Fossilized human feces from 14th century contain antibiotic resistance genes

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A team of French investigators has discovered viruses containing genes for antibiotic resistance in a fossilized fecal sample from 14th century Belgium, long before antibiotics were used in medicine. They publish their findings ahead of print in the journal *Applied and Environmental Microbiology*.

"This is the first paper to analyze an ancient DNA viral metagenome," says Rebecca Vega Thurber of Oregon State University, Corvallis, who was not involved in the research.

The viruses in the fecal sample are phages, which are viruses that infect bacteria, rather than infecting eukaryotic organisms such as animals, plants, and fungi. Most of the viral sequences the researchers found in the ancient coprolite (fossil fecal sample) were related to viruses currently known to infect bacteria commonly found in stools (and hence, in the human gastrointestinal tract), including both bacteria that live harmlessly, and even helpfully in the human gut, and human pathogens, says corresponding author Christelle Desnues of Aix Marseille Université.

The communities of phage within the coprolite were different, taxonomically, from communities seen within modern human fecal samples, but the functions they carry out appear to be conserved, says Desnues. That reinforces the hypothesis that the viral community plays a fundamental role within the human gastrointestinal tract, and one which remains unchanged after centuries, even while the human diet and other

human conditions have been changing.

Over the last five years, considerable evidence has emerged that bacteria inhabiting the gut play an important role in maintaining human health, for example, as part of the human metabolic system, says Desnues. Her own research suggests that the bacteriophage infecting the gut bacteria may help maintain these bacteria. Among the genes found in the phage are antibiotic resistance genes and genes for resistance to toxic compounds. Both toxins and antibiotics are common in nature, and Desnues suggests that the resistance genes may simply be protecting the gut bacteria from them.

"Our evidence demonstrates that bacteriophages represent an ancient reservoir of resistance genes and that this dates at least as far back as the Middle Ages," says Desnues.

"We were interested in viruses because these are 100 times more abundant than human cells in our bodies, but their diversity is still largely unexplored," says Desnues. "In the present study, we thus focused on the viral fraction of the coprolite by using, for the first time, a combination of electron microscopy, high-throughput sequencing and suicide PCR approaches."

Desnues and her collaborators are currently conducting further studies on the fungi and parasites in the coprolites, which she says will be of interest not only to microbiologists, but to historians, anthropologists, and evolutionists.

The genesis of the research was an urban renewal project in the city of Namur, Belgium, in which latrines dating back to the 1300s were discovered beneath a square.

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