Development of hemostatic materials made of electrochemically oxidized bacterial cellulose

Sara Pinheiro, Eugénia Queirós, Vera Carvalho, Miguel Gama, Pier Parpot

CEB - Centre of Biological Engineering, Universidade do Minho, 4710-057 Braga, Portugal
Group: FUNCARB Line: Health Biotechnology and Bioengineering

Cellulose is the most abundant polysaccharide in nature, being the main constituent of plant cell walls. It can undergo structural modification by oxidative methods, making it absorbable when implanted in the organism, contrarily to what happens with the non-oxidized cellulose. This way it can be used as raw material in medical devices, such as absorbable hemostatic materials and as a barrier to prevent post-operative adhesions. Cellulose can also be produced by bacteria (mainly from the species *Glucanocetobacter xylinus*), being this way known as bacterial cellulose (BC).
With the increasing use of the hemostatic materials based on oxidized cellulose in surgical procedures, there has also been an increase in the number of case studies that describe post-operative complications associated with the use of these materials. BC has improved characteristics and unique properties compared with polysaccharide derived from plants, namely a higher biocompatibility. It has therefore been the subject of increased research over the past years allowing its application in various fields, especially in biomedical applications [1].
This project aims to develop a hemostatic material to reduce post-operative complications, based on the oxidized BC, using electrochemical oxidation methods [2]. These methods are based on the stable nitroxyl radicals commercially available.
The oxidation of BC was investigated in aqueous medium using 2,2,6,6-Tetramethyl-1- piperidinyl-oxy (TEMPO) as redox mediator. TEMPO is a representative radical of the reagents used for these processes, occurring in a highly selective oxidation of C6 primary hydroxyl to carboxylic groups, which was verified by ^{13}C-NMR. After oxidation, samples were also analysed by ATR-FTIR technique indicating the successful oxidation of the hydroxyl groups. The degradation of the CB membranes is being studied and, to verify the hemostatic behaviour of the modified membranes some preliminary assays, namely whole blood coagulation tests, are ongoing.
One improvement in this field is the anodic regeneration of oxidizing species rather than using co-oxidants, considering a cleaner approach, which will highlight this project.

References

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