Paper ID: 85501
oral
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IPB)

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THE EFFECT OF SIMULATED MICROGRAVITY BY CLINOSTAT ON THE STABILITY OF CIRCULAR DNA AND CIRCULAR MRNA.

Abstract

In outer space, astronauts face extreme environments that drastically impact health, from molecular to cellular levels within the body and tissues. Gene therapy might offer another approach to curing health issues and diseases caused by radiation and microgravity. Nucleic acid-based gene therapies, comprising DNA and mRNA medicines, which have been experimentally studied in clinical trials for many diseases on Earth, might yield therapeutic results differently when performed in outer space, such as in a space station, due to possible differences in the structural behavior of DNA and mRNA. Thus, the objective of this study is to ascertain that simulated microgravity by a Clinostat affects the stability of circular DNA (plasmid) and circular mRNA, both of which contain a coding sequence for green fluorescence protein (GFP). The stability of the nucleic acid samples was compared at 25^oC under normal gravity versus simulated microgravity at different time points of 12 hours, 24 hours, and 48 hours, respectively, with simulated microgravity being generated by a Clinostat. Gel electrophoresis was performed to determine the stability of circular DNA and circular mRNA. Our preliminary observation found that, throughout the course of the simulation, the integrity of the two types of nucleic acids was not affected by microgravity. This result suggests that microgravity simulation for up to two days does not lead to the degradation

of circular DNA and circular mRNA. In further work, our study will determine nucleic acid integrity by using TapeStation, an automated electrophoresis system, to achieve quantitative data. Additionally, the resulting circular DNA and circular mRNA containing the GFP coding sequence will be introduced into the in vitro culture of mammalian cells to test the expression level of the protein, which offers a functional readout of the nucleic acids. Together, this study will eventually facilitate our understanding of the microgravity effect on nucleic acid structure and stability, leading to a better design approach for gene therapy in outer space medicine.