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Compounds incorporation that modify *Streptococcus mutans* virulence in restorative materials

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Purpose/aim: The objectives of this in vitro study were to evaluate the effect of the addition of two natural antimicrobial compounds derived from Brazilian propolis (Apigenin (A) and tt-Farnesol (T)) on the chemical/physical properties of resin composites (CO) and resin cements (CE), and on the virulence of *Streptococcus mutans* (SM) and secondary caries formation.

Materials and methods: A and F were added separately, in combination and combined with fluoride (F) to a resin composite and a resin cement. Dry weight (DW), bacterial viability (BV), protein (P), water-soluble (WSP), alkali soluble (ASP) and intracellular (IPS) polysaccharides were determined from SM biofilms grown for five days on resin composites and resin cements disks. The A and T effects on the physical/chemical properties were analyzed by flexural strength (FS), flexural modulus (FM), curing kinetics and overall degree of conversion (DC). SEM images were made from the biofilm and confocal images from the secondary caries development (in presence of gap for 14 days of growing biofilm).

Results: The DW and IPS decreased when A, AT and ATF was added for both materials, compared to the control group. A and AT addition decreased the P for CO and A and T into CE. BV decreased with addition of AT and ATF and ASP with addition of A and ATF into CE. No statistically difference was observed for BV, WSP and ASP for CO and WSP for CE. No difference was observed for curing kinetics, FS and FM for both materials. A lower DC was obtained when A and AF was added to CO, and a higher DC when A, T and ATF was added to CE. For both materials a less dense biofilm is observed under SEM images when A, AT and ATF was added. From confocal images no difference is observed when dentin is exposed, however, when remaining enamel is found the demineralization seen to be lower for all additions tested compared to the control group.

Conclusions: A, alone and combined showed better results reducing the expression of virulence of SM. No addition was able to completely avoid secondary caries formation or bacterial penetration, however, the additions into restorative materials seen to be promising when remaining enamel is present.

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Y-TZP low temperature degradation: A sigmoidal or a linear behavior?

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Purpose/aim: The aim of this study was to evaluate the in vitro aging behavior of a dental Y-TZP submitted to an accelerated hydrothermal aging. Specifically: (a) determine the kinetic curve of tetragonal to monoclinic phase transformation (t-m); (b) calculate the speed of the front of phase transformation zone into the bulk during aging; (c) compare the relationship between monoclinic percentage and depth of phase transformation with biaxial flexural strength.

Materials and methods: Fully sintered (1530 °C/2 h) discs of dental Y-TZP (VITA YZ) were aged in ionized water using a hydrothermal pressurized reactor to follow the kinetics of phase transformation. Four samples per aging time were submitted to X-ray diffraction analysis (XRD), Cu-Kα, 20° to 80°, 2θ. The data was refined using the Rietveld method (GSAS). Discs were divided according to the aging time ($n = 10$): 0, 5, 25, 70 and 140 h (150 °C/3.01 bar). One specimen of each group was sectioned at the transversal section, polished and submitted to backscatter SEM to calculate the phase transformation depth (Image J). The speed of the front transformation zone was determined plotting the phase transformation depth versus aging time. Each group was submitted to biaxial flexural strength test (ISO 6872) and one way Anova ($\alpha = 0.05$) was used to compare the results.

Results: XRD results indicated that Y-TZP presented a sigmoidal phase transformation behavior, and a monoclinic phase plateau (65%) was reached at 15 h (150 °C). However, the depth of XRD penetration was limited to ~6.1 μm. SEM analysis showed that the degradation process did not follow the sigmoidal behavior indicated by XRD. Although the percentage of monoclinic phase was constant at the maximum penetration depth (~6.1 μm), SEM analysis showed a transformation front constituted of a porous microstructure (due to the polishing process) that increased linearly ($R = 0.9997$) from the surface to the bulk with a speed of 1.24.10–10 m/s at 150 °C and 3.01 bar. One way ANOVA showed that hydrothermal aging for 70 h (958 MPa, 65% of monoclinic phase, 30 μm depth) did not significantly decrease the biaxial flexural strength compared to the control group (1032 MPa). However, 140 h (849 MPa, 65% of monoclinic phase, 62 μm depth) is deleterious to the flexural resistance of the Y-TZP.

Conclusions: The results indicate that Y-TZP submitted to hydrothermal aging presents a linear front of phase transformation zone according to the aging time. The front depth of 62 μm decreased the biaxial flexural strength after 140 h of aging (150 °C).

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