Extremely high UV-C radiation resistant microorganisms from desert environments with different manganese concentrations

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Desiccation resistance and a high intracellular Mn/Fe ratio contribute to ionizing radiation resistance of Deinococcus radiodurans. We hypothesized that this was a general phenomenon and thus developed a strategy to search for highly radiation-resistant organisms based on their natural environment. While desiccation is a typical feature of deserts, the correlation between radiation resistance and the intracellular Mn/Fe ratio of indigenous microorganisms or the Mn/Fe ratio of the environment, has not yet been described. UV-C radiation is highly damaging to biomolecules including DNA. It was used in this study as a selective tool because of its relevance to early life on earth, high altitude aerobiology and the search for life beyond Earth. Surface soil samples were collected from the Sonoran Desert, Arizona (USA), from the Atacama Desert in Chile and from a manganese mine in northern Argentina. Microbial isolates were selected after exposure to UV-C irradiation and growth. The isolates comprised 28 genera grouped within six phyla, which we ranked according to their resistance to UV-C irradiation. Survival curves were performed for the most resistant isolates and correlated with their intracellular Mn/Fe ratio, which was determined by ICP-MS. Five percent of the isolates were highly resistant, including one more resistant than D. radiodurans, a bacterium generally considered the most radiation-resistant organism, thus used as a model for radiation resistance studies. No correlation was observed between the occurrence of resistant microorganisms and the Mn/Fe ratio in the soil samples. However, all resistant isolates

showed an intracellular Mn/Fe ratio much higher than the sensitive isolates. Our findings could represent a new front in efforts to harness mechanisms of UV-C radiation resistance from extreme environments. © 2016 Elsevier B.V.

Desiccation

Extremophile

Manganese

Microbial diversity

Ultraviolet radiation resistance

iron

manganese

iron

manganese

Argentina

Article

bacterium isolate

Chile

Deinococcus radiodurans

desert

desiccation

mass spectrometry

microorganism detection

nonhuman

nucleotide sequence

priority journal

radiation exposure

radiosensitivity

surface soil

survival rate

ultraviolet C radiation

United States

desert climate

drug effects

extracellular space

intracellular space

metabolism

microbiology

phylogeny

radiation response

radiation tolerance

ultraviolet radiation

Desert Climate

Extracellular Space

Intracellular Space

Iron

Manganese

Phylogeny

Radiation Tolerance

Soil Microbiology

Ultraviolet Rays