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Development of Chlorhexidine-Loaded Lipid Nanoparticles Incorporated Into Endodontic Sealers

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Objectives This study aimed to assess several bioceramic sealers (BCS) incorporating liposomal chlorhexidine digluconate (CHX) for its antibacterial activity, drug release capacity, and physicochemical properties**.**
Methods Drug release of CHX liposomal formulations in combination with BCS was evaluated spectrophotometrically and through mathematical release models for 30 days. A selected combination was evaluated for antimicrobial properties against *Enterococcus. faecalis (E. faecalis)* biofilm growth on human dentin. Cytotoxicity was assessed following the ISO 10993-5:2019 standard on days 1, 3, and 7. Physicochemical properties were evaluated through setting time, Fourier transform infrared spectroscopy (FTIR), solubility, contact angle, and film thickness.
Results From BR, liposomal CHX released up to 7-fold higher CHX than CHX solution ($p<0.05$), following a triphasic drug release pattern compared to the CHX solution, which followed a quasi-Fickian diffusion. BCS combined with a selected liposomal CHX completely inhibited *E. faecalis* biofilm growth compared to the combination of BCS with CHX solution and the control group ($p<0.05$). Liposomal CHX decreased the contact angle ($p<0.05$) and solubility but increased cytotoxicity ($p<0.05$) of BCS, staying above the ISO threshold. None of the other physicochemical characteristics tested differed from BR ($p>0.05$).
Conclusions This liposomal formulation improved CHX release from BCS, enhancing the antibacterial effectiveness. It presents a promising approach for local anti-biofilm therapy in endodontics without substantially altering the physicochemical characteristics of BCS.