (1950) Science 111, 229-230.

0022-3573/81/120059P-01$02.50/0