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Natural polymers of bacterial origin and their medical applications

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Polyhydroxyalkanoates (PHAs) are natural polymers produced by bacteria under nutrient limiting conditions. These polymers are biodegradable and biocompatible in nature and hence can be used in a variety of medical applications such as tissue engineering, wound healing, medical device production, and drug delivery. PHA synthases are the main enzymes involved in the biosynthesis of PHAs. There are two main types of PHAs, short chain length PHAs, scl-PHAs, with monomer chain length C3-C5, these are generally hard and brittle; mcl-PHAs, with monomer chain length C_6-C_{16}, these are soft and elastomeric in nature. Due to their varied mechanical properties and degradation rates, PHAs can be used to replace a range of tissue types including bone nerve cartilage pancreas cardiac and skin. In addition they can be used for short-term and long-term controlled drug delivery. PHAs are known to be particularly cardio-regenerative in nature. Myocardial infarction results in the generation of scar tissue with limited or no regeneration. The concept of a cardiac patch is tailored to meet the unmet medical need of cardiac regeneration where a biomaterial-based patch with/without cells would be used to induce efficient cardiac regeneration. Mcl-PHAs have been shown to be excellent substrates for the growth and function of neonatal cardiomyocytes. We have carried out an in-depth study of the potential of MCL-PHAs for the development of functional cardiac patches.PHAs are also known to be highly neuro-regenerative in nature. Peripheral nerve injuries caused due to accident or disease are highly debilitating in nature. Gaps longer than 5mm do not regenerate naturally and lead to loss of function. We have developed Nerve guidance conduits using PHA based blends. These have been tested using animal models and were found to result in functional regeneration comparable to autografts, an excellent outcome.In conclusion, PHAs are a highly promising family of medical polymers with huge potential in the future.

Biography

Ipsita Roy is an expert in Microbial Biotechnology, Biomaterials and Tissue Engineering. She is currently a Professor at the Faculty of Science and Technology, University of Westminster, London. She was awarded the Inlaks Scholarship to study for her PhD at the University of Cambridge. Her postdoctoral work was at the University of Minnesota, USA. Subsequently, she has been at the University of Westminster since 2000 and leads the Applied Biotechnology Research Group. She has published over 100 papers in high Impact Factor journals such as Biomaterials, Biomacromolecules, Journal of Royal Society Interface. Her group is currently focussed on the production of novel polyhydroxyalkanoates (PHAs), a group of FDA-approved natural polymers and their characterisation. Her work has been funded by the EPSRC, EU, DuPont and WESTFOCUS, London. Professor Roy's current projects involve the use of PHAs for the production of drug eluting biodegradable stents, nerve guidance conduits, antibacterial polymers and wound healing.

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