Enzymatic phosphorylation of silk fibroins: a platform for the production of biocompatible, cell-static, materials

Vadim Volkov[1], Andreia Vasconcelos[1], Marisa P Sárria[1,2], Andreia C Gomes[2], Artur Cavaco-Paulo[1]*

[1] Centro de Engenharia Biológica (CEB), Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal
[2] Centro de Biologia Molecular e Ambiental (CBMA), Departamento de Biologia, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

Contact e-mail: vadimbiu@gmail.com

Abstract

Silks are natural protein polymers produced by insects[1]. Silk heavy chain of *B.mori* is primarily composed of hydrophobic, –(–Ala–Gly–)$_n$– β-sheet crystalline domains[3]. Based on silk biocompatibility, biodegradability and strength, different materials were developed[4, 5]. Silk offers a stabilizing environment for incorporated proteins and molecules[6]. Silk properties can be controlled via structure manipulation[8,9], by coupling molecules[11,12] of biological significance; its Tyr and Ser residues can be modified[13,14]. Once incorporated into a protein, the phosphate group establishes hydrogen bonds that affect intra- and inter-molecular interactions[16]. Phosphorylation is stable under physiological conditions[17], thus directing the formation and reorganization of protein networks. Curiously, using phosphorylation for protein functionalization is largely unexplored[14]. Significant research is devoted to bio-inspired materials with various cell-differentiating[20] and cell-supporting[21,22] features. However, little attention is paid to develop cell-static bio-materials. Such materials do not promote cell growth. That can be achieved by lowering the probability of cell attachment to the material, via creation of negatively charged material surface[23].

The goal of this study was to produce bio-compatible materials with the cell-static properties by phosphorylation. Silk solutions were made to cast films of variable pH and phosphorylated content. Obtained materials were tested and a dependency between amount of phosphorylation and bio-chemical properties confirmed.