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Press release
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Communication via sacs: Med Uni Graz investigates archaea vesicles and their importance for the gut microbiome

Graz, 8 August 2025: Microorganisms in the human gut are in constant exchange—with each other and with their host. A new Medical University of Graz study published in the renowned *Nature Communications* journal shows how archaea, a little studied group of microorganisms, control this exchange via tiny sacs called vesicles. The research was conducted by first author Viktoria Weinberger and Christine Moissl-Eichinger's team at the Diagnostics and Research Institute of Hygiene, Microbiology and Environmental Medicine.

Communication by means of mini-packages

Organisms have developed a variety of ways to share important information and disseminate it through different cells, tissue and organs. In humans, for example, this happens through hormones or electrical conduction via the nervous system.

Yet microorganisms in the human microbiome must "speak" to each other and their human host. One of the ways this occurs is through small packages enclosed by a membrane, the so-called vesicles. While vesicles in bacteria have been the subject of intensive research for years, little was known about the corresponding mechanisms in archaea.

What are archaea?

Archaea are single-celled microorganisms that constitute a separate domain of life—besides bacteria and eukarya (the domain to which humans belong). For a long time, they were regarded as ancient eccentrics that were only found in extreme habitats such as hot springs or salt lakes. Today it is known that they also live in less extreme environments, for example the human gut, where one of their functions is methane production. They are an important yet little studied element of the microbiome. In contrast to bacteria, archaea differ in their cellular structure, metabolic pathways and genetics—which makes them an exciting field of research.

How archaea communicate with humans

"We were able to show that gut archaea also actively form extracellular vesicles with which they influence their environment," explains Viktoria Weinberger. "These packages contain proteins, nucleic acids, metabolic products and lipids—and are thus a versatile tool for communicating with other microorganisms or the human immune system."

For the first time, the team from Graz and colleagues from Norwich (UK) and Vienna have investigated in detail the composition of extracellular vesicles from four different gut archaea.

"Our findings provide important indications that archaea actively intervene in the molecular communication processes in the gut," says Christine Moissl-Eichinger, the last author of the study. "This opens up completely new prospects for microbiome research—especially with regard to the role of archaea in health and disease—and their effect on the immune system." The paper emerged as part of a FWF funded special research area on the topic of immunometabolism led by Prof. Thomas Weichhart of the Medical University of Vienna. Depending on their concentration and the archaea species or strain, the vesicles release cytokines into epithelial and immune cells.

What is in the packages?

In addition to a variety of special proteins, the archaeal vesicles also contained interesting metabolites including the free amino acids glutamate and aspartate, which are already familiar as neurotransmitters.

"It could quite well be that these archaea actively send us signals—for instance through abrupt changes in the gut environment," says Moissl-Eichinger. "Particularly exciting is the question of how these vesicles interact with the immune system—and whether they can be used therapeutically, for example as a delivery system for vaccines or medications."

The study lays the foundation for a better understanding of how microorganisms in the human gut not only coexist but specifically interact with each other—with potential effects on immune response, metabolic processes and even on diseases such as chronic inflammatory bowel disease or colon cancer.

Link to the study:
https://doi.org/10.1038/s41467-025-60271-w

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Profile: Christine Moissl-Eichinger

Christine Moissl-Eichinger has been a professor at Med Uni Graz since 2014 and leads a research group at the Diagnostic and Research Institute of Hygiene, Microbiology and Environmental Medicine. The subject of her research is how microbes interact with each other and with their environment, e.g., the human body. Her focus is on exploring the function of archaea in the human gastrointestinal microbiome. Director of the BioTechMed Graz research initiative and codirector of the "Microbiomes drive Planetary Health" Cluster of Excellence, she has been awarded an ERC Advanced Grant.

Profile: Viktoria Weinberger

Viktoria Weinberger is a PhD student in Christine Moissl-Eichinger's group at the Diagnostic and Research Institute of Hygiene, Microbiology and Environmental Medicine. As part of her dissertation, she works on archaea in the human gut. The goal is to better characterize this little studied group of microorganisms and investigate their interaction and communication with other microorganisms and the human host, especially with the immune system.