Abstract

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Thesis Title: Special application of bioactive glass as active ingredient in woundcare and hemostasis

Recently, bioactive glass (BG) has emerged as a promising solution for treating injuries such as diabetic and venous ulcers. BG release the therapeutic ions that helps in fibrin clot formation by aid in platelet aggregation, supporting the coagulation cascade and helping in the regeneration of soft tissue.

In the Part A of this thesis, we synthesized a binary glass composition (named, AgBG) containing varying mol% of SiO_2, CaO, B_2O_3, and Ag_2O using the sol-gel technique, followed by electrospinning with an FDA-approved polymer to fabricate a fibrous matrix named ABGmnf based wound care matrix. We then conducted various material characterization techniques including XRD, FTIR, TG-DSC, FESEM, BET, angle of repose, zeta potential, solubility assessment, and mechanical property testing. Biological studies included *in vitro* cytocompatibility, immunofluorescence staining for cellular proliferation and morphology, 2D wound healing assays, and antibacterial experiments to estimate zone of inhibition (ZOI) and determines minimum inhibitory concentration (MIC) using gram positive and gram negative strains. The *in vitro* material characterizations and biological studies confirmed the successful fabrication of ABGmnf based wound care matrix, its cytocompatibility, and antibacterial activity. Subsequently, *in vivo* pharmacokinetic and biodistribution studies along with biocompatibility study by assessing IL-6 and TNF-α confirmed its safety profile. This was followed by *in vivo* wound healing assay, which exhibited fast closure of wound, and histological assessment of various vital organs. These findings suggest that compositions like AgBG as ABGmnf based wound care matrix have great potential in the wound care market and could pave the way for new directions in tissue engineering.

In the Part B of the thesis, we report a unique composition of bioactive glass, 70 SiO_2: (30-x-y) CaO: x.Al_2O_3: y.ZnO, where x=10-18 mole% and y= 0-8 mole%, exhibiting haemostatic property as well as antibacterial activity. The as-prepared glass was characterized using XRD, SEM-EDX, FTIR, BET and TG-DSC along with *in vitro* degradation study and biological studies e.g., cytocompatibility, haemocompatibility, *in vitro* thrombus formation, *in vitro* blood absorption capacity, blood coagulation assays (PT, aPTT), erythrocyte adhesion assay, measuring blood clotting index (BCI), *in vitro* antibacterial assay against *S. aureus* as well as *in-vivo* acute dermal toxicity followed by histopathological analysis) and *in vivo* haemostasis efficacy were undertaken. The novel bioactive glass composition exhibits promises to be an efficient haemostatic agent with antibacterial activity.

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