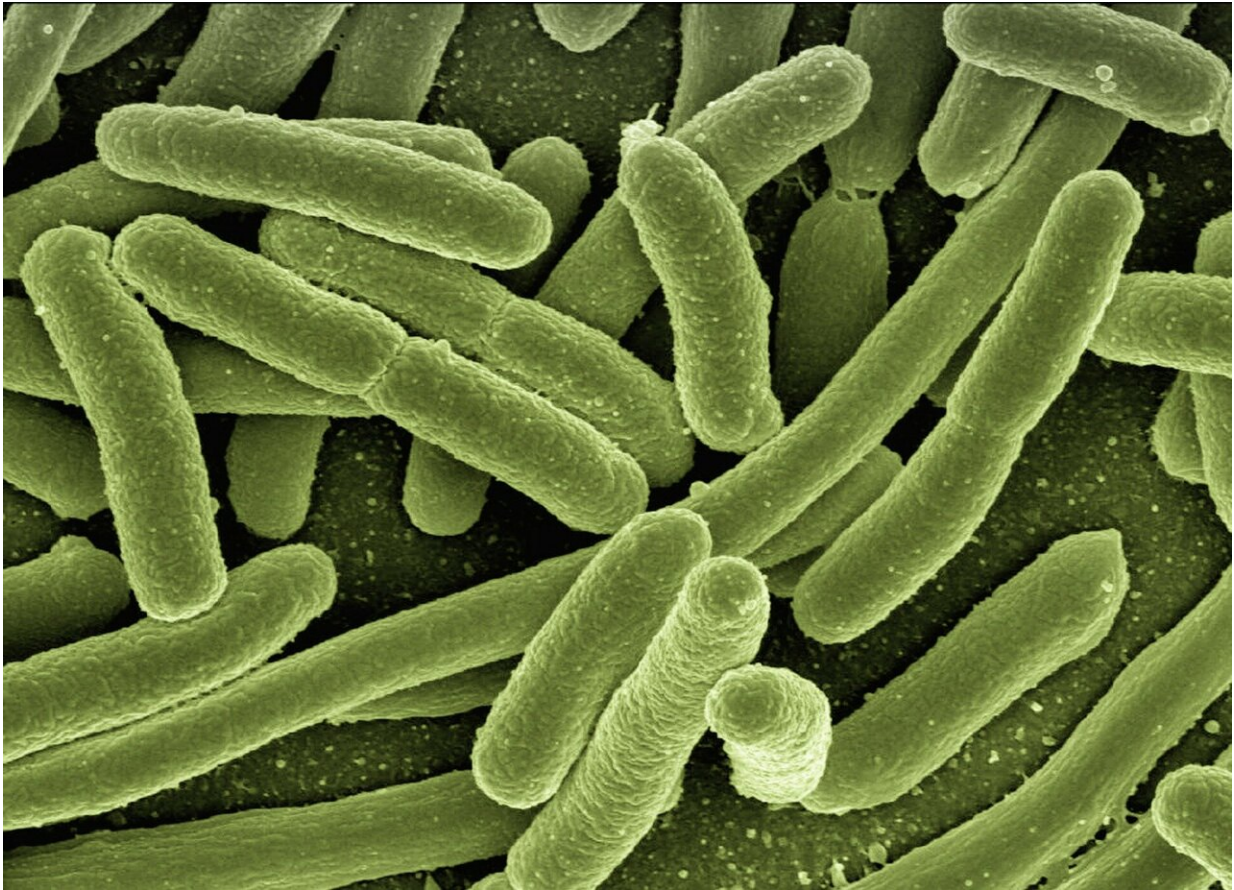


Researchers study the microbiome of ciliates

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A microbiome is a community of microorganisms that inhabit an ecological niche. Microbiomes exist in environmental biotopes, for example, a water body or forest soil, as well as in living multicellular

host organisms such as humans, animals or plants. A microbiome may be composed of bacteria, archaea, and unicellular eukaryotes like protists and fungi.

For the last three years, scientists have been analyzing the microbiomes of two ciliates, paramecium and stentor. The results of the study on paramecium were published last winter. The new publication is the next step in the study of protistan microbiomes.

"The human and animal microbiome studies are at the cutting edge of biology, while only few studies investigated bacterial consortia associated with protists. Previously, the question whether protists [host](#) their own microbiomes—that is, they harbor prokaryotic communities—had not been properly addressed. Therefore, the results of our study are setting a new direction for scientific research," said Alexey Potekhin, professor at the Department of Microbiology of St Petersburg University.

The idea that ciliates might have their own microbiomes was not random. Microbiologists know that in sterile conditions, these organisms die. Their viability depends strongly on the presence of bacteria in the environment. However, it was almost impossible to characterize their bacterial composition in detail, nor to separate the 'lodgers' of the ciliates from the inhabitants of their aquatic environment water source—there were no available methods. Metagenomic analysis, which not been used extensively for this purpose, enabled the researchers to deepen their inquiries.

"This approach enables us to sequence a complete set of certain genetic markers in the total DNA of a sample. Hence, all sequences are assigned to their hosts, allowing us to identify them. For bacteria and archaea, this is the 16S rRNA gene sequence. Metagenomics and high-throughput sequencing have expanded our understanding of the microbial diversity

in [natural environments](#) tremendously over the last 10 to 15 years. In our study, we used [metagenomic analysis](#) to identify bacteria associated with the cells of two common freshwater ciliate genera—stentor and paramecium," the scientist explains.

The researchers have discovered that the bacterial community of environments such as stream water or a laboratory culture medium differs significantly from the microbial consortium associated with ciliates. The variety of microorganisms in natural reservoirs is always richer than in ciliates. However, the microbiologists were able to detect representatives of a few dozen bacterial genera in stentor cells. Each ciliate appeared to be an independent ecological microniche. "Thus, ciliates indeed do have their own microbiome," says Alexey Potekhin.

The second important conclusion is that stentor microbiome is different from the paramecium [microbiome](#). In other words, different ciliates, even from the same water source, coexist with different bacteria. However, scientists have yet to determine the species-specific traits of ciliate microbiomes, or their stability and specificity, which will require further study.

The last discovery is that the microbiomes of ciliates, especially of stentor, comprise representatives of bacterial genera which include a number of species known as opportunists, commensals and even potential human pathogens, such as Mycobacterium, Streptococcus, and Neisseria. The research method does not allow identification of individual species (only the genus). Therefore, at present, it cannot be claimed that ciliates are natural carriers of pathogenic bacteria.

"In any case, it is evident that it is mainly bacteria adapted to form symbiotic associations with host organisms that cohabit with ciliates. Apparently, once outside the host in a water body, these bacteria colonize protists, for lack of better alternatives. After all, protists are

large eukaryotic cells, which are not so dissimilar to those of multicellular organisms. So depending on the tactics of a particular bacterium, it can survive for some time either outside or inside the host cell. The associated bacteria, however, rarely thrive in association with protists to be able to propagate rapidly. Their numbers, as our analyzes have shown, are always small, but they are comfortable enough to survive the challenging times. Thus, [ciliates](#) (and, most likely, other protists) may play the role of transient reservoirs for [bacteria](#) outside their preferred multicellular host," concludes the scientist.

More information: Olivia Lanzoni et al, The core microbiome of sessile ciliate *Stentor coeruleus* is not shaped by the environment, *Scientific Reports* (2019). [DOI: 10.1038/s41598-019-47701-8](https://doi.org/10.1038/s41598-019-47701-8)

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