Preliminary study on the survival of extremophilic bacteria against irradiations of synchrotron X-ray and iron ion

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One of major problems in astrobiology is intense radiation, theoretical and experimental studies on panspermia survivability as well as biological protection and tolerance to radiation are needed. We have conducted high dose irradiations of synchrotron X-ray and high energy Fe ion against various microorganisms including extremophiles and assessed their survivability by residual colony-forming units (CFU) and cellular adenosine triphosphate (ATP).

Irradiation of synchrotron X-ray (0.2 nm) at a high dose rate of 500 R/s (8.77 mGy/s) was done at KEK Photon Factory against the dried cells of radiation-sensitive *Escherichia coli* and radiation-resistant *Deinococcus radiodurans*. Both species showed exponential decrease in CFU and ATP against total dose. *D. radiodurans*, showing survival at 56 kGy, was about 100 times resistant compared with *E. coli*. Non-cellular free ATP showed linear (not exponential) decrease with total dose.

Irradiation of 500 MeV/nucleon Fe ion at a dose rate of 0.172 Gy/s (2.5×10^8 particles/s) was done at NIRS HIMAC against the dried cells of *E. coli*, *D. radiodurans* and highly stress-resistant *Virgibacillus* spp. Generally similar results to X-ray irradiation were observed, while *D. radiodurans*, showing survival at the highest experimental dose of 2000 Gy, was as sensitive as *E. coli* at relatively low doses of 50-100 Gy. The *Virgibacillus* cells showed highest survivability due probably to spore formation.