Tardigrades Genes for Innovation

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Why in News?

Recently, researchers are exploring a range of **unique** tardigrade **features** to inspire advancements in **medicine,** biotechnology, **and space exploration.**

What are the Key Facts About Tardigrades?

- **About:** Tardigrades (*Tardigrada*), also known as **water bears or moss piglets, are microscopic, eight-legged** creatures **without a backbone.**
- **Species and Evolution:** They belong to the **phylum Tardigrada.**
  - The earliest known fossils date from **around 90 million years ago**, in the Cretaceous Period (145 - 66 million years ago).
  - Molecular dating suggests they originated at l**east 600 million years ago.**
- **Adaptations**: Tardigrades are known for their ability to withstand **extreme radiation**, starvation, lack of oxygen and water, and **subzero temperatures.**
  - They can inhabit extreme ecosystems like the **Arctic, deep-sea floors,** deserts, and even the vacuum of **space.**
- **Cryptobiosis**: Tardigrades can enter cryptobiosis, **halting biological activity** to survive extreme conditions like **dehydration, freezing, and radiation damage.**
  - The **DODA1 gene** helps synthesise **betalains,** a type of antioxidants that likely **protect cells from radiation damage** and allows them to **recover and resume** normal activities afterward.

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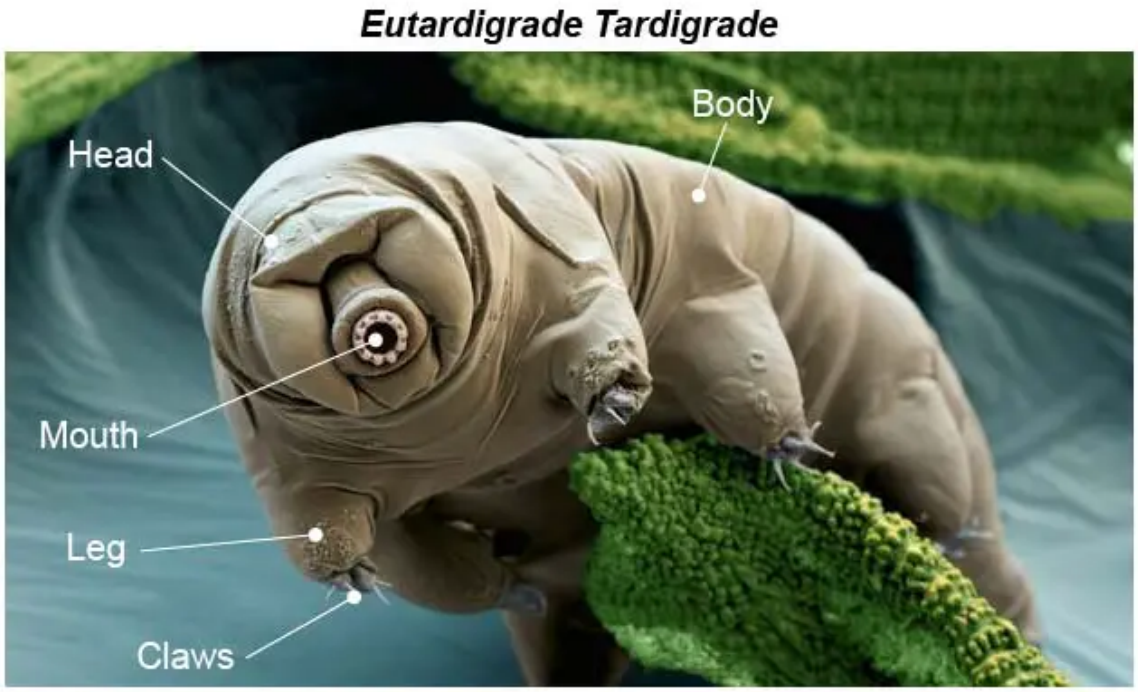

How Tardigrade Properties Could be Applied for Human Use?

- **Intrinsically Disordered Proteins (IDPs): Secretory-abundant heat-soluble IDPs** synthesised in microbes **improve desiccation (completely drying up) tolerance**, potentially enabling resilient microbes and organisms.
- **Small Heat Shock Proteins**: When cloned into microbes, these proteins can improve microbial **survival and stability in hot or dry environments.**
- **Protein Stability**: Tardigrades' ability to stabilise their proteins in extreme environments could be used to improve the shelf life and effectiveness of vaccines, antibodies, **and** enzymes used in medicine.
- **Cell Preservation**: Tardigrades' mechanisms to **resist cellular damage** could be used for **cell therapies,** aiding in transport and storage, and ultimately improving treatment delivery.
    - Researchers may develop enhanced protective measures for **humans and materials in outer space.**