Development of Electrospun Marine-based Collagen Membranes as Biomaterial for Tissue Engineering Applications

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The ultimate goal in tissue engineering is the design and development of a scaffold that can perfectly mimic the biological structure and microenvironment of the targeted tissue, giving to cells the need 3D support for the biosynthesis of new tissues. The extracellular matrix (ECM) is essential for structural and biochemical support of cells and surrounding environment, from which several attempts have been made to simply mimic this structure as scaffolding strategy, with electrospinning technique receiving significant attention as a reliable methodology. Using this technique, submicron- or nanometre-scale polymer fibres can be produced, derived from a wide range of polymers, both synthetic (e.g. poly(glycolic acid) (PGA), poly(lactic-co-glycolic acid) (PLGA)) and natural (e.g. collagen, chitosan, keratin). In this work we present different combinations of electrospun membranes using only natural but also blends of synthetic and natural polymers to produce new biomaterials envisaging Tissue Engineering (TE) applications such as corneal, bone and wound regeneration. For bone regeneration applications, a combination of ceramic and polymer is targeted because it is the natural bone tissue composition and formulations composed by hydroxyapatite (HAp, the major inorganic component of human bone), polycaprolactone (PCL, a biodegradable synthetic polyester) and marine-derived Collagen (Col) and Gelatin (Gel) were studied. Marine collagens and gelatins are regarded as a safe alternative to the mammal sources, which represent social and religious constraints as well as risks associated to zoonosis (bovine spongiform encephalopathy (BSE)), and in this work blue shark and Atlantic cod skins, by-products from Portuguese and Galicians fishing industries, were used as raw-materials for the production of those valuable biopolymers, further characterized to assess its purity and biochemical features. Also, the ceramic component chosen (HAp) is derived from marine sources, namely blue shark teeth. The different materials were electrospun in different combinations (PCL; Col/Gel; PCL + Col/Gel; PCL + Col/Gel + HA), crosslinked with EDC/NHS and characterized to address morphological (SEM), chemical (FTIR) and physical (water content, contact angle) characteristics. Mechanical performance upon tensile stress will be studied, as well as biological evaluation with different cell types according to the TE application.

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