FABRICATION AND CHARACTERIZATION OF ALGINATE-KERATIN BASED COMPOSITE MICROSPHERES CONTAINING BIOACTIVE GLASS FOR TISSUE ENGINEERING APPLICATIONS

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3D cell encapsulation within hydrogels has attracted more and more attention in tissue engineering applications because hydrogels provide a hydrated environment closely mimicking the in vivo environment for cell and tissue growth[1]. This present study considers the fabrication of alginate-keratin based composite microspheres containing bioactive glass (BG) of 45S5 composition for cell encapsulation. We propose the use of alginate di-aldehyde (ADA) synthesized via periodate oxidation of alginate to enhance the biodegradability of alginate, and the incorporation of keratin into the alginate based hydrogel to improve cellular interaction of the hydrogel. Keratins extracted from wool contain cell adhesive peptide sequences including RGD (arginine-glycine-aspartic acid), and LDV (leucine-aspartic acid-valine)[2]. BG particles, well known for promoting calcium phosphate deposition, were incorporated into the microspheres to enhance osseointegration[3]. The microspheres were prepared via a pressure-driven extrusion technique. Weight loss, protein release measurements, and FTIR spectroscopy of the fabricated microspheres were carried out. The morphology and microstructure of the microspheres were investigated by light microscopy and scanning electron microscopy (SEM), respectively. The results demonstrated that the composition of the hydrogels had a significant effect on their physical properties. Biological properties of ADA-keratin based microspheres were evaluated by encapsulating MG-63 osteosarcoma cells into the microspheres. Cell viability of MG-63 cells in ADA-keratin-1%BG hydrogels was found to be comparable to that of alginate-keratin and ADA-keratin after culturing for 21 days. The results proved that such novel composite hydrogel might be a promising material for biofabrication in bone healing approaches.

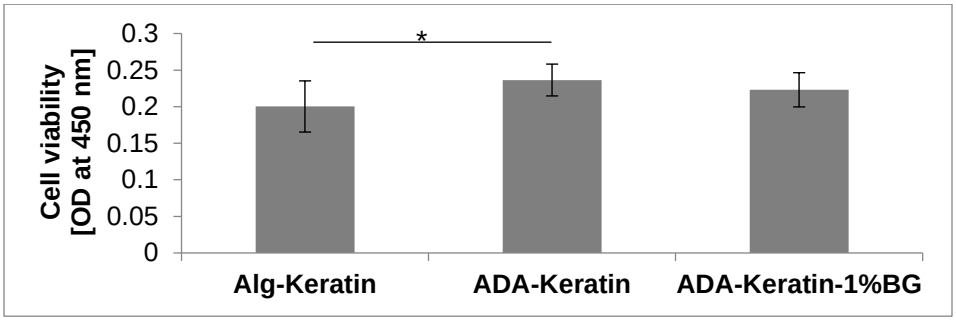

Figure 1 – Cell viability of encapsulated MG-63 cells in hydrogel microspheres after 21 days of cultivation.

References:
1. G. D. Nicodemus and S. J. Bryant. “Cell encapsulation in biodegradable hydrogels for tissue engineering applications” Tissue Engineeriing: Part B 2008, 14 (2): 149-65
2. R. Silva, et al. “Hybrid hydrogels based on keratin and alginate for tissue engineering” Journal of Materials Chemistry B 2014, 2: 5441-51.
A. J. Leite, et al. “Bioplotting of a bioactive alginate dialdehyde-gelatin composite hydrogel containing bioactive glass nanoparticles” Biofabrication 2016, 8: 035005