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Properties of Dental Composite With Biosafe Bisguaiacol-Based Monomers From Wood

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Objectives Bisphenol-A dimethacrylate (BisGMA) is the main matrix monomer in resin-based composites (RBCs) but contains Bisphenol-A (BPA) as monomer backbone. Elution of BPA from RBCs raises public concern. The KU Leuven bio-based platform of bisguaiacols synthesized biosafer BisGMA analogues. This study aimed to measure the degree of conversion (DC), elastic modulus (EM), flexural strength (FS), including fractographic analysis, and Knoop hardness (KH) of composites, containing either novel BPA-free BGPGMA or BGFGMA, or BisGMA (control). The in-house prepared experimental composites differed for the abovementioned monomer and further contained 14.85wt% TEGDMA, 0.06wt% camphorquinone and 0.24wt% EDMAB (photo-initiator system), and 70wt% silanated barium-borosilicate glass filler.
Methods Twenty-two one-sided mirror-polished bar-shaped specimens were prepared to measure (1) DC using micro-Raman spectroscopy at the time points 'uncured', 30 min, 2 hrs, 72 hrs and 1 week after light-curing, (2) EM using an impulse excitation technique, (3) FS using four-point bending, including fractographic analysis by SEM, and (4) KH using a micro-hardness tester. Statistical analysis involved One-Way ANOVA and Tukey's multiple comparisons test ($p<0.05$).
Results DC of the BGPGMA and BGFGMA composites (81.8% and 80.8% at 1 week, respectively) was significantly higher than that of the BisGMA composite (78.9% at 1 week). For all composites DC increased significantly to flatten out after 72 hrs. No significant difference in FS and IET was recorded among all three composites, with FS ranging around 105 MPa and IET around 14 GPa. For all composites, fracture initiated approximately for 1/3 of the specimens either at the surface, at a matrix agglomeration or at an air bubble. The composites significantly differed for KH (lowest KH measured for BGFGMA [56.4 kg/mm^2]), except for the BGPGMA (61.6 kg/mm^2) versus BisGMA (59.1 kg/mm^2) composite.
Conclusions BGPGMA and BGFGMA resulted in promising composite properties, by which both BPA-free monomers appear promising novel biocompatible BisGMA alternatives.