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Collagen- vs. Gelatine-Based Biomaterials and Their Biocompatibility: Review and Perspectives

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1. Introduction

Selection of a starting material, which will somehow mimic a naturally-existing one, is one of the most important points and crucial elements in biomaterials development. Material biomimetism is one of those approaches, where restoration of an organ’s function is assumed to be obtained if the tissues themselves are imitated (Barrere et al., 2008). However, some of the biopolymers as e.g collagen can be selected from within a group of biomimetic materials, since they already exist and have particular functions in the human body.

Collagen is one of the key structural proteins found in the extracellular matrices of many connective tissues in mammals, making up about 25% to 35% of the whole-body protein content (Friess, 2000; Muyonga et al., 2004). Collagen is mostly found in fibrous tissues such as tendons, ligaments and skin (about one half of total body collagen), and is also abundant in corneas, cartilages, bones, blood vessels, the gut, and intervertebral discs (Brinckmann et al., 2005). It constitutes 1% to 2% of muscle tissue, and accounts for 6% of strong, tendinous muscle-weight. Collagen is synthesized by fibroblasts, which originate from pluripotential adventitial cells or reticulum cells. Up to date 29 collagen types have been identified and described. Over 90% of the collagen in the body is of type I and is found in bones, skins, tendons, vascular, ligatures, and organs. However, in the human formation of scar tissue, as a result of age or injury, there is an alteration in the abundance of types I and III collagen, as well as their proportion to one another (Cheng et al., 2011).

Collagen is readily isolated and purified in large quantities; it has well-documented structural, physical, chemical and immunological properties, is biodegradable, biocompatible, non-cytotoxic, with an ability to support cellular growth, and can be processed into a variety of forms including cross-linked films, steps, sheets, beads, meshes, fibres, and sponges (Sinha & Trehan, 2003). Hence, collagen has already found considerable usage in clinical medicine over the past few years, such as injectable collagen for the augmentation of tissue defects, haemostasis, burn and wound dressings, hernia repair, bioprosthetic heart valves, vascular grafts, a drug-delivery system, ocular surfaces, and nerve regeneration (Lee et al., 2001). However, certain properties of collagen have adversely influenced some of its usage: poor dimensional stability due to swelling in vivo; poor in vivo mechanical strength and low elasticity, the possibility of an antigenic response (Lynn et
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These contribution books collect reviews and original articles from eminent experts working in the interdisciplinary arena of biomaterial development and use. From their direct and recent experience, the readers can achieve a wide vision on the new and ongoing potentialities of different synthetic and engineered biomaterials. Contributions were selected not based on a direct market or clinical interest, but on results coming from a very fundamental studies. This too will allow to gain a more general view of what and how the various biomaterials can do and work for, along with the methodologies necessary to design, develop and characterize them, without the restrictions necessary imposed by industrial or profit concerns. Biomaterial constructs and supramolecular assemblies have been studied, for example, as drug and protein carriers, tissue scaffolds, or to manage the interactions between artificial devices and the body. In this volume of the biomaterial series have been gathered in particular reviews and papers focusing on the application of new and known macromolecular compounds to nanotechnology and nanomedicine, along with their chemical and mechanical engineering aimed to fit specific biomedical purposes.

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