

## Characterization of a novel biodegradable 3D-scaffold designed for medical applications

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**INTRODUCTION:** An increasing need for biodegradable 3D-scaffold materials usable as interactive wound dressings or scaffolds in tissue engineering requires characterization of novel materials with respect to their mechanical and chemical properties, their ways of processing to form the requested shape and to adjust their degradation kinetics to the requirements of specific applications. However, prior to any envisioned medical application biocompatibility of an implanted material needs to be analyzed. A new family of Degrapol<sup>®</sup> polymers is aimed to be explored for medical applications. These polymers show essential requirements for materials used for medical applications; namely mechanical properties and degradation rates can be independently controlled. The aim of this work was to determine endothelial cell survival and proliferation on Degrapol<sup>®</sup> polymers.

**METHODS:** Polylactic acid (PLA) and Degrapol<sup>®</sup> polymer scaffolds were supplied by ab medica, Italy. NIH-3T3 fibroblasts were cultured in DMEM supplemented with 10% NCF. Human Umbilical Vein Endothelial Cells (HUVECs) were cultured in Endothelial Cell Medium (Promocell) supplemented with 2% FCS, 2 mL ECGS/H, 0.1 ng/mL EGF, 1.0 ng/mL bFGF and 1.0 µg/mL hydrocortisone at 37°C at 5% CO<sub>2</sub>. Prior to cell seeding, Degrapol<sup>®</sup> or PLA have been treated in several ways in order to improve cell survival and proliferation. Scaffolds have been: rinsed in water (1, 3 d or more than 7 d), O<sub>2</sub>-plasma cleaned or decorated with cell adhesive proteins: fibronectin or collagen I. Cellular mitochondrial activity was assessed with Alamar Blue proliferation assay after 0, 4 and 8 d. Cell adhesion on the scaffolds of chemically fixed, dehydrated and critically point-dried samples was observed by SEM.

**RESULTS:** For both HUVECs and NIH-3T3 fibroblasts, scaffolds treatment affected cell adhesion and cell survival. As shown in Figure 1, pre-treatment of Degrapol<sup>®</sup> polymers was essential for cell adhesion and proliferation. In the presence of cell adhesive proteins collagen I or fibronectin, cell activity was strongly increased with time on Degrapol<sup>®</sup> and PLA surfaces as compared to the native polymers.

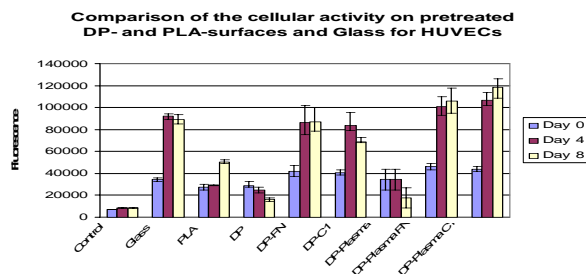


Figure 1: Cell proliferation on Degrapol<sup>®</sup> and PLA surfaces. 20'000 HUVECs were seeded on 1% PLA or 1% Degrapol<sup>®</sup>-coated glass surfaces. The surfaces were further treated with O<sub>2</sub>-plasma and adsorbed with 2 µg/ml collagen I or fibronectin. Cellular activity was measured four hours after seeding (day 0) and at day 4 and 8 by Alamar Blue proliferation assay.

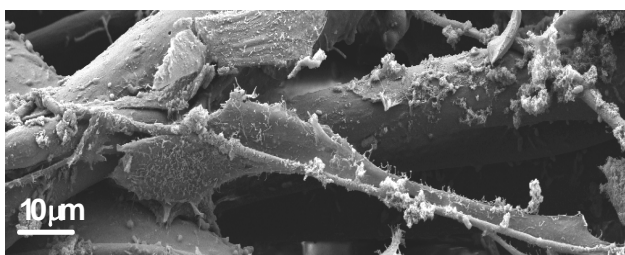


Figure 2: SEM image of NIH-3T3 fibroblasts cultured for 14 days on Degrapol<sup>®</sup> fibers.

**DISCUSSION & CONCLUSIONS:** Degrapol<sup>®</sup> polymers provided biocompatible surfaces that allowed HUVECs and NIH-3T3 fibroblasts to proliferate with time. Pre-treatment with O<sub>2</sub>-plasma and adsorption of cell adhesive proteins enhanced cell adhesion and proliferation. HUVECs and NIH-3T3 fibroblasts adhered on Degrapol<sup>®</sup> fibers (Figure 2) and spanned within them. Overall, Degrapol<sup>®</sup> showed comparable results to PLA, a polymer already used for medical applications and therefore, Degrapol<sup>®</sup> might be a valuable alternative for the production of medical scaffolds.

**REFERENCES:** <sup>1</sup>Das S, Hollister S. *Tissue Engineering scaffolds*. Elsevier Ltd. 2003  
<sup>2</sup>Sperling.C *Design and evaluation of novel blood incubation systems for in vitro hemocompatibility of planar solid surfaces*. Wiley Interscience 2002.

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