Bacteriophages, the ‘good viruses’

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Context:

For such tiny agents, viruses have taken a huge toll on humanity. Outbreaks of viral diseases, such as smallpox, influenza, HIV, and COVID-19 have killed billions and fundamentally shaped societies throughout human history.

But not all viruses are killers. As with bacteria, “good” or “friendly” viruses can also be beneficial for health.

Bacteriophages: Anti-bacterial guard dogs

The vast majority of viruses inside us are bacteriophages — viruses that kill bacteria in our microbiomes.

Bacteriophages, also known as phages, are harmless to human cells as they do not recognize them as their bacterial prey.

They work by hunting down bacteria and attaching themselves to the surface of a bacterial cell, before injecting viral DNA material into the cell.

The viral DNA then replicates inside the bacteria, sometimes by borrowing the DNA replication hardware of the bacteria.

Once enough new viruses have been created inside the bacterial cell, the cell then bursts to release the new viral particles.

Phage therapy: A short history

The ability of phages to take down bacteria had scientists pondering whether they could be used to treat bacterial infections in the early 20th century, but when antibiotics like penicillin came along, that research faded away.

But antibiotic-resistant strains of bacteria are now on the rise, with experts saying antibiotic resistance is one of the greatest medical challenges facing global communities.

As a result, scientists are racing to find new forms of antibiotic agents, putting phages back on the menu as agents to fight bacterial infections.

The advantages of phages lie in their effectiveness against every multi-resistant pathogen

Further, Phages are extremely precise in their elimination of bacterial strains — so much so that you don’t disturb the gut microbiome, as is the case with antibiotics.

Development of Medicines using Phages

Due to the scarcity of antibiotics in Soviet-era Russia, phages were used to treat bacterial infections, and their use has continued in countries like Georgia, Ukraine and Russia for decades.

Georgia is a hot spot for phage tourism, with patients from all over the world going there to be treated with phages. It’s from these clinics that some scientists say we have good evidence that phages can work against infections that are resistant to conventional antibacterial agents.

Georgia has developed into one of the global centers of phage therapy, hosting one of the largest therapeutic collections of bacteriophages in the world.

But countries like Belgium and the US are beginning to use phages for exceptional cases in specialized therapy centers as well.

Germany is beginning to take an interest in phage therapies, too. A research report published on July 18 urged policymakers to ensure phages are better explored and used, not just for human medicine but also for foodborne infections and crop protection.

Limitations of Phages

There are disadvantages to phage therapies that need to be addressed before they are approved for widespread use.

A central problem is that there is no standardization of therapy. Phage therapy must be precisely tailored to the bacteria that cause an infection in a patient

Infections can be caused by bacteria with various properties, so there is a need for cocktail of different phages as a therapy, and that mix of phages has to be available very quickly before the infection gets out of hand

And bacteria do also develop resistance to phage therapies.But phage therapies have good safety records.

Humans ingest billions of phages every day with our food without any relevant side effects. That means our bodies should be able to tolerate phage therapies very well.

The German research report recommends the next steps should include large-scale research and clinical projects to nail down effective phage therapies for different types of infections.

The Way Ahead

For now, bacteriophages are unlikely to replace antibiotics. But scientists are optimistic they could be used in combination to make antibiotics more effective, especially against resistant strains of bacteria