DIVERSITY OF MICROORGANISMS EXTREMELY UV-C RADIATION RESISTANT ISOLATED FROM MANGANESE DEPOSITS IN DESERT ENVIRONMENTS.

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Introduction: Desiccation resistance and a high intracellular Mn/Fe ratio are thought to contribute to the radiation resistance of *Deinococcus radiodurans* [1]. 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. Desiccation and high levels of ultraviolet radiation are often present in deserts [2], [3], but their correlations with the Mn/Fe ratio of cells, and of the environment itself, have not yet been described. In this study we focused on culture-dependent methods to isolate microorganisms that were extremely resistant to UV-C radiation from desert soil samples containing different manganese concentrations, and to investigate whether the availability of Mn in the environment favors the occurrence of radiation-resistant microorganisms.

Material and Methods: In order to study the occurrence of radiation-resistant microorganisms in deserts with high-Mn availability, 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. Pigmented microorganisms were selected after UV-C irradiation treatments and growth. The isolates comprised 28 genera grouped within 6 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. Microscopy and Raman spectroscopy allowed further insights on the survival mechanisms used by the most UV-C radiation resistant microorganisms isolated until the present date.

Results: Five percent of the isolates were highly resistant and two isolates (*Geodermatophilus* sp. strain MN04-01 and *Hymenobacter* sp. strain AT01-02) were more resistant than *D. radiodurans*, a bacterium generally considered the most radiation-resistant organism and thus used as a model for radiation resistance studies. No correlation was observed between the occurrence of resistant microorganisms and the Mn concentration in the soil samples. However, all resistant isolates showed a Mn/Fe ratio much higher than the sensitive isolates. Electromicrographs of *Hymenobacter* sp. strain AT01-02 using colonies with a clear center revealed the presence of viral-like particles, which might play a role on radiation resistance. Microscopic analysis of *Geodermatophilus* sp. strain MN04-01 revealed the presence of extracellular material, probably Functional Bacterial Amyloid [4] and a dark pigmentation in late stationary phase cultures that strongly absorbs in the UV-C range, as demonstrated by uv-vis absorbance experiments. Raman spectroscopy indicates the pigment is consistant with melanin.

Conclusions: The remarkable diversity of UV-C radiation resistant isolates obtained through our culture methods represents the potential of this type of environment as a bio-resource for both fundamental and applied research. We hypothesize that different biological systems can be dramatically improved through synthetic biology, enabling the design of radiation-resistant microbiological chassis for different purposes. This is the first report of microorganisms more resistant than *D. radiodurans* to UV-C irradiation.

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