Project Number: **DST/INT/POL/P-41/2020**

INDO-POLAND BILATERAL PROJECT

entitled

"DEVELOPMENT OF A SMART SCAFFOLD FOR ASSISTING EFFICIENT BONE REPAIR"

Sanctioned Date: **01.03.2021**

INDIA

Project Investigator: Dr. K. Ravichandran

Co-Investigator: Dr. Suvro Chatterjee

POLAND

Project Investigator: Professor dr hab. inż. Elżbieta Pamuła

Financed by

Ministry of Science and Technology

Department of Science and Technology (DST)

Government of India

Journal of *Functional Biomaterials*

MDPI

Article

Characterization and In Vitro Evaluation of Porous Polymer-Blended Scaffolds Functionalized with Tricalcium Phosphate

Iwona Pudełko-Prażuch [1], Mareeswari Balasubramanian [2], Sundara Moorthi Ganesan [2], Stanisław Marecik [1], Kamila Walczak [1], Kinga Pielichowska [1], Suvro Chatterjee [3], Ravichandran Kandaswamy [2,*] and Elżbieta Pamuła [1,*]

[1] Department of Biomaterials and Composites, Faculty of Materials Science and Ceramics, AGH University of Krakow, Al. Mickiewicza 30, 30-059 Krakow, Poland; ipudelko@agh.edu.pl (I.P.-P.); smarecik@agh.edu.pl (S.M.); kamwalczak@agh.edu.pl (K.W.); kingapie@agh.edu.pl (K.P.)
[2] Department of Rubber and Plastics Technology, Madras Institute of Technology Campus, Anna University, Chromepet, Chennai 600 044, Tamil Nadu, India; venibala18@gmail.com (M.B.); sundaramoorthi1997@gmail.com (S.M.G.)
[3] Department of Biotechnology, Golapbag Campus, University of Burdwan, Burdwan 713 104, West Bengal, India; soovro@yahoo.ca
* Correspondence: ravi@mitindia.edu (R.K.); epamula@agh.edu.pl (E.P.)

Abstract: Bone tissue is one of the most transplanted tissues. The ageing population and bone diseases are the main causes of the growing need for novel treatments offered by bone tissue engineering. Three-dimensional (3D) scaffolds, as artificial structures that fulfil certain characteristics, can be used as a temporary matrix for bone regeneration. In this study, we aimed to fabricate 3D porous polymer scaffolds functionalized with tricalcium phosphate (TCP) particles for applications in bone tissue regeneration. Different combinations of poly(lactic acid) (PLA), poly(ethylene glycol) (PEG with molecular weight of 600 or 2000 Da) and poly(ε-caprolactone) (PCL) with TCP were blended by a gel-casting method combined with rapid heating. Porous composite scaffolds with pore sizes from 100 to 1500 µm were obtained. ATR-FTIR, DSC, and wettability tests were performed to study scaffold composition, thermal properties, and hydrophilicity, respectively. The samples were observed with the use of optical and scanning electron microscopes. The addition of PCL to PLA increased the hydrophobicity of the composite scaffolds and reduced their susceptibility to degradation, whereas the addition of PEG increased the hydrophilicity and degradation rates but concomitantly resulted in enhanced creation of rounded mineral deposits. The scaffolds were not cytotoxic according to an indirect test in L929 fibroblasts, and they supported adhesion and growth of MG-63 cells when cultured in direct contact.

Keywords: PLA; polymer scaffolds; porous scaffolds; polymer blends; TCP; polymer functionalization

Citation: Pudełko-Prażuch, I.; Balasubramanian, M.; Ganesan, S.M.; Marecik, S.; Walczak, K.; Pielichowska, K.; Chatterjee, S.; Kandaswamy, R.; Pamuła, E. Characterization and In Vitro Evaluation of Porous Polymer-Blended Scaffolds Functionalized with Tricalcium Phosphate. *J. Funct. Biomater.* **2024**, *15*, 57. https://doi.org/10.3390/jfb15030057

Academic Editor: Silvia Panzavolta

Received: 24 January 2024
Revised: 16 February 2024
Accepted: 22 February 2024
Published: 26 February 2024

1. Introduction

In recent years, bone tissue was the second most transplanted tissue after blood [1,2]. This growing demand for new solutions provided by bone tissue engineering is caused by common trauma or pathologies, different diseases, and the ageing population [3]. The aim of bone tissue engineering is to design biomaterials that temporarily mimic the three-dimensional structure and functions of bone to promote cell adhesion, proliferation, and differentiation [4].

Bone tissue has a very complex and highly organized structure. When it comes to its chemical composition, it consists of from 50% to 70% inorganic constituents (mainly hydroxyapatite), 20% to 30% organic constituents (type I collagen), 5% to 10% water, and 3% lipids. While if its architecture is taken into account, bone tissue can be classified as hard cortical bone (with a porosity of 10–30%) or spongy cancellous bone (with a