

Silver makes antibiotics thousands of times more effective

Ancient antimicrobial treatment could help to solve modern bacterial resistance.

Brian Owens

19 June 2013

Like werewolves and vampires, bacteria have a weakness: silver. The precious metal has been used to fight infection for thousands of years — Hippocrates first described its antimicrobial properties in 400 BC — but how it works has been a mystery. Now, a team led by James Collins, a biomedical engineer at Boston University in Massachusetts, has described how silver can disrupt bacteria, and shown that the ancient treatment could help to deal with the thoroughly modern scourge of antibiotic resistance. The work is published today in *Science Translational Medicine*¹.

“Resistance is growing, while the number of new antibiotics in development is dropping,” says Collins. “We wanted to find a way to make what we have work better.”

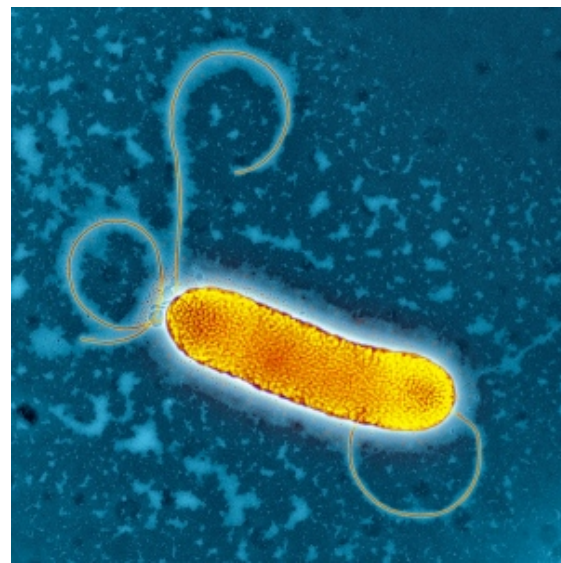
Collins and his team found that silver — in the form of dissolved ions — attacks bacterial cells in two main ways: it makes the cell membrane more permeable, and it interferes with the cell’s metabolism, leading to the overproduction of reactive, and often toxic, oxygen compounds. Both mechanisms could potentially be harnessed to make today’s antibiotics more effective against resistant bacteria, Collins says.

Resistance is futile

Many antibiotics are thought to kill their targets by producing reactive oxygen compounds, and Collins and his team showed that when boosted with a small amount of silver these drugs could kill between 10 and 1,000 times as many bacteria. The increased membrane permeability also allows more antibiotics to enter the bacterial cells, which may overwhelm the resistance mechanisms that rely on shuttling the drug back out.

That disruption to the cell membrane also increased the effectiveness of vancomycin, a large-molecule antibiotic, on Gram-negative bacteria — which have a protective outer coating. Gram-negative bacterial cells can often be impenetrable to antibiotics made of larger molecules.

“It’s not so much a silver bullet; more a silver spoon to help the Gram-negative bacteria take their medicine,” says Collins.



Coloured transmission electron micrograph by CFI/PHE/SCIENCE PHOTO LIBRARY

Silver may help in the fight against drug-resistant bacteria such as *Stenotrophomonas maltophilia* by easing large antibiotic molecules through the microbes' outer coating.

Related stories

- The resistance against resistance
- Scientists map protein that creates antibiotic resistance
- Infectious disease: TB's revenge

More related stories

Toxic assets

Vance Fowler, an infectious-disease physician at Duke University in Durham, North Carolina, says the work is “really cool” but sounds a note of caution about the potential toxicity of silver. “It has had a chequered past,” he says.

In the 1990s, for example, a heart valve made by St. Jude Medical, based in St. Paul, Minnesota, included parts covered with a silver coating called Silzone to fight infection. “It did a fine job of preventing infection,” says Fowler. “The problem was that the silver was also toxic to heart tissue.” As a result the valves often leaked².

Before adding silver to antibiotics, “we’ll have to address the toxicity very carefully”, says Fowler. Ingesting too much silver can also cause argyria, a condition in which the skin turns a blue-grey colour — and the effect is permanent.

Collins says that he and his colleagues saw good results in mice using non-toxic amounts of silver. But, he adds, there are ways to reduce the risk even further. “We’re also encouraging people to look at what features of silver caused the helpful effects, so they can look for non-toxic versions,” he says.

Nature doi:10.1038/nature.2013.13232

References

1. Morones-Ramirez, J., Winkler, J. A., Spina, C. S. & Collins, J. J. *Sci. Transl. Med.* <http://dx.doi.org/10.1126/scitranslmed.3006276> (2013).

Show context

2. Grunkemeier, G. L. *et al. Eur. J. Cardiothorac. Surg.* **30**, 20–27 (2006).

Show context

Article PubMed

Related stories and links

From nature.com

- **The resistance against resistance**
30 May 2013
- **Scientists map protein that creates antibiotic resistance**
27 March 2013
- **Infectious disease: TB's revenge**
02 January 2013

From elsewhere

- **James Collins**
- **Vance Fowler**
- **NIH Antimicrobial Resistance**

For the best commenting experience, please login or register as a user and agree to our Community Guidelines. You will be re-

directed back to this page where you will see comments updating in real-time and have the ability to recommend comments to other users.

Comments for this thread are now closed.

8 comments

[Subscribe to comments](#)

Phil Abbott · 2013-07-07 08:55 AM

Silver sulfadiazine has been used for burns, but recent studies have suggested that there is either no difference or that it actually slows healing. I think there are some situations where it has been tested and shown preliminary benefits, but the burn coverings don't seem to be among them.



Short Stuff · 2013-06-28 12:09 AM

Colloidal silver is all that's needed, but they are still trying to tell people it's the antibiotics that are doing the work, and silver is only helping them. Once people find out it's only the silver that's needed, the pharmaceutical companies are going to be making so much less money ... boo hoo.



Colloidal Silver Wrks · 2013-06-23 04:35 PM

It would be interesting to see test done with colloidal silver 3000 to 18000 PPM, this type of colloidal silver is the purest of its kind no chemicals from start to finish and the particles sizes are about the size of an atom.



Heenan73 · 2013-06-21 09:29 AM

Silver has been used effectively in wound management for many years, and it's good to see that the anti-bacterial qualities may be able to be utilised in antibiotics. Is this the silver bullet we've been waiting for [groan]! On a small but pedantic point, while werewolves are vulnerable to silver, this is not an issue for vampires (except in low-grade movies). Stakes rule.



Andrew Larder · 2013-06-21 12:42 AM

At the end of it all, non toxic versions of silver sounds very promising! It's always neat to see old wives tales, or ancient remedies, that have a basis in science.



Lothar Lindemann · 2013-06-20 03:04 PM

This is an excellent discovery which might help to help to deal with antibiotic's resistance. If the study translates into clinical use it would be important to ban the abundant use of silver ions in cloths where it can be convneient to prevent smell, but

where it likely will contribute to development of resistance mechanisms against silver itself.



Sandra Hethrington · 2013-06-19 08:46 PM

I've used a colloidal silver generator for about 20 years..for everything from infected cuts to bacterial infections of the gut. I haven't used antibiotics since then. I don't need them.



Brian Owens · 2013-06-19 09:53 PM

Be careful with the colloidal silver, that's the stuff that can cause Argyria if you take too much of it.

See other News & Comment articles from *Nature*

Nature ISSN 0028-0836 EISSN 1476-4687

© 2016 Macmillan Publishers Limited, part of Springer Nature. All Rights Reserved.

partner of AGORA, HINARI, OARE, INASP, CrossRef and COUNTER