Response: Efficacy of ultraviolet sterilization of liquid nitrogen

To the Editor

We would like to thank Professor Parmegiani and colleagues for their interest in our study and the issues that they raised in their letter (Parmegiani et al., 2010). We have an opposite opinion and three publications, mentioned below, can demonstrate that the risk of microbial contamination of cells through liquid nitrogen after ultraviolet treatment is high enough.

Firstly, the bacterium Deinococcus radiodurans, with a diameter of 1.5–3.5 \( \mu \text{m} \), is extremely resistant to ionizing radiation and ultraviolet light and capable of withstanding an acute dose of 5000 Gy of ionizing radiation with almost no loss of viability and an acute dose of 15,000 Gy with 37% viability. A dose of 5000 Gy is estimated to introduce several hundred double-strand breaks (DSB) into the organism’s DNA (~0.005 DSB/Gy/Mbp (haploid genome)). For comparison, a chest X-ray or Apollo mission involves about 1 mGy, 5 Gy can kill a human and 200–800 Gy will kill Entamoeba coli (Wikipedia).

Secondly, the colony-forming ability of ultraviolet-irradiated Mycoplasma cells completely recovered after 3 h in the dark (Aoki et al., 1979). Secondly, the colony-forming ability of ultraviolet-irradiated Mycoplasma cells completely recovered after 3 h in the dark (Aoki et al., 1979).

Thirdly, experiments with the following methodology have been performed. Five ml of filtered human stomatitis virus in a 100-mm open Petri dish was irradiated on a horizontal shaker using two Sylvania G15T8 germicidal lamps set at a distance to give 50 ergs (5 \( \mu \text{J} \)/mm\(^2\)/s. Activation (increasing of viability of viruses) was observed beginning from 5 min of ultraviolet treatment and maximal activation was noted on 10 min of the beginning of ultraviolet treatment (Hampar et al., 1976).

However, the risk in medicine can be principally explanted by necessity of procedure. Thus, the question arises: does the procedure of vitrification need a direct contact of cells with liquid nitrogen? Results of experiments, including our own (Isachenko et al., 2005), have shown that the very quick cooling of cells with direct contact of these cells with liquid nitrogen is not obvious.

References


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