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RADIATION RESISTANCE OF THE TARDIGRADE: RAMAZZOTTIUS VARIEORANATUS –
PATHWAY TO RADIATION RESISTANT ASTRONAUTS?

Abstract

Survival mechanisms of organisms capable to tolerate large degrees of stress remain largely unexplained, despite its relevance to astrobiology. An observation of these organisms (extremophiles) in wide range of environmental conditions clarifies the survival strategies. For example, an environment associated with lowering the temperature, is causing to slow down and even stop the cellular chemistry. Understanding the molecular mechanisms allowing withstanding extreme environment is one of the goals of astrobiology. Extremophiles are mostly unicellular organisms and their adaptation to extreme environmental conditions was widely investigated. In contrast to multiple studies of unicellular organisms, little attention has been paid to multicellular organisms. Among them, the most tolerating organisms are tardigrades, because of their ability to exhibit high resistance to many environmental stresses. These organisms are being considered as a model for astrobiological studies. Tardigrades, or water bears, are invertebrates (0.1-1.0 mm length) found everywhere on Earth, from the bottom of the oceans to the high mountains. They are also found in dry and cold conditions of arctic and Antarctic. When tardigrades become dehydrated their water content drops to less than 3%. In their dehydrated state, tardigrades can survive near absolute zero temperature 0.008K. They also tolerate high doses of radiation, for example: 1000s of Grays of X-rays, gamma rays, and heavy ions. The radiation damage is thought to be due to double strand breaks of their DNA. We are following a working hypothesis that the tolerance against the radiation damage is due to trehalose being produced as part of the chromatin structure. Trehalose is keeping the DNA strands from migration after an occurrence of double strand break and cell can fix the damage.