Microbiome study: Gum disease-causing bacteria borrow growth molecules from neighbors to thrive

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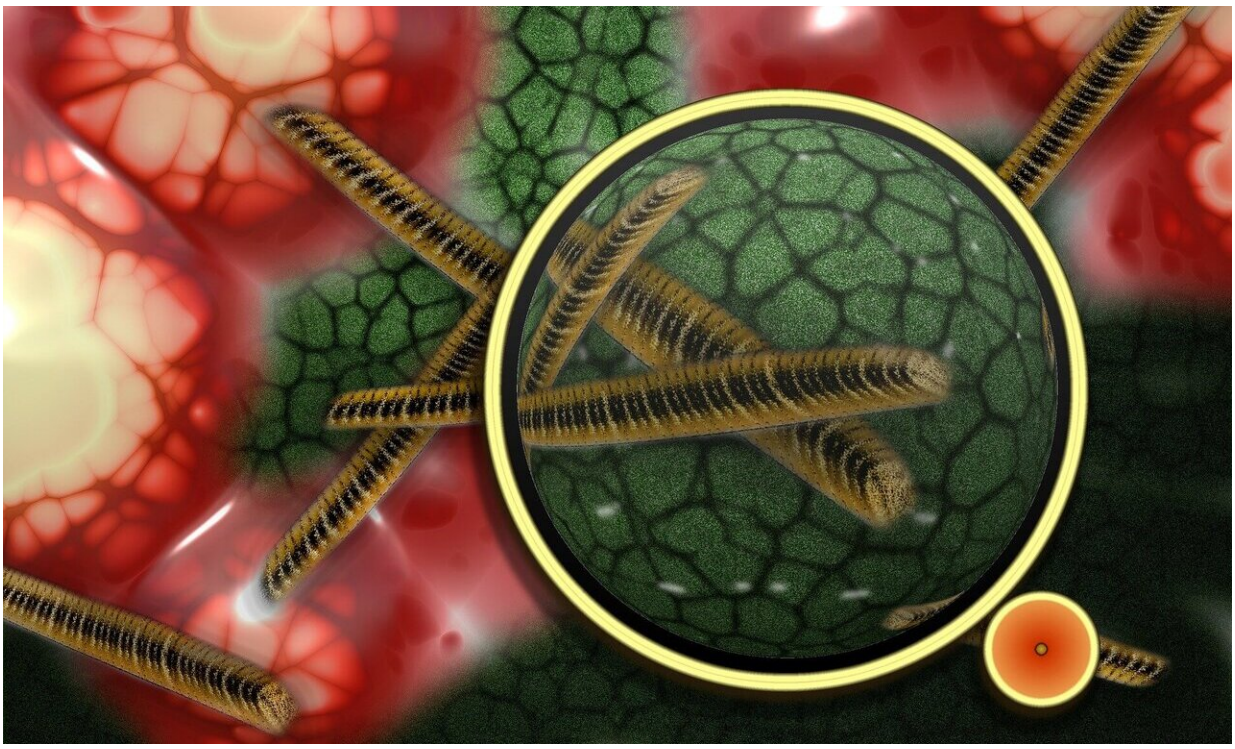

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The human body is filled with friendly bacteria. However, some of these microorganisms, such as Veillonella parvula, may be too nice. These peaceful bacteria engage in a one-sided relationship with pathogen

Porphyromonas gingivalis, helping the germ multiply and cause gum disease, according to a new University at Buffalo-led study.

The research sought to understand how P. gingivalis colonizes the mouth. The pathogen is unable to produce its own growth molecules until it achieves a large population in the oral microbiome (the community of microorganisms that live on and inside the body).

The answer: It borrows growth molecules from V. parvula, a common yet harmless bacteria in the mouth whose growth is not population dependent.

In a healthy mouth, P. gingivalis makes up a miniscule amount of the bacteria in the oral microbiome and cannot replicate. But if dental plaque is allowed to grow unchecked due to poor oral hygiene, V. parvula will multiply and eventually produce enough growth molecules to also spur the reproduction of P. gingivalis.

More than 47% of adults 30 and older have some form of periodontitis (also known as gum disease), according to the Centers for Disease Control and Prevention. Understanding the relationship between P. gingivalis and V. parvula will help researchers create targeted therapies for periodontitis, says Patricia Diaz, DDS, Ph.D., lead investigator on the study and Professor of Empire Innovation in the UB School of Dental Medicine.

"Having worked with P. gingivalis for nearly two decades, we knew it needed a large population size to grow, but the specific processes that drive this phenomenon were not completely understood," says Diaz, also director of the UB Microbiome Center. "Successfully targeting the accessory pathogen V. parvula should prevent P. gingivalis from expanding within the oral microbial community to pathogenic levels."

The study, which was published on Dec. 28 in the *ISME Journal*, tested the effects of growth molecules exuded by microorganisms in the mouth on P. gingivalis, including molecules from five species of bacteria that are prevalent in gingivitis, a condition that precedes periodontitis.

Of the bacteria examined, only growth molecules secreted by V. parvula enabled the replication of P. gingivalis, regardless of the strain of either microbe. When V. parvula was removed from the microbiome, growth of P. gingivalis halted. However, the mere presence of any V. parvula was not enough to stimulate P. gingivalis, as the pathogen was only incited by a large population of V. parvula.

Data suggest that the relationship is one-directional as V. parvula received no obvious benefit from sharing its growth molecules, says Diaz.

"P. gingivalis and V. parvula interact at many levels, but the beneficiary is P. gingivalis," says Diaz, noting that V. parvula also produces heme, which is the preferred iron source for P. gingivalis.

"This relationship that allows growth of P. gingivalis was not only confirmed in a preclinical model of periodontitis, but also, in the presence of V. parvula, P. gingivalis could amplify periodontal bone loss, which is the hallmark of the disease," says George Hajishengallis, DDS, Ph.D., co-investigator on the study and Thomas W. Evans Centennial Professor in the University of Pennsylvania School of Dental Medicine.

"It is not clear whether the growth-promoting cues produced by P. gingivalis and V. parvula are chemically identical," says Diaz. "Far more work is needed to uncover the identity of these molecules."

More information: Anilei Hoare et al. A cross-species interaction with a symbiotic commensal enables cell-density-dependent growth and

in vivo virulence of an oral pathogen, *The ISME Journal* (2020). DOI: 10.1038/s41396-020-00865-y