ABSTRACT FOR THE GENERAL PUBLIC

Comprehensive evaluation of biomedical potential of novel macroporous cryogel-based biomaterials produced by freeze-drying technique combined with foaming agent

In the developing European population, there are still thousands of cases of severe fractures and defects in bone tissue requiring surgical intervention. In modern medicine there are several methods for bone defects treatment in order to accelerate the regeneration of bone tissue and thus to improve the success rate of surgical procedures. Conventional therapeutic strategy for bone regeneration is based on biological grafts, in particular on autografts. However, in some cases – such as extensive bone defects, osteoporotic fractures or bone defects/fractures in oncological patients who underwent radiotherapy – regeneration of bone tissue is hindered and requires application of modern strategy like tissue engineering.

The skin is the largest organ of the human body with numerous complex functions essential for our survival. Injury to the skin provides a unique challenge, as wound healing is a complex and intricate process. Unhealed chronic wounds that may develop in patients after trauma, burns or with metabolic disorders like diabetes cause serious problems for not only the individual, but also society. The increasing number of accidents, injuries, bone tumours, and severe burns along with developments in biomedical sciences results in growing demand for innovative scaffolding biomaterials for bone defect repair as well as novel wound dressings for acceleration of skin healing.

Considering biomedical potential of the novel biomaterials for tissue engineering/regenerative medicine applications, it is very important to determine their biocompatibility and also basic structural, mechanical, and physicochemical properties. The aim of this project is produce 2 types of novel chitosan/agarose cryogel-based biomaterials characterized by high open porosity for potential regenerative medicine applications: (1) bone scaffolds reinforced with nanohydroxyapatite (nanoHA) for potential acceleration of bone regeneration, including antibacterial and osteopromotive variants containing Zn- and Mg-doped nanoHA and (2) vitamin C-enriched wound dressings for potential skin regeneration revealing optimal pH of 4.5-5 for skin healing, high absorption capacity, ability to enhance skin fibroblast proliferation and collagen synthesis, and having antibacterial properties. The main goal of this project is to comprehensively assess biomedical potential of produced novel chitosan/agarose cryogel-based biomaterials (bone scaffolds and wound dressings) via determination of their mechanical properties, porosity, surface topography, physicochemical properties, biodegradation, bioactivity (scaffold biomineralization *in vitro*), and biocompatibility *in vitro*. Since both Zn ions and chitosan are known to possess antibacterial properties, the project also involves evaluation of antibacterial activity of biomaterials against bacteria which are typical of wound and implantable biomaterial infections.