Advanced silk-based genetic polymers with improved cell adhesion properties

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Recombinant protein-based polymers (rPBPs) are an emerging class of genetic polymers inspired by Nature and produced by synthetic protein biotechnology approaches. Due to their exceptional physical-chemical and biological characteristics, as well as their ability to be customized for specific applications, rPBPs have been explored for the development of advanced biomaterials [1]. Most of the polymers used as biomaterials thus far have been chemically synthesized, originating random copolymers with diverse and uncontrolled distribution of molecular weight (MW) and composition. However, advances in recombinant DNA technology allow the biological synthesis of fine-tuned rPBPs with precise control of their composition, polymer size and structure [2]. Furthermore, with the development of recombinant protein engineering and biotechnology, it is now possible to design new bioactive rPBPs by combining active peptides/domains from different natural proteins in the same fusion protein.

In this work, and for the first time, the three modules of fibronectin type II (FNII) of the human matrix metalloproteinase-2 were used as functional domain for the development of genetic silk-based polymers with enhanced cell adhesion. The three FNII modules were fused with a synthetic gene coding for six repetitions of a structural motif from the spider dragline silk protein MaSp1. The chimeric protein 6mer+FNII was recombinantly expressed in *E. coli* and purified by a facile non-chromatographic approach. Preliminary results showed that 6mer+FNII alone was not appropriate for tissue engineering and biomedical applications. For this reason, we have created novel biocomposites composed of 6mer+FNII and a silk-elastin-like protein previously designed and synthesized by our group [3]. After being processed into films, the composites were assessed for their cytotoxicity and ability to induce cell adhesion. Results unveil a novel class of non-toxic biopolymer composites able to promote cell adhesion, suitable to be used as biomaterials for tissue engineering and biomedical applications.

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