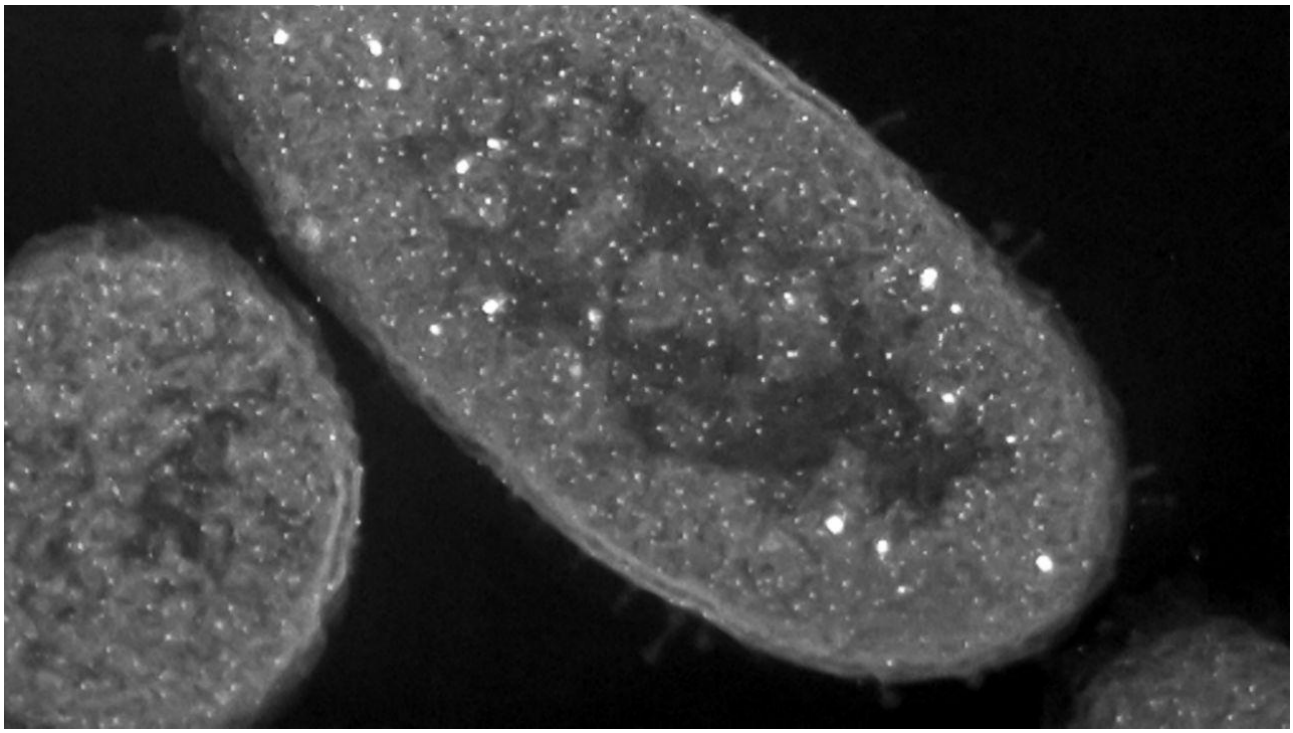

Bacteria killed by silver store it in their cells, making them deadly to other bacteria. Silver nanoparticles are visible inside the bacteria as white spots.

RACHELI BEN-KNAZ WAKSHLAK, RAMI PEDAHZUR, AND DAVID AVNIR

Silver turns bacteria into deadly zombies

By Emily Conover

The zombie apocalypse may be more than just a horror story for some bacteria. New research shows that when exposed to a microbe-slaying silver solution, the germs can “go zombie,” wiping out their living compatriots even after death. The results may explain silver's long-lasting antibacterial power and could improve the performance of medical products that keep us safe from harmful pathogens.

The use of silver in medicine dates back thousands of years, and scientists have long known that the metal is a potent antibacterial agent. Silver ions perform their deadly work by punching holes in bacterial membranes and wreaking havoc once inside. They bind to essential cell components like DNA, preventing the bacteria from performing even their most basic functions.

But silver's "zombie effect" has gone unrecognized—until now. To uncover this grisly mechanism, scientists first killed a sample of the bacterium *Pseudomonas aeruginosa* using a solution of silver nitrate. Then, they carefully separated the dead bacteria from the silver solution. When they exposed living bacteria to the dead, they witnessed a microscopic massacre: Up to 99.99% of the living bacteria met their doom.

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Using electron microscopy, the researchers imaged the dead bacteria and discovered what caused them to go on their killing spree. Reservoirs of silver nanoparticles had built up in their corpses, indicating that the dead bacteria act like sponges, soaking up silver as they die. The stored silver can leach out to the environment, "especially if the environment contains other sponges for that silver," says chemist David Avnir of the Hebrew University of Jerusalem, the senior author of the new study. "In our case, the other sponge is a living bacterium."

