Survivability and DNA damage of *Deinococcus* spp. in cell-aggregates exposed to space in Tanpopo mission

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[Background] The interplanetary transfer of microbes (panspermia hypothesis) is tested in Tanpopo mission on the Exposure Facility of Japanese Experimental Module of ISS [1]. The capture and exposure experiments of terrestrial microbes have started since May 2015. The previous space exposure experiments suggested that microbes inside rocks, which have enougn thickness to shield UV, could survive for a long period in space [2]. On the other hand, we proposed that sub-millimeter cell-aggregate (biofilms) might survive for long time in space (massapanspermia) [3]. We analyzed survival fractions of space-exposed cell-aggregates of *Deinococcus* spp. with various thicknesses. We also investigated DNA damage caused in space environment using DNA repair-deficient mutant strains: *D. radiodurans* UVS78 deficient in the excision repair, rec30 deficient in the homologous recombination repair and KH311 deficient in the non-homologous end-joining.
[Method] Dried deinococcal cell-aggregates in wells of aluminum plates were exposed to space for about one year. The dried cells were resuspended in phosphate buffer and recovered from wells. The cell suspension was inoculated to mTGE agar and incubated at 30ºC before enumerating colonies. The surviving fraction was calculated as the number of viable cells after exposure divided by the number of viable cells without exposure.
[Result and Conclusion] Although the *D. radiodurans* R1 cell-aggregates with less than 100 μm- thickness exhibited a low survival rate, those with more than 500 μm-thickness was well-survived (Fig. 1). It was suggested that DNA damage in the cell-aggregates with more than 500 μm-thickness are readily repaired by homologous recombination and excision repair systems. The surviving fractions of the ground control and the space exposed cell-aggregates with 1000 μm-thickness were comparable. The result might reflect intracellular moisture content that was removed by a long-time space exposure. Low moisture content will help cells to survive in space. From these results, we concluded that the deinococcal cell-aggregate with 500 μm-thickness is sufficient to shield UV, thus surviving for more than one year in space. DNA damage caused in space was mainly base damage such as pyrimidine dimer caused by UV irradiation and double strand breaks.
[References][1] Yamagishi, A. et al., (2007) *Bio. Sci. Space* 21: 67–75; Kawaguchi, Y. et al., (2016) *Astrobiology* 16: 363–367 [2] Onofri, S. et al., (2012) *Astrobiology* 12: 508–518 [3] Kawaguchi, Y. et al., (2013) *Orig. Life Evol. Biosph* 43: 411–428

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