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A microbiological assay for the sun protection factor of sunscreen products

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The ultraviolet radiation from the sun can give rise to sunburn or even skin cancer with metastases (Brash 1997; Donawho & Wolf 1996). However, human vanity dictates that people like to get a sun tan either by sunbathing or using tanning lamps. In order to tan without burning sunscreen products are used. The efficacy of a sunscreen product is measured by its sun protection factor which is defined as the time taken to develop erythema in the presence of sunscreen divided by the time taken in its absence. The sun protection factor was once assessed using shaved rabbits or hairless mice. More recently the trend has been to use human volunteers (Spielman et al 1994). While there have been no reports of short term effects on these volunteers there must be concern about long term effects given the carcinogenic nature of ultraviolet radiation. Consequently there is interest in developing *in vitro* assays (Spielman et al 1994). We have developed an assay using the bacterium *Escherichia coli* to measure the sun protection factor of commercially available sunscreen creams.

E. coli 9002 was grown for 12 to 18 hours in nutrient broth at 37°C. This culture was diluted such that 0.1ml spread on a 9cm petri dish of nutrient agar would give rise to approximately 200 colonies. Sunscreen creams over a range of sun protection factors 4 to 25 were purchased locally. The sunscreen creams were spread onto an ultraviolet permeable membrane at a density of 2.0mg.cm^{-2}. Ultraviolet radiation was provided by a lamp in a sterilizing cabinet. The membrane with or without sunscreen was interposed between the petri dishes and the lamp. Plates were irradiated for 0, 20, 40, 60 or 80 seconds and then incubated at 37°C for 24 hours and the colonies counted. The decimal reduction time, the time taken to reduce the viable count by 90%, was estimated from a plot of log survivors *versus* time of irradiation at each sun protection factor. Only data with a correlation coefficient of greater than 0.9 were used.

The data in Fig. 1 show a good correlation (correlation coefficient of 0.97) between decimal reduction time, D, and log sun protection factor over the range tested.

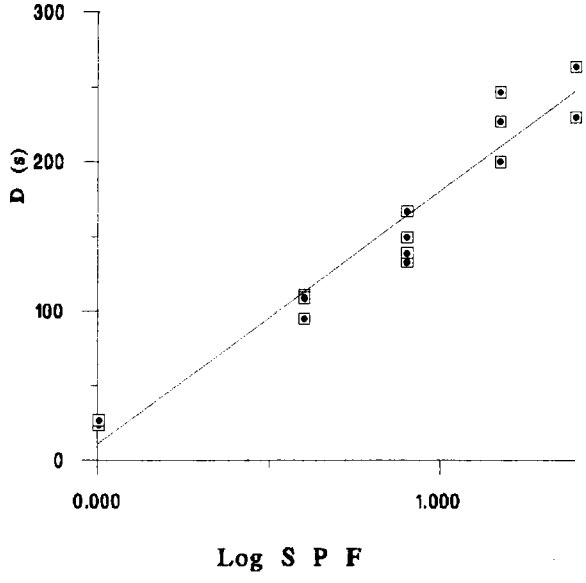

Fig. 1. The relationship between log sun protection factor (SPF) and decimal reduction time (D)

Our study indicates that this microbiological system may provide the basis for an animal-free assay for sunscreen products, although, of course, it does not take into account any skin protection due to the moisturizing effect of the creams.

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