IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Biology in Space (8)

Author: Dr. Petra Rettberg
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, petra.rettberg@dlr.de

Dr. Elke Rabbow
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, Elke.Rabbow@dlr.de
Ms. Johanna Piepjohn
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, johanna.piepjohn@dlr.de
Dr. Corinna Panitz
RWTH Aachen University, Germany, cpanitz@ukaachen.de
Dr. Kristina Beblo-Vranesevic
Deutsches Zentrum fur Luft- und Raumfahrt e.V. (DLR), Germany, Kristina.Beblo@dlr.de
Dr. Christine Hellweg
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, christine.hellweg@dlr.de

REPAIR OF RADIATION INDUCED DNA DAMAGE IN SPACE - PREPARATION OF THE BIOLAB EXPERIMENT LUX-IN-SPACE

Abstract

In space, all organisms are exposed to and affected by space radiation and microgravity. This applies for microorganisms, plants and animals used as components of bioregenerative life support systems, for cells, tissues and organoids investigated in scientific space experiments and for astronauts. Radiation and microgravity were identified as two of the five most important hazards for manned spaceflight. Therefore, the knowledge of biological space radiation effects as well as the impact of microgravity on enzymatic repair processes is mandatory for risk assessment, especially in view of long duration missions to Mars or permanently inhabited bases on the Moon.

The repair kinetics of radiation induced DNA damages will be investigated with a bioassay, the SOS-Lux Test, in the space experiment LUX-in-Space on the ISS. Bacteria serve as model organisms. They posses the same type of nucleotid excision repair as all other living organisms including humans. *Salmonella enterica subsp. enterica* (ATCC 53648) cells are transformed with the pBR322-derived plasmid pPLS-1, carrying the promoterless lux operon of *Photobacterium leiognathi* as the reporter element controlled by a DNA damage-dependent SOS promoter as sensor element. Due to safety issues, UV radiation was choosen for DNA damage induction. It causes defined types of DNA damage, e.g. cyclobutan pyrimidine dimers, which are among those also induced by ionising radiation. In response to exposure to radiation the SOS promoter is activated. Due to the genetic modification, the connected so-called lux genes are expressed, resulting in the emission of measurable bioluminescence proportional to the applied dose of radiation. The DNA repair kinetics are followed by bioluminescence and optical density measurements.

LUX-in-Space is the first space experiment where the whole series of events from DNA damage induction in metabolically active cells to the different steps of enzymatic repair will take place in real microgravity and the repair kinetics will be monitored *in situ* by optical measurements. The effects of microgravity will be clearly separated from other spaceflight factors by comparison with parallel samples on an onboard 1g centrifuge in the Biolab facility on the ISS and in a parallel ground control experiment with identical samples in flight-identical hardware.