

## Radiation: water bear to the rescue?

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*A microscopic creature known as the tardigrade possesses a DNA repair system that is very powerful, permitting it to tolerate extreme environmental conditions. Japanese scientists have recently shown that this ability could be used to protect human DNA against radiation.*

Nicknamed “the water bear”, the tardigrade is a microscopic animal (between 0.1 and 1.5 mm in length) which has fascinated scientists for many years. These animals possess an incredible resistance to several extreme conditions that are normally fatal to all living creatures. For example, the tardigrades survive:

- variations in temperature between  $-270^{\circ}\text{C}$  and  $+150^{\circ}\text{C}$ .
- the vacuum of space at 270 km altitude.
- extreme pressure (600 MPa, the equivalent of an ocean depth of 60 km).
- ultraviolet rays 1000 times greater than those received at Earth’s surface.
- the absence of water and food. Tardigrades are capable of dehydrating and replacing lost water with a sugar (trehalose) which acts as a protective factor. This phenomenon, called cryptobiosis, allows the tardigrade to survive for millennia.

### PROTECTION GENES

To identify the cause of this exceptional resistance, Japanese scientists sought to determine the complete genomic sequence of *Ramazzottius varieornatus*, one of the most resistant species of tardigrades<sup>1</sup>.

They initially observed that the animal’s DNA exhibited several adaptations which should improve resistance to physical stress. For example, it possesses a large repertoire of genes (antioxidant enzymes, superoxide dismutases and catalases) which counter the effects of oxidative stress and could thus contribute to survival under extreme conditions. They also noted the absence of certain genes involved in autophagy (degradation of cellular components induced by stress conditions), an adaptation which should favour the resumption of normal animal activities once the environment return to more clement conditions.



One of the principal characteristics of the tardigrade is its extraordinary resistance to radiation and the highlight of the study was the discovery of the protein responsible for this property. Named Dsup (for Damage suppressor), this protein (unique to tardigrades) interacts with DNA and reduces the damage caused by radiation.

Because the tolerance towards X-rays and the adaptation of the animal to severe dehydration require similar mechanisms, it is thus probable that the protein Dsup plays an essential role in the extraordinary resistance of the tardigrade.

### A MOLECULAR SHIELD

Even more interesting, the researchers found that addition of the Dsup protein to human cells was itself sufficient to diminish by half the damage caused by a massive dose of X-rays. Because the protection and repair of DNA plays a fundamental role in several diseases, including cancer, the researchers suggested that this discovery could allow the development of new approaches towards improving the resistance of human cells, such as by protecting against the secondary effects of radiotherapy.

That an animal as strange and small as the tardigrade could one day contribute to improving human health is a good example of the importance of fundamental research based on intellectual curiosity and the desire to better understand the world in which we live.

<sup>(1)</sup> Hashimoto T et al. Extremotolerant tardigrade genome and improved radiotolerance of human cultured cells by tardigrade-unique protein. *Nat. Commun.* 2016;7:12808.