The researchers, who published their findings last week in *Scientific Reports*, also looked at the killing power of the solution they separated from the zombie bacteria. When they started with low concentrations of silver nitrate, the leftover solution wasn't strong enough to completely wipe out the second round of bacteria. This indicates the bacteria are actually removing silver from the solution, researchers say. When they started out with high concentrations of silver nitrate, the solution retained its killing power through both groups of bacteria, presumably because the first round of bacteria hadn't been able to soak up all of the silver.

"This is an important aspect of [silver] that I've not seen anyone talk about before," says molecular microbiologist Simon Silver of University of Illinois, Chicago, who was not involved in the research. "This paper is a new spin on it, to me, and I think rather a good one."

The finding could lead to an enhanced ability to control the longevity of silver-based treatments. Doctors and hospitals already rely on an array of silver-infused medical products—from bandages to catheters—to prevent the proliferation of bacteria. The metal is commonly used on severe wounds, and coatings on door handles can cut down on germs. Consumers can even buy products to reduce unwanted microbes at home, like silver-infused socks and washing machines that disinfect clothes with silver.

"Right now, the dominant idea is, if you want a certain lifetime of antibacterial performance, you have to engineer your device to sort of give off these ions over the full course of the time you want this activity," says nanomaterials chemist Robert Hurt of Brown University, who was not involved in the research. But an understanding of the zombie effect could lead to better designs for such products, Hurt says. For example, engineers may now tailor their products to keep dead bacteria around, fortifying their antimicrobial powers and keeping germs at bay.

Zombies might not be so bad after all.

Posted in: **Biology; Chemistry**

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https://www.sciencemag.org/news/2015/05/silver-turns-bacteria-deadly-zombies

MEDICAL NEWS TODAY

Colloidal silver: Does it work and is it safe?

Colloidal silver is a popular dietary supplement. However, very little evidence suggests that it benefits the body.

Many people use colloidal silver to cleanse the gut, boost the immune system, and combat inflammation.

However, official bodies, such as the National Centre for Complementary and Integrative Health (NCCIH), state that colloidal silver can cause serious side effects and that there is no strong scientific evidence for its effectiveness as a home remedy.

Silver is antimicrobial, meaning that it can kill harmful microbes. This is why manufacturers use silver in bandages. However, no scientific findings suggest that it can kill microbes when swallowed.

This article gives an overview of colloidal silver, including its potential risks and how people use it as a homeopathic remedy.

What is it?

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Image credit: Silverliving, 2015.

Colloidal silver is a solution that consists of very small silver particles suspended in a liquid. A “colloid” is a liquid that evenly distributes certain particles within it.

Some people take colloidal silver by mouth as a dietary supplement. Many internet-based sources claim that colloidal silver has a range of health benefits.

However, there is little scientific evidence to support these claims, and ingesting silver may have mild to severe health consequences.

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Safety and risks

According to the NCCIH, regularly taking colloidal silver can cause severe side effects, including the following:

- argyria, which causes a person's skin or eyes to take on a permanent silver-blue tone
- a reduced ability to absorb certain medications, such as antibiotics, which can treat bacterial infections, and thyroxines, which can treat thyroid deficiencies
- fatal poisoning

The *Handbook on the Toxicology of Metals* reports that animals repeatedly exposed to silver may develop anemia, which is an iron deficiency. The authors note that the animals also experienced enlargement of the heart, stunted growth, and harmful changes to the liver.

Scientists have conducted very little research into colloidal silver, which means that there may be additional risks. Also, humans may experience different effects from animals.

Without conducting further research, scientists are unable to determine the safety of regular exposure to colloidal silver. Researchers also do not know whether it interacts with any medications.

People should take the established risks seriously. Anyone interested in taking colloidal silver should speak to a doctor first. It is always a good idea to consult a healthcare professional before taking a natural remedy for the first time.

Uses and alleged benefits

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Many websites and news outlets claim that colloidal silver has a range of health benefits, including the ability to prevent certain diseases.

However, because there has been so little research, it is not clear whether it has these effects.

Some people use colloidal silver as a natural remedy. The purported benefits include:

- cleansing the gut
- boosting the immune system
- treating fungal infections

- improving skin health
- preventing the flu
- preventing shingles
- preventing herpes
- preventing certain types of cancer

Because of the lack of evidence, in 1999 the Food and Drug Administration (FDA) ruled that products containing colloidal silver could not claim to be safe or effective.

According to the NCCIH, there are no known benefits to taking silver orally, and it is not an essential nutrient for the body.

Silver does have some medical uses. It is an effective antimicrobial when applied to a person's skin, meaning that it can kill harmful microbes. This is why some manufacturers use silver in their bandages.

However, little evidence suggests that taking it orally has any benefit to humans.

How does it work?

Silver can kill microorganisms by binding to their cells, without necessarily damaging human cells. Researchers are still looking into the mechanisms behind silver's antimicrobial properties.

However, there is no evidence that colloidal silver has beneficial antimicrobial effects when ingested by mouth.

Summary

Very little evidence supports claims about the health benefits of colloidal silver. Taking large doses may carry significant risks.

Until researchers have conducted more tests, a person should take other medications, ensuring that they are backed by substantial evidence.

- Infectious Diseases / Bacteria / Viruses
- Complementary Medicine / Alternative Medicine

4 sourcesexpanded

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