POROUS BIOGLASS-ALGINATE COMPOSITE GRANULES AS THE ANTIBIOTIC DELIVERY SYSTEM WITH THERAPEUTIC AND REGENERATIVE POTENTIAL IN STOMATOLOGY

The treatment of odontogenic infections (originating within a tooth) of facial bones is challenging due to their potential for systemic complications. Current treatment of odontogenic infections consists of surgical procedures and systemic antibiotic therapy (oral or intravenous). Due to the systemic side effects of antibiotic therapy and increasing antibiotic resistance, local antibiotic delivery systems dedicated for the treatment of odontogenic infections of bones have been extensively investigated in stomatology. In the latest approach, such systems should not only release the antibiotic locally in the desired manner but also support the regeneration of damaged tissue after surgery. Unfortunately, most of the presently available biomaterials on the market, designed for the local treatment of odontogenic infections, are characterized by only one function – either of drug carrier or regenerating agent.

Thus, this project aims to obtain and evaluate the *in vitro* and *in vivo* properties of novel composite-type local antibiotic delivery systems in the form of spherical granules (pellets) made of porous bioglass and alginate.

Bioglasses are biomaterials composed of osteogenic compounds such as SiO_2-CaO-P_2O_5 with well-established regenerative properties in stomatology related to apatite-forming ability followed by bone binding. However, the commercially available bioglasses exhibit limited antibiotic-loading capacity due to the reduced porosity; thus, we will synthesize a new type of bioglass with increased porosity. Alginates are another type of biomaterial with excellent healing properties. They have several advantages over other biopolymers such as superior absorptive capacity, low immunogenicity, and hemostatic properties. In addition, they are cost-effective and characterized by unique hydrogel-forming ability in the presence of calcium ions that support the regeneration of damaged tissues including tooth extraction wounds.

Porous antibiotic-loaded bioglass and alginates will be combined together into the final form of pellets using the pharmaceutical processes of wet granulation, extrusion, and spheronization (so-called pelletization process). Regarding pellets (with 1-2 mm size suitable for potential implantation into tooth socket), we assume that the porous bioglass will act as a drug carrier for model antibiotics and will induce the bone-like apatite formation, whereas the alginate will act as a gelling agent that prolongs the antibiotic release and support both the proliferation and differentiation of osteoblasts as well as will enhance healing processes. Comprehensive characterization of pellets will involve advanced physicochemical, pharmaceutical, and biological assessments, including *in vitro* studies with human osteoblasts and endothelial cells, alongside *in vivo* biocompatibility assays.

By integrating drug carrier and regenerative functionalities within a single systems in the form of composite pellets, **our research aims to address current limitations in local drug delivery strategies, potentially transforming clinical approaches to the management of odontogenic infections.** The research will explore how engineered pellets can support tissue regeneration in stomatology by developing a system that not only delivers antibiotics locally but also promotes bone formation and healing. The combination of antibiotic-loaded porous bioglass with alginate fulfills the multifunctional biomaterials research and potentially creates a new approach of localized medical interventions in stomatology; thus, influences future research strategies in the pharmacological treatment of odontogenic infections. This creates opportunities for technological transfer. In the future, proposed composite pellets may accelerate healing processes in dental surgical interventions, reduce patient recovery time, and lower healthcare costs associated with prolonged treatments.