## The mystery of centuries-old bacteria

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How bacterial spores can survive for centuries, even in the absence of food and exposed to powerful antiseptics, is one of the great mysteries of science. A recent discovery finally solves this enigma.

Since the work of Charles Darwin, we know that the great variety of life forms on Earth is the result of an adaptation of species to their environment that gives them a survival advantage and increases the probability of transmitting their characteristics to their offspring.

This natural selection is particularly spectacular in the case of humans, the fauna and flora that surrounds us, but we must not forget that it is also at work for all microscopic organisms, including pathogens such as viruses and bacteria.

## BACTERIAL RESISTANCE

Bacteria reproduce at a very high rate and can therefore quickly pass on to their offspring new characteristics that allow them to adapt to changing conditions.

The emergence of bacterial strains, which acquire resistance to antibiotics, is a good example: repeated exposure of bacteria to these substances often leads to the selection of certain genes that can improve the survival of the bacteria, for example by expelling the drug from the cell or by degrading it to neutralize its bactericidal effect.

To survive unfavorable environmental conditions, another resistance mechanism of bacteria selected by evolution is to enter a state of dormancy, in the form of spores.

When they are in this state, the bacteria have suspended their metabolism and double-lock themselves under a layer of protective armor that protects the cell.

These biologically inert mini-fortresses allow bacteria to survive periods of famine, while protecting themselves from the ravages of extreme heat, drought, exposure to UV rays, disinfectant chemicals and antibiotics.

## FOOD SENSOR

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This resistance can pose a problem for human health, because when the spores detect the return of favorable conditions (such as the presence of food), they quickly lose their protective layers, restart their metabolism and come back to life, which can cause the emergence of infections or contamination of food. It is a real bacterial resurrection...

An extremely important article has finally elucidated the signal responsible for this bacterial awakening (1).

Researchers have found that receptors specialized in detecting nutrients essential for bacterial growth are present in the outer membrane of spores.



In the presence of these nutrients, these receptors assemble together to form a channel that allows ions to escape from inside the spores, which triggers a cascade of events that will activate enzymes specialized in the elimination of the protective armor of the spore.

With the result that the bacterium is now "resurrected" and ready to restart its growth.

## CLINICAL APPLICATIONS

In addition to solving a mystery as old as the discovery of bacterial spores itself, this discovery could have major implications for human health.

Certain bacteria capable of going dormant for long periods are indeed very dangerous pathogens (responsible for botulism and listeriosis, in particular) which cause millions of infections as well as serious food poisoning each year.

By better understanding how spores detect nutrients and quickly come out of dormancy, we can consider: 1) accelerating this bacterial awakening to subject them to bactericidal agents that will eliminate them, or 2) blocking this awakening by keeping the bacteria trapped of their protective armor.

<sup>1)</sup> Gao Y et al. Bacterial spore germination receptors are nutrient-gated ion channels. Science 2023; 380: 387-391.