Survival of halophilic archaeon Halovarius luteus gen. nov., sp. nov., to desiccation, simulated Martian UV radiation and vacuum in comparison to Bacillus atrophaeus

N. Feshangsaz[1,6*];F. Semsarha[2], S. Hesami Tackallou[3], K. Nazmi[4], E. Monaghan[5], J. van Loon[6,7]

(1) Department of Biology, Science and Research Branch, Islamic Azad University, Tehran, Iran
(2) MIM Daroo Pharmaceutical Co., Tehran, Iran
(3) Department of Biology, Central Tehran Branch, Islamic Azad University, Tehran, Iran
(4) ACTA-Vrije Universiteit, Department of Oral Biochemistry,, The Netherlands
(5) Huygens Laboratory, Leiden University, J.H. Oort Building, The Netherlands
(6) DESC (Dutch Experiment Support Center), Dept. Oral and Maxillofacial Surgery / Oral Pathology, VU University Medical Center & Academic Centre for Dentistry Amsterdam (ACTA), The Netherlands
(7) ESA/ESTEC, TEC-MMG, The Netherlands

Introduction

Some of the most ancient inhabitants on Earth are microorganisms with the capability of coping with high levels of salinity, even ten-fold that of sea water, also able to withstand high temperatures, extreme desiccation and ionizing radiation. Extraterrestrial environments have lethal effects on organisms and imply devastating tensions on their biochemistry due to high levels of radiation, extreme vacuum, temperatures, lack of water and nutrients. Haloarchaea are considered interesting species for astrobiological studies due to their high capabilities of tolerating desiccation, radiation and hypersaline environments.

Materials and Methods

In this study a novel haloarchaea, isolated from Urmia Salt Lake, Iran, *Halovarius luteus* strain DA50^T, was exposed to varying levels of simulated space conditions, UV-radiation, high and low vacuum and desiccation, and compared with *Bacillus atrophaeus*. Thin films were produced with different concentrations from both strains and their viability studied without any protective effect of thick cell multi-layers. *Hvr. luteus* and *B. atrophaeus* were desiccated in salt crystals and PBS, respectively. Resistance to Mars UV light intensity was measured at 54.78 W/m^2. Samples were exposed to desiccation, low and high vacuum conditions and their viabilities were studied by Most Probable Number methods for both strains. The proteome was analyzed by electrophoresis (SDS-PAGE).

Results

Changes in viability of the spore-forming bacteria *B. atrophaeus* were only minor. On the other hand, the halophile strain under the extreme conditions demonstrated a range of different viabilities. The highest intensity radiation flux was 100000 J/m^2 with nitrogen gas and two weeks of desiccation shows the highest decrease in viability. This study further expands our understanding of the boundary conditions of astrobiologically relevant cells to survive the harsh space environment.

Key words

Halovarius luteus, *Bacillus atrophaeus*, desiccation, simulated Martian UV radiation, vacuum, Most Probable Number

Short Summary

Very novel haloarchaea, Halovarius luteus, was exposed to UV-radiation, high and low vacuum, desiccation and compared with Bacillus atrophaeus. These two strains were desiccated in salt crystals and PBS, respectively. The highest intensity radiation flux was 100000 J/m2 with nitrogen and two weeks of desiccation shows the highest decrease in viability.