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Studies on the hemocompatibility of bacterial nanocellulose

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Cardiovascular disease is a leading cause of mortality in the Western countries. Surgical bypass with autologous grafts remains the most used treatment, saphenous veins and mammary arteries being preferably used but not always available in many patients. For the reconstruction of arteries of large caliber currently available synthetic grafts offer a reasonable solution and proven clinical efficacy. However, for small sized (<6 mm) grafts these materials generally give poor performance, due to anastomotic intimal hyperplasia and surface thrombogenicity. The production of functional blood vessels by tissue engineering techniques is already possible, however due to the associated costs and lengthy production, the development of new materials appropriated for small diameter blood vessel replacements is still required. Among the strategies developed over the years to modify materials for vascular devices, pre-coating with the tripeptide Arg-Gly-Asp (RGD) improves endothelialization thus lowering thrombogenicity.

In this work, bifunctional recombinant proteins, with a Cellulose-Binding Module – CBM, from the cellulosome of *Clostridium thermocellum* - and cell binding sequences were successfully cloned and expressed in *Escherichia coli.* These RGD-containing cellulose-binding proteins were purified and used to coat bacterial cellulose fibres. Bacterial cellulose (BC) secreted by *Gluconacetobacter xylinus* is a material with unique properties and promising biomedical applications. CBMs adsorbs specifically and tightly on cellulose. Thus, they are a useful tool to address the fused RGD sequence (or other bioactive peptides) to the cellulose surface, in a specific and simple way. The blood compatibility of native and RGD-modified BC was also studied. The clotting times (aPTT, PT, FT and PRT) and whole blood clotting results showed that neither the bare or endothelialized BC activate the coagulation pathways. A significant amount of plasma protein adsorbed to BC fibres but, according to analysis carried out by intrinsic tryptophan fluorescence, the BC adsorbed albumin, fibrinogen and γ-globulin do not undergo major conformational modifications. Although the presence of the adhesion peptide on bare-BC surface increases the platelet adhesion, when the material was cultured with human microvascular endothelial cells a confluent cell layer was readily formed, inhibiting the adhesion of platelets.

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