Analysis of Bovine Enamel Subjected to Artificial Demineralization

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ABSTRACT

Bovine enamel is frequently used in dental research due to the more readily available supply of bovine teeth compared to human teeth. While there are some differences, the two are similar enough to provide a viable model for the study of carious lesion progression. Like human enamel, bovine enamel is susceptible to acid demineralization and lesion formation through the metabolic processes of S. mutans as well as through the use of artificial demineralization solutions. The purpose of this study was to examine the progression of artificially induced carious lesions over a wide range of exposure times to lactic acid demineralization solution.

BACKGROUND

The formation of carious lesions and their remineralization is a widely studied area in dental research. Current models involve use of an artificial demineralization solution to induce carious lesions and use of artificial or natural saliva to stimulate their remineralization. This model provides a useful predictor for the efficacy of oral health care products and the degree to which they may prevent or assuage damage to the enamel. Surface microhardness testing is an accepted method to assess the degree of mineral loss, while scanning electron microscopy is an accurate means to assess surface morphology on the micron scale.

MATERIALS & METHODS

Materials and Methods: Extracted bovine central incisors were obtained from 2 Midwest slaughterhouses. 4x4x2 mm slabs were cut from the facial surface of the teeth with a Buehler low-speed diamond saw. The resulting slabs were polished on a Struers polishing machine using successively finer grits of silicon carbide paper, from 500-grit, ending with 2400-grit. Final polish was achieved with a 1 µm diamond suspension polish. Samples were screened for SMH soundness with a criteria of 43±3 µm indent length. Early caries-like lesions were formed in the specimens by immersing them in 0.05 M lactic acid, 0.2 % Carbopol 907 solution that is 50% saturated with respect to hydroxyapatite at pH 5.0. Samples were divided into 7 groups of 30 and demineralized for the following times: 4.5, 9, 16, 18, 22, 27, and 32 hours. SMH testing was again performed to assess mineral loss. Samples were finally analyzed for surface morphology with a JEOL 7100F Field-Emission Scanning Electron Microscope.

RESULTS

SMH results demonstrated a linear progression of carious lesions as acid exposure time increased, with $y = 2.3204x + 74.629$ and coefficient of determination $R^2 = 0.9481$. Lesion progression was as predicted except for the 16-18 hour exposures, where SMH means were reversed. Morphological surface changes to the enamel prisms as well as the individual hydroxyapatite rods were also observed. Scanning Electron Microscope images taken post-immersion at magnifications of 30,000x and 100,000x showed varying sizes of inter-prism spaces as well as roughening of the enamel rods at high magnifications. The observed smoothness of the 32-hour treatment suggests a remineralization phase occurring at the surface of the sample, independent of sub-surface lesion depth.

REFERENCES


