Tardigrade Mech: A Biomimetic System for Advanced Radiation Protection in Space

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The purpose of this project is to determine how the Damage Suppressor (Dsup) protein is implemented in vivo in tardigrades, demonstrating how Dsup potentially protects DNA from ionizing radiation. Tardigrades are micro-animals that are extremotolerant due to cryptobiosis, allowing protection from high levels of radiation (4 000 Gy for several days). Dsup is a protein largely responsible for this tolerance, able to reduce radiation damage by ~40% due to its C-terminal region. Tardigrades were placed into two groups: ones that underwent cryptobiosis and ones with normal metabolic activity. The first group had a higher survival rate of 85% after induced DNA damage, with a high of 67% in the other group. This demonstrated that Dsup was more effective once it was already deployed. It was predicted the interaction for Dsup was between lysine and phosphate on DNA, because lysine has a higher percent by number composition in the C-terminal region (14%) than any other basic amino acid. Polylysine forms torus complexes with DNA when neutralized as does H1, Dsup was calculated to form complexes 7.7 times larger than H1. This is because it is a larger protein and both use the C-terminus for interaction, making Dsup most likely to neutralize DNA, maximizing binding. The most important aspect of the DNA-Dsup interactions is the electrostatic relationship, since Dsup is intrinsically disordered and is therefore able to follow the folding tendencies of neutralized DNA. A possible application is the use of boron nitride nanotubes due to their high polar binding affinity.

Awards Won:

National Aeronautics and Space Administration: Second Award of $750