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細胞の重層により真空紫外線照射下での微生物の生存率が高まる
Prolonged survival of multilayer bacteria under UV radiation and vacuum

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In early 20th century, Arrhenius proposed the possible migration of life through space. The Hypothesis is called Panspermia Hypothesis (1908). In the hypothesis, the interplanetary transfer of single spores is propelled by radiation pressure. However, the solar UV has been proven to be lethal for unshielded microorganisms (Nicholson et al., 2000; Horneck et al., 2010), which invalidated his Hypothesis.

Another possible form of the interplanetary transfer of life, micro-aggregate or micro-clump, has just emerged from recent studies. Space environment exposure experiments evidenced that microorganisms in thick layers can survive larger UV doses than single cells. Some bacterial spores in multilayer-spore samples survived intense solar UV radiation, while all the spores in monolayer were killed (Horneck et al., 1994, 1995; Mancinelli and Klovstad, 2000). Terrestrial microorganisms may be transported into the upper atmosphere and space by human activities (e.g., spacecraft launch) and natural mechanisms (e.g., electric field, meteorite impact). Based on the microbiological studies in the upper atmosphere, we have roughly estimated the altitude-dependent distribution of microorganisms, suggesting the extended distribution of microorganisms into space (Yang et al., 2009). Bacterial cell clumps have been found in the upper atmosphere (about 40-km altitude) (Wainwright et al., 2003). The cells of the *Deinococcus* strains (ST0316 and TR0125) we isolated from the upper atmosphere (about 10-km altitude) multiply and grow in aggregated form (Yang et al., 2009).

However, there has no study to quantitatively examine the relationships between microbial survival, size of micro-aggregate and UV doses. It is unknown what size of micro-aggregate may protect some cells inside it from long-term space UV radiation. Our current study investigates quantitatively the survival of bacteria against extraterrestrial UV radiation in dependence of sizes of cell aggregates, assessing the possibility of viable transfer of microorganisms in aggregated form.

We have obtained preliminary data on the survival of *D. radiodurans* against UV_{172nm} radiation under vacuum in dependence of the cell aggregate thickness. At the same UV_{172nm} dose, larger cell aggregate exhibited higher survival rate. The preliminary results suggest that upper layers of cells protected cells underneath from the UV_{172nm} inactivation, and that 20 micrometer of thickness was enough for protecting a high percent of cells at lower layers alive under UV_{172nm} and vacuum conditions.

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