STEM CELLS RESPONSE ON PHOTO-CROSSLINKED HEPARIN – BONE MORPHOGENETIC PROTEINS (BMP-2/-7) HYBRID SYSTEMS

MAGDALENA WYTRWAL-SARNA[1]*, AGATA POMORSKA[2], MAŁGORZATA SEKULA-STRYJEWSKA[3], EWA ZUBA-SURMA[3], KRZYSZTOF SZCZUBIAŁKA[4]

[1] ACADEMIC CENTER FOR MATERIALS AND NANOTECHNOLOGY, UNIVERSITY OF SCIENCE AND TECHNOLOGY AGH, POLAND
[2] JERZY HABER INSTITUTE OF CATALYSIS AND SURFACE CHEMISTRY PAS, POLISH ACADEMY OF SCIENCES, POLAND
[3] MALOPOLSKA CENTER OF BIOTECHNOLOGY, JAGIELLONIAN UNIVERSITY, POLAND
[4] FACULTY OF CHEMISTRY, JAGIELLONIAN UNIVERSITY, POLAND
*E-MAIL: WYTRWAL@AGH.EDU.PL

[ENGINEERING OF BIOMATERIALS 158 (2020) 16]

Introduction
Biomaterial scientists recognized the importance of the integrin-mediated signaling that influences key cellular responses, such as adhesion, migration, proliferation. The studies were focused on bone morphogenetic proteins (BMP-2 and BMP-7) embedment optimization onto polyelectrolyte multilayers (PEM). The covalent binding of two types of BMPs allow to decrease the required amount of proteins for efficient cell differentiation by creating the synergy pairs between them [1,2]. Than physicochemical and biological properties of such hybrid materials were examined as a function of stem cells response. The aim was to prepare active coatings of bone implants or scaffolds enabling the proliferation and differentiation of stem cells.

Materials and Methods
The studies were focused on bone morphogenetic proteins (BMP-2 and BMP-7) embedment optimization onto polyelectrolyte multilayers (PEM) composed from polyanion: heparin (HEP) and polycation: diazoresin (DR) as $(DR/HEP)_6$ system. PEM physicochemical properties before and after BMPs embedment, and before and after UV photo-crosslinking were optimized and analyzed by atomic force microscopy (AFM) and quartz crystal microbalance (QCM-D). MSCs biological responses were examined by MTT, trypan blue assays, immunocytochemistry staining (FIG. 1), and qRT-PCR technique.

Results and Discussion
The effective both BMP types immobilization was confirmed by AFM and QCM measurements. It was proven that chosen polymeric films enhanced cell viability, proliferation and adhesion. Moreover, covalent embedment of both BMPs enhances cells differentiation into bones, compared to those embed separately.

Conclusions
The reason for using PEM is dictated by that it still serves as a versatile platform allowing the use of various substrates on which they can be deposited. Examined PEM/BMPs systems are versatile coatings that can be used to coat a wide range of scaffolds or implants. Embedding of two different bone morphogenetic proteins (BMPs) combining with glycosaminoglycan - heparin gave the synergistic effect. Thanks to the covalent binding of two BMPs types, their osteogenic properties are enhanced by the activation of several signaling pathways. Such a method will reduce the required amount of growth factors for efficient stem cells differentiation, and lower the cost, both in in vitro culture and bone tissue engineering.

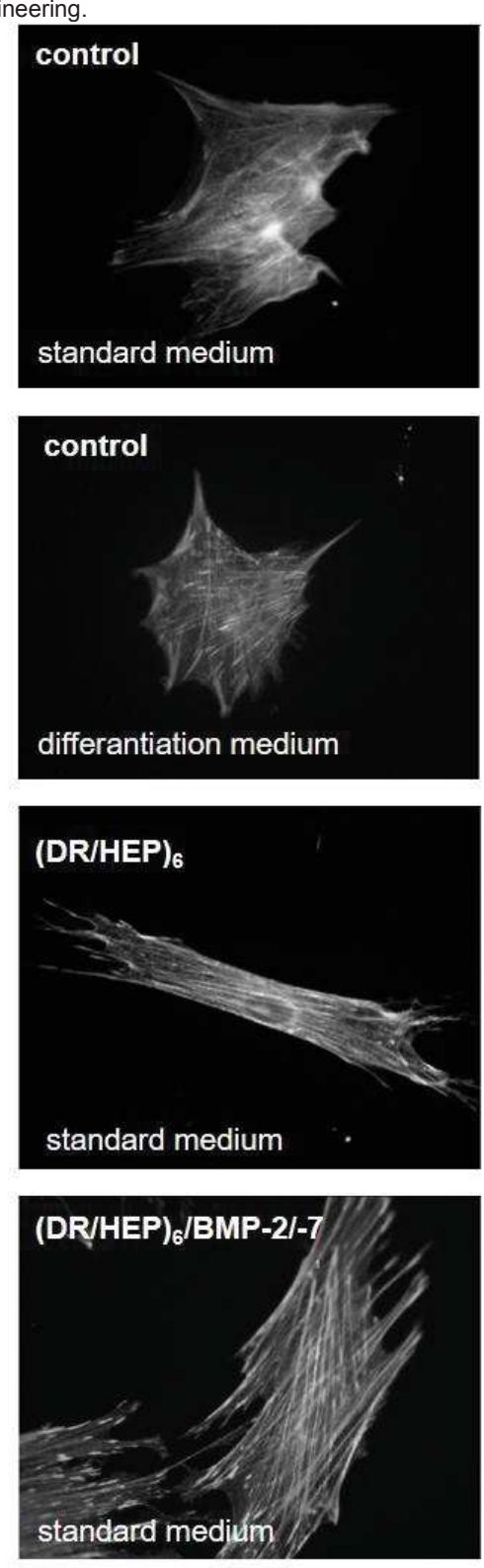

FIG. 1. hUC-MSCs cytoskeleton organization (fluorescence of F-actin, winkulin, nucleus) cultured in different environment.

Acknowledgments
This work was supported by the Polish National Science Centre, project no. 2016/21/D/ST5/01636.

References
[1] X. Li, W. Yi *et al.*, Am. J. Transl Res. 7 (2015) 1417-1428.
[2] H. H. Luu, W. X. Song *et al.,* J. Orthop. Res. 25 (2007) 665-677