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Nano-encapsulated Gel based on Chlorhexidine, Calcium Phosphate and Amazonian Plant Extract for Peri-Implant Conditions

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In recent years, a significant increase in the number of dental implants has been observed, reaching a figure of 800,000 per year, according to the Federal Council of Dentistry. However, this trend has brought about a growing concern regarding the emergence of complications, such as peri-implant mucositis and peri-implantitis, whose incidence rates post-implantation have been rising. This reality underscores the urgent need to develop biomaterials with various properties, such as controlling bacterial plaque and inflammation while promoting osseointegration and minimizing pain. These properties are ensured in the formulation under investigation in this research, which is a dentistry gel containing nanostructured calcium phosphate. This gel exhibits a controlled release of active ingredients and promotes osseointegration. It also contains extract of jambu, a resource from Brazilian biodiversity known for its anti-inflammatory and analgesic properties, and chlorhexidine recognized, for its bactericidal action. The active ingredients were prepared using impregnation and nanoencapsulation techniques. Impregnation was performed by heating, with solutions of jambu extract and chlorhexidine solution being dripped onto calcium phosphate. Ten milliliters of a 20% jambu extract in ethanol (EtOH) and 10 milliliters of a 20% chlorhexidine solution in EtOH were used. Each solution was simultaneously dripped onto 0.1 grams of calcium phosphate, concentrated at 0.01 g/ml, maintaining the temperature between 30 and 40°C to optimize the incorporation of active principles. During the nanoencapsulation process, the impregnations of the active ingredients in calcium phosphate were mixed with alginate and then dripped into an ionic solution of calcium hypochlorite in a beaker, aided by a sonicator. The interaction of alginate with the solution resulted in the formation of a membrane, generating spherical microparticles for the protection and controlled release of the active ingredients. To identify the presence of the active ingredients in the impregnations and determine the size of the nano-encapsulated particles, Dynamic Light Scattering (DLS) and spectrophotometry analyses were performed. DLS identified that the nanoencapsulated particles exhibited a size distribution, with the majority population having dimensions of 13,000 nm. Spectrophotometry characterization confirmed the presence of the drugs, showing peaks at 230 and 250 nm, characteristic of jambu and chlorhexidine, respectively. These preliminary results suggest the adherence of the active ingredients to the calcium phosphate matrix. The next step involves formulating the gel from these actives, followed by mechanical and release assays, as well as cellular assays to optimize the formulation, enhancing the product's adherence to the oral mucosa and ensuring its efficacy during patient treatment.