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Analysing Healthy Versus Decayed Tooth Tissues Using Spectroscopic Methods

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Objectives The aim of this study is to understand the chemical alterations in deep dental and grossly decayed caries in contrast to healthy dentine and enamel.

Methods Enamel and dentine samples from 20 healthy teeth and 21 carious teeth were collected using a low-speed bur, pooled into vials, and weighed. Samples were ground under liquid nitrogen and divided into sound enamel (ME1), sound dentine (MD1), deep dentine (DDo) and grossly decayed dentine (GDi), respectively. Fourier-transform infrared (FTIR) analysis followed by ¹³C and ¹⁵N nuclear magnetic resonance (NMR) analysis was performed to compare the chemical composition of healthy and decayed tooth material.

Results FTIR revealed notable differences in the Amide I (1650 cm⁻¹) and phosphate (1100 cm⁻¹) bands between sound and carious tooth material. Decayed dentine exhibited an increase in the ratio of transmission of amide I / transmission of phosphate in carious as compared to ratio for healthy teeth.

This trend was confirmed by ¹³C and ¹⁵N NMR. Sound enamel has the lowest signal ratio organic carbon/inorganic carbon compared to the corresponding ratio for the dentine tissues (healthy and carious) This signal ratio infers that the protein/mineral content in carious tissues increases with higher degree of decay. The ¹⁵N NMR analysis aligned with the ¹³C NMR and FTIR results.

Conclusions It is evident from FTIR and ¹³C, ¹⁵N NMR analyses that the ratio of the protein and mineral components increases in decayed as compared to healthy teeth.