ABSTRACT

Untreated dental caries can lead to structural damage and serious infection, thus requiring filling materials like dental composite resins. This research aims to synthesize Beta Tricalcium Phosphate (β-TCP) as an additional filler in commercial dental composite resins, which are generally composed of urethane dimethacrylate (UDMA), triethylene glycol dimethacrylate (TEGDMA), and glass powder. Furthermore, this study investigates the effect of varying weight percentages of β-TCP on the composite's properties, including chemical, mechanical, and surface characteristics. The β-TCP material was synthesized via the sol-gel method using calcium and phosphate precursors. The synthesized product was characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Particle Size Analyzer (PSA). The synthesized β-TCP results showed a pure β-TCP phase product with a rhombohedral structure, crystallite size of 12.2 nm, crystallinity of 83.17%, relatively uniform particles with an average size of 716 nm, and a zeta potential of -25 mV. Resin composites with β-TCP addition (2–10% by weight) were tested using FTIR for chemical interaction, a Universal Testing Machine (UTM) for mechanical properties, and Field Emission Scanning Electron Microscopy equipped with Energy Dispersive X-ray Spectroscopy (FE-SEM-EDX) for morphology and elemental distribution. Test results indicated an interaction between β-TCP and the resin (Si-O-Ca group in FTIR) and an optimal increase in compressive strength and toughness at a 4% by weight concentration. FE-SEM-EDX analysis confirmed the distribution of Ca and P elements from β-TCP on the composite surface. It's concluded that the addition of 4% by weight of β-TCP can optimally enhance the compressive strength and toughness of commercial composite resins, and it holds significant potential as a remineralizing agent in bioactive dental restoration applications.

Keywords: *Dental Composite Resin, β-TCP filler, Polymerization Reaction, Composite Characteristics*