Scientists examine bacterial cannibalism

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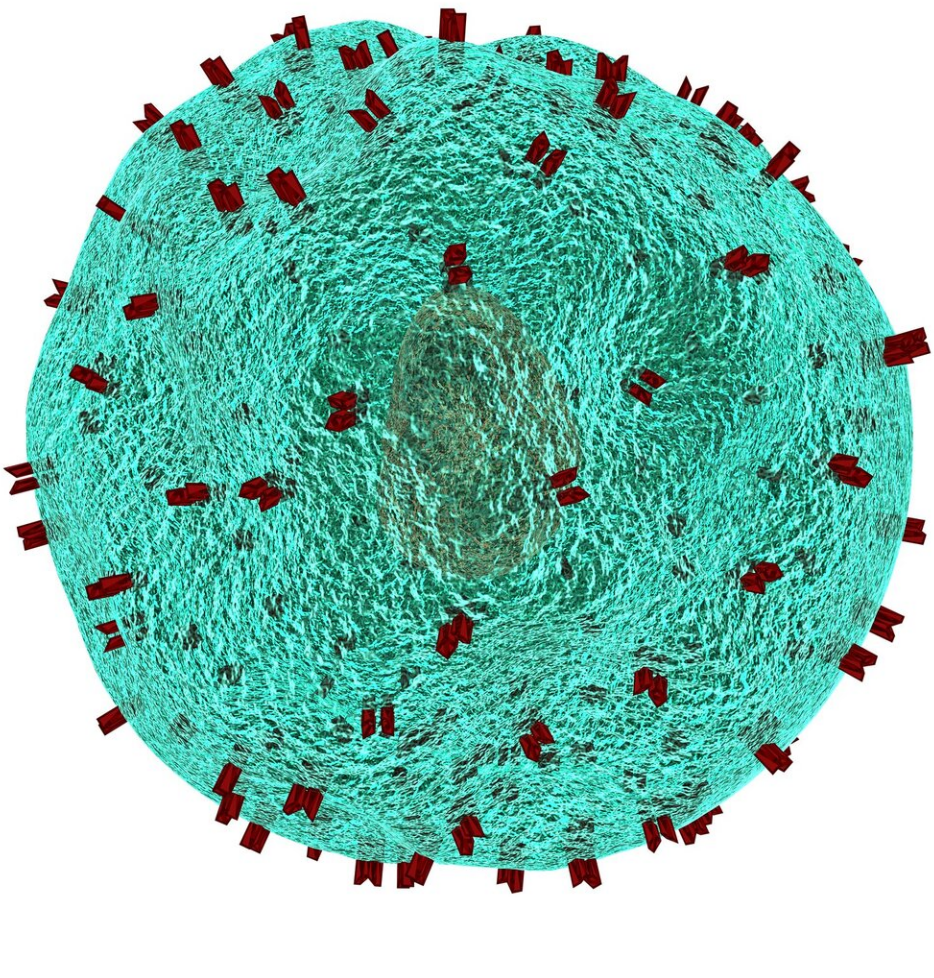

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Researchers from Sechenov University and their colleagues summarised the results of various studies devoted to a process that can be described as bacterial cannibalism. Why some microorganisms start to kill their relatives of the same species and whether we can use this phenomenon to combat infectious diseases is explained in the article published in *Antibiotics*.

Allolysis is a phenomenon that happens when some bacterial cells kill their isogenic (genetically identical) neighbours under certain conditions. This process has been studied for almost two decades and scientists still have some gaps in their understanding of its biological role and its mechanisms. There are lots of questions that are yet to be answered: why do kin bacteria suddenly begin to kill each other, how do the "killers" survive (even though the toxins they produce are deadly for them too), are these toxins used only for kin killing or do they take part in other cellular processes as well? Finding the answers to these questions can help to develop new ways to affect crucial processes within cell communities, something that is especially important nowadays when antibiotics are becoming less and less effective.

"The understanding of how to manage the density of bacterial communities is exciting not only in terms of fundamental research. We believe that this knowledge will help us with developing brand-new antibacterial medicines," said one of the authors, Andrey Zamyatnin, director of the Institute for Molecular Medicine, Sechenov University.

There are several speculations about the reasons why under certain conditions one part of an isogenic population acts as "killers" while the other falls "victim" to its relatives, either willingly or unwillingly. The most obvious but maybe not the only correct one is that allolysis helps a bacterial community to reduce its numbers when resources are insufficient and thus saves a small number of cells and the species itself. But there is another guess that earned the sympathy of most of the scientists: microorganisms do not need the death of their kin but rather fragments of their DNA available after bacteria's killing. Including these fragments in its genome, a cell can repair damaged or mutant parts or gain useful mutations, e.g. making it resistant to antibacterial drugs.

Researchers that studied allolysis among pneumococci (Streptococcus pneumoniae) suggested that these bacteria can benefit from the death of part of their population since it causes the prompt release of compounds that help bacteria adapt in the host's organism, e.g. pneumococcal pneumolysin. Other bacteria, such as hay bacillus (Bacillus subtilis), may use allolysis to postpone the beginning of the sporulation process. When they don't have enough resources for living, bacteria can place their DNA into a spore that is resistant to adverse environmental conditions and thus save the species for many years, but the process of sporulation itself takes too much energy. Using the products of lysis of their relatives ("volunteer victims") for food, part of the population can prolong its existence for some time. Furthermore, allolysis may help communities of Paenibacillus dendritiformis to reduce their population density and prevent "overcrowding." It was also proved that cannibalism plays an important role in biofilm development, since DNA fragments of killed cells are crucial components of the biofilm matrix.

Discovery and study of phenomena similar to bacterial allolysis encourage us to review established concepts and paradigms in microbiology. The death of one part of the population for the benefit (survival) of the other lets scientists consider microbial communities as some kind of multicellular organism with clear differentiation of cells into specialised subpopulations and "division of labour": during starvation, some of them become victims and die while others act as killers and survive, saving the species itself. Such understanding of bacterial communities may help to develop brand new antibacterial drugs that will focus on the complicated system of interrelations within a community rather than on killing a single bacterial cell which adapts quickly to any possible impact.

More information: Larisa N. Ikryannikova et al, Harnessing the Potential of Killers and Altruists within the Microbial Community: A Possible Alternative to Antibiotic Therapy?, *Antibiotics* (2019). DOI: 10.3390/antibiotics8040230

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