Injectable Gellan gum-based hydrogels for intervertebral disc regeneration

Silva-Correia J, Oliveira JM, Caridade SG, Oliveira JT, Sousa RA, Mano JF, Reis RL

IBB-Institute for Biotechnology and Bioengineering, 3B's Research Group – Biomaterials, Biodegradables and Biomimetics, Universidade do Minho, AvePark, 4806-909 Caldas das Taipas, Portugal

Introduction: Intervertebral disc (IVD) degeneration is a challenging pathology that, due to the inefficiency of the current treatments, urgently demands for the development of new regenerative approaches[1]. The best viable implant material for nucleus pulposus (NP) regeneration has yet to be identified, but it is believed that biodegradable hydrogel-based materials are promising candidates[2]. In this work, we are proposing the use of ionic- and photo-crosslinked methacrylated gellan gum (GG-MA) hydrogels as potential acellular and cellular injectable scaffolds for IVD regeneration.

Methods: Gellan gum (GG) was reacted to glycidyl methacrylate (GMA) to enable incorporation of methacrylate groups in GG structure. Ionic- and photo-crosslinked hydrogels, obtained either by immersion in phosphate buffered saline (PBS, pH 7.4) solution or by UV exposure, were physico-chemically characterized by FTIR, ^{1}H NMR and DSC. Hydrogels swelling capacity and degradation rate were also analyzed in PBS, for the period of 30 days. Additionally, the morphology and mechanical properties of the hydrogels were assessed by SEM and DMA, respectively. Cytotoxicity of the GG-based hydrogel leachables was evaluated by carrying out a cellular viability assay (MTS test) on rat lung fibroblasts (L929 cell line) cells until 7 days.

Results: Results demonstrated that GG was successfully methacrylated and allowed to produce both ionic- and photo-crosslinked GG-MA hydrogels. The developed GG-MA hydrogels possess improved mechanical properties and lower water uptake ability and degradation rate as compared to those for GG. This work also revealed that GG-MA hydrogels are non-cytotoxic *in vitro* (Figure 1).

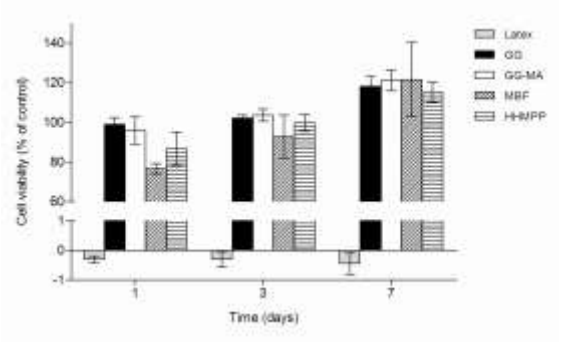

Figure 1. Cytotoxicity screening of the GG-based hydrogel leachables using L929 cells (GG: gellan gum; GG-MA: ionic-crosslinked hydrogel; MBF: photo-crosslinked hydrogel with MBF 0.1% w/v; HHMPP: photo-crosslinked hydrogel with HHMPP 0.05% w/v).

Conclusions: The results indicate that the proposed ionic- and photo-crosslinked GG-based hydrogels are promising biomaterials to be used as acellular and cellular substitutes of the NP.

Keywords: Gellan gum, intervertebral disc, methacrylation, photo-crosslinking.

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References:

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2. Peppas NA *et al.* (2006), *Adv. Mater.*, **18**: 1345-1360.