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THE ART OF CELLULAR RESILIENCE: UNLOCKING THE SECRETS OF DNA PROTECTION IN A RADIATION-FILLED UNIVERSE

Abstract

Bacteria have been shown to have extraordinary adaptability and resilience, allowing them to thrive in diverse and extreme environments. Radiation exposure is one of the most difficult factors that bacteria can face, as it can cause significant DNA damage. Some bacteria, on the other hand, have developed unique mechanisms to protect and repair their genetic material in such adverse conditions, allowing them to survive and even thrive in radiation-rich environments. In this study, we look at the effect of radiation and its absence on bacterial DNA protection and repair. We investigate the genetic and molecular mechanisms underlying bacterial radiation resistance, such as the activation of specific DNA repair pathways and the production of protective proteins. We do this in both *Escherichia coli* as a standard model organism, and *Cutibacterium acnes*, the most abundant microbe in our skin's microbiome. Genomics, transcriptomics, and proteomics analysis are done to understand how bacteria respond and even adapt to the absence and specific wavelengths of radiation. Our findings shed light on the evolution of these mechanisms and their potential for biotechnological applications. Furthermore, we look at the remarkable survival strategies of tardigrades, which are microscopic animals known for their ability to withstand harsh environmental conditions. We look into a specific DNA protection mechanism found in tardigrades and its potential application to bacterial survival in harsh environments, the Dsup protein. This protein, which is hardly conserved at a genetic level among the different tardigrade species, effectively protects DNA from ionizing radiation, and its effects have been proven to be transferable to other organisms, from bacteria to plants. In this project we identified and characterized new Dsup protein candidates. Our findings have significant implications in environmental science, biotechnology, and space exploration. Understanding the adaptability of bacteria and tardigrades can help us develop new biomaterials and therapies, as well as improve our ability to explore and colonize extreme environments, including those beyond Earth. Join us as we uncover the secrets behind bacteria's and tardigrades' remarkable resilience.