'Damage Suppressor' Protein Protects Adorable Tardigrades ... and Human Cells, Too

By Mindy Weisberger - Senior Writer 24 days ago Animals

The protective protein binds to cell structures that contain DNA.

A protein found only in tardigrades provides cellular DNA with a unique form of protection.
(Image: © Shutterstock)

Scientists recently deciphered a key ingredient in tardigrades' arsenal of superpowers, unraveling how a unique protein in everyone's favorite microscopic water bears acts as a barrier against harmful radiation.

Though tiny, tardigrades are notoriously tough. They can weather extreme conditions that would kill most forms of life, including exposure to freezing cold, broiling heat, and the vacuum and lethal radiation of space.
But what are the chemical secrets that lend tardigrades their near-invulnerability? To answer that question, researchers peered closely at a compound found only in tardigrades: the so-called damage-suppressor protein, or Dsup.

This protein's protective powers were previously found to extend beyond tardigrades; when added to human cells, Dsup safeguards against damage from X-rays. And now, scientists have discovered how Dsup binds to chromosome structures and protects DNA from the harmful effects of radiation, the researchers reported in a new study.

"We thought this fascinating protein in an extreme organism might tell us something new that we wouldn't get from regular proteins," said study co-author James Kadonaga, a professor with the Division of Biological Sciences at the University of California, San Diego.

Though tardigrades may seem indestructible, they require water in order to be active and reproduce. In water's absence, they retreat into a form of suspended animation called a tun state, expelling moisture from their bodies and existing in a desiccated limbo until more-hospitable conditions return.
As tuns, tardigrades are impervious to most forms of harm and can even be revived after decades, possibly even after spending time on the moon. Thousands of tuns may have

been scattered on the lunar surface after the Israeli lunar lander Beresheet (which was carrying a payload of desiccated water bears) crashed on April 11 during a failed landing attempt. Under certain conditions, if they survived the crash landing, those freeze-dried tardigrades could still come back to life, Live Science previously reported.

Seemingly indestructible

Some of the proteins that allow tardigrades to revive after being dried out are found in other organisms, but Dsup is exclusive to water bears. And while prior studies found that this protein made human cells resistant to X-ray radiation, the mechanisms of how Dsup did that were uncertain.

In the new study, the researchers discovered that Dsup binds to a structure called chromatin, a package that holds a cell's long strands of DNA in a dense package, Kadonaga told Live Science.
"We found it binds to chromatin. Then we asked, 'How does it make it resistant to X-rays?'" he said.

When cells are bathed in X-rays, water molecules split and form highly reactive particles of oxygen and hydrogen called hydroxyl radicals; these radicals can damage DNA inside cells, according to the study.
"We thought, 'Why don't we just see if Dsup can protect DNA from hydroxyl radicals?' And the answer is yes, it can," Kadonaga explained. High-energy Dsup has a cloud-like structure; the cloud surrounds the DNA's chromatin envelope, blocking hydroxyl radicals and preventing them from disrupting cellular DNA, the researchers reported.

"Now that we know how it worked, that's a stepping stone to potentially using it for practical applications," Kadonaga said.

By piecing together how Dsup functions at ever-more-precise levels, scientists can then use it as a blueprint for building other types of proteins — "better versions of Dsup" — that are even more effective at protecting cells from DNA damage, Kadonaga said. These new proteins probably won't be used to produce radiation-proof people, but they could improve the hardiness of cultured cells that are used for growing pharmaceuticals, he added.

"You can have more-durable cells, more-longer-lived cells. That might be a case for putting some form of Dsup in that cell," he said.

The findings were published online Tuesday (Oct. 1) in the journal eLife.

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