

Title The use of biosimetry to measure the UV-C dose delivered to a sphere, and implications for the commercial treatment of fruit

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Abstract

Commercialization of UV-C treatment of horticultural produce in order to induce beneficial responses in the produce following treatment requires both accurate dose delivery and a method of treating large quantities of produce efficiently. Furthermore, it has long been assumed that such effects require the entire surface of the horticultural commodities – typically fruit – to be exposed to UV-C. This has invariably been achieved by manually rotating the fruit in a UV-C field whilst reducing the dose delivered at each rotation in direct proportion to the number of rotations. However, the resulting UV-C dose distributions achieved under these circumstances are generally not reported in the literature. In the work described here a polystyrene sphere (dia. 70 mm) was used to simulate fruits such as tomatoes, apples, peaches, etc., that have an approximately spherical form in order to provide a means of measuring the total doses of UV-C accumulated during treatment and comparing such estimates to theoretically-derived ones. This was achieved using dosimetry based on spores of *Bacillus subtilis* in which spore-impregnated membranes were attached to the surface of the sphere. The fraction of spores surviving exposure was used to estimate dose from a dose–response curve for the spores. Under irradiation conditions leading to a theoretically calculated dose of 10.6 J, spore dosimetry yielded estimates of 9.1, 10.7 and 6.1 J for UV-C delivered in, respectively, one, two or four exposures. In the case of exposure of the sphere during continuous mechanical rotation for the same length of time (80 s) a value of only 3.5 J was obtained. Irradiation conditions resulting in the spores being subject to intermittent exposure to UV-C led to dose estimates below the theoretically derived ones. The circumstances under which spore dosimetry can be used to obtain surface dose distributions are discussed