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Original Article

Erythritol alters microstructure and metabolomic profiles of biofilm composed of *Streptococcus gordonii* and *Porphyromonas gingivalis*

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Summary

The effects of sugar alcohols such as erythritol, xylitol, and sorbitol on periodontopathic biofilm are poorly understood, though they have often been reported to be non-cariogenic sweeteners. In the present study, we evaluated the efficacy of sugar alcohols for inhibiting periodontopathic biofilm formation using a heterotypic biofilm model composed of an oral inhabitant *Streptococcus gordonii* and a periodontal pathogen *Porphyromonas gingivalis*. Confocal microscopic observations showed that the most effective reagent to reduce *P. gingivalis* accumulation onto an *S. gordonii* substratum was erythritol, as compared with xylitol and sorbitol. In addition, erythritol moderately suppressed *S. gordonii* monotypic biofilm formation. To examine the inhibitory effects of erythritol, we analyzed the metabolomic profiles of erythritol-treated *P. gingivalis* and *S. gordonii* cells. Metabolome analyses using capillary electrophoresis time-of-flight mass spectrometry revealed that a number of nucleic intermediates and constituents of the extracellular matrix, such as nucleotide sugars, were decreased by erythritol in a dose-dependent manner. Next, comparative analyses of metabolites of erythritol- and sorbitol-treated cells were performed using both organisms to determine the erythritol-specific effects. In *P. gingivalis*, all detected dipeptides, including Glu-Glu, Ser-Glu, Tyr-Glu, Ala-Ala and Thr-Asp, were significantly decreased by erythritol, whereas they tended to be increased by sorbitol. Meanwhile, sorbitol promoted trehalose 6-phosphate accumulation in *S. gordonii* cells. These results suggest that erythritol has inhibitory effects on dual species biofilm development via several pathways, including suppression of growth resulting from DNA and RNA depletion, attenuated extracellular matrix production, and alterations of dipeptide acquisition and amino acid metabolism.

Citing Literature

Supporting Information

Filename	Description
omi12037-sup-0001-TableS1.xls MS Excel, 174 KB	**Table S1.** Hierarchical clustering analysis of erythritol-treated *Porphyromonas gingivalis* metabolomes.
omi12037-sup-0002-TableS2.xls MS Excel, 131 KB	**Table S2.** Comparative analysis of erythritol-treated *Porphyromonas gingivalis* metabolomes.
omi12037-sup-0003-TableS3.xls MS Excel, 192 KB	**Table S3.** Hierarchical clustering analysis of erythritol-treated *Streptococcus gordonii* metabolomes.
omi12037-sup-0004-TableS4.xls MS Excel, 124.5 KB	**Table S4.** Comparative analysis of erythritol-treated *Streptococcus gordonii* metabolomes.
omi12037-sup-0005-TableS5.xls MS Excel, 143 KB	**Table S5.** Comparative analysis to compare between erythritol- and sorbitol-treated *Porphyromonas gingivalis* metabolomes.
omi12037-sup-0006-TableS6.xls MS Excel, 138.5 KB	**Table S6.** Comparative analysis to compare between erythritol- and sorbitol-treated *Streptococcus gordonii* metabolomes.

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