Dental plaque proves useful in oral cavity

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Dental plaque has been shown to utilize human saliva as a nutrient source, opening up new possibilities in oral biofilm development.

“For normal oral microflora to survive and grow, the bacteria must be able to digest and utilize nutrients from the immediate environment,” explained one of the researchers, Dr Claes Wickström from the Faculty of Odontology at Malmö University, Sweden. “We wanted to show that dental plaque, harvested directly from the source, was able to degrade natural occurring substrates such as salivary mucins.”

Salivary mucins, such as MUC5B, can influence the establishment and selection of the oral microflora, promoting adhesion of certain bacteria or facilitating clearance by aggregation and swallowing of other species. “Since the MUC5B mucin constitutes the backbone of the mucus gel, it also provides the most abundant source of carbohydrate for the oral microflora and initial attachment sites for the bacteria,” he added. “All this makes MUC5B a key player in the host-microbe balance.”

According to Wickström, earlier studies have developed multispecies communities using pooled inocula in chemostats to investigate the growth of the consortium from the energy derived from the synergistic degradation of complex glycoproteins, such as hog gastric mucin and bovine submaxillary mucin. The advantage of using a system like this is the ability to control many parameters, like temperature, pH and so on. Using commercial animal derived mucins also facilitates the process.

“The aim of our study was more to mimic the situation occurring in nature, using the actual dental plaque and human derived salivary mucins, aiming for a less reductionist approach,” Wickström explained. “One of the novelties in this work has been that we used human salivary mucins, a much more complex substrate and one that the oral bacteria is expected to encounter in nature.”

The researchers isolated the MUC5B mucin using a novel non-dissociative technique, trying to keep the complex structure of the mucins intact as much as possible. The dental plaque was harvested before breakfast and was shown to exhibit a very low metabolic activity, indicating a balance between the biofilm and the surroundings. When MUC5B was introduced to the microbial community, an immediate rise in metabolic activity was seen, in line with the mucins acting like fresh media. The other isolated species that were tested in this work, Streptococcus oralis and Streptococcus gordonii, did not exhibit the same metabolic rise of activity and were not able to utilize the MUC5B. “What this suggests is that the plaque bacteria already possessed the instruments required to utilize the complex mucin-substrate, whereas the isolated species used did not,” said Dr Wickström.

The researchers say this is the first time that a complex, natural occurring substrate that has been isolated with most of the original structure intact, has been shown to elicit a physiological response in freshly harvested dental plaque. “This is a first step to elucidate how cooperation in the bacterial community, together with the influence of MUC5B, determines the development of the establishment and selection of the oral biofilm,” he adds. “In a near future, rather than looking at specific
microorganisms such as *Streptococcus mutans*, we might be able to look at the physiological activity of the whole biofilm and how that relates to different imbalances in the oral cavity.”

The authors are continuing to use MUC5B in elucidating cooperation within the microbial community. They are currently introducing a number of different metabolic markers in an attempt to find a more accurate characterization of the types of metabolic changes that occur in the biofilm, and to study these phenomena on surfaces.

“It is well known that surface associated bacteria displays different physiological characteristics than bacteria found in solution,” Wickström concludes. “We hope to achieve a deeper understanding of the complex relationship between the normal oral microflora and the host. It might also be possible to develop new clinical tools to ‘type’ different physiological properties in different plaque and use them for diagnostic purposes.”

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