Genetic Adaptation Strategies for Humans Inspired by Extremotolerant Organisms

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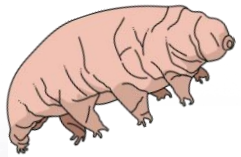
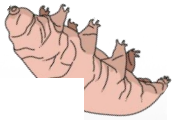
Introduction

In Swedish, the word *lagom* means "just right", a concept similar to the "goldilocks zone". *Lagom* not only reflects a cultural ideal but also defines conditions necessary for survival, on Earth, and other planets.

The human body is sensitive and the harsh environment in space makes life next to impossible. Extreme temperatures, radiation, low oxygen levels and drought are some of the problems we meet in the search for habitable planets. We weigh our options in the hunt for the "just right", but the question remains;

Do we find the *lagom* or do we create it ourselves?



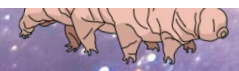


Extreme Creatures on Earth

Extremophiles are organisms able to withstand extreme environments. These creatures have evolved to thrive in some of the harshest places on Earth and may hold the answer to our question.

Their abilities stem from genetic varieties and expressions that produce unique proteins. One example is the tardigrade, a known radioresistant organism that can survive radiation up to 5,000 Gy. Its radio resistance is believed to originate from a damage-suppressing protein (dsup) that binds to its nucleosomes, protecting DNA from damage.

Thermophilic organisms, such as Thermus aquaticus, have already been utilized in medical applications, where their heat-resistant enzymes, taq polymerase, is essential for PCR. Could proteins such as dsup be used to make human more extremophilic?



Protein Delivery into Host Organism

There are several techniques for delivering proteins to an organism. These methods can either be direct, administration of pure protein, or indirect, where the protein is produced inside the cells.

Direct delivery

Pure protein is either synthetically manufactured or isolated and purified from natural sources. It is then injected into the organism intravenously, intramuscularly or subcutaneously. Because of degradation, repeated administrations are required to maintain lasting effects.

Indirect delivery

A gene sequence that encodes the target protein is introduced to the recipiant, allowing cells to produce it endogenously. Gene- and stem cell therapy are both approaches where the desired gene is inserted into a vector system, often viral, such as adenovirus or lentivirus, which then transfers the genetic information into the host cells. When integrated, the cells produce the protein as normal.

Additionally, mRNA-based approaches, similar to modern vaccines, deliver instructions for synthesis without altering the hosts genome. The injections introduce synthetic mRNA into the cells where they are translated into the target protein. This method offers temporary controlled expression with a lower risk of genomic integration.

As previously mentioned, the human body is sensitive. Introducing unknown proteins could trigger adverse reactions and serious side effects. To ensure safety, any new protein should be thoroughly researched and its properties fully understood. Furthermore, animal testing and compliance with regulatory protocols must be completed before initiating human clinical trials.

Conclusion

Even though the idea of extremophile humans may still be far in the future, these approaches could have applications elsewhere. For instance, enhancing radio resistance in humans could potentially reduce cases of melanoma and lower cancer rates overall.

However, human modification raises complex ethical questions. How much can we change and remain fundamentally human? Alongside our efforts in space exploration and the search for habitable planets, we must also consider whether the ideal planet *lagom* truly exists. If it does not, should we not also explore the limits of our own adaptability and change our own perspective on *lagom*?

Refrences
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