TAILORING COLLAGEN-BASED MATRICES FOR BIOMEDICAL RESEARCH

T. Teplický [1], O. Hanzel [2], B. Čunderlíková [1, 3]

[1]Institute of Medical Physics, Biophysics, Informatics and Telemedicine, Faculty of Medicine, Comenius University, Bratislava, Slovakia

[2]Institute of Inorganic Chemistry, Slovak Academy of Sciences, Bratislava, Slovakia

[3]International Laser Centre, Slovak Centre of Scientific and Technical Information, Bratislava, Slovakia

Introduction

Extracellular matrix (ECM) in human tissues is made mainly of collagens, however, additional ECM components may be accumulated in certain pathologies. This may have implications for cell biology, since specific cues provided by the ECM to cells are determined by the ECM composition and type of the cell-surface receptors binding ECM components specifically. Moreover, mechanical properties of collagen assemblies are also able to affect intracellular signalling pathways involved in cell survival, differentiation and proliferation [1]. Accordingly, model systems used in biomedical research, consisting of naturally occurring ECM components are likely to provide more physiologically relevant information. The aim of our study was to describe properties of matrices mimicking human tumour ECM.

Material and Methods

Matrices made of human collagen type I were formed by self-organization of collagen fibres and modified by the addition of either human fibronectin or human tenascin-C. Turbidity measurements were used to assess assembly kinetics [2], whereas bulk rheology was applied to assess mechanical properties of resultant matrices. Confocal fluorescence and reflection microscopies were used for fibre visualisation.

Results

Addition of fibronectin and tenascin-C influenced assembly kinetics of collagen matrices. It also resulted in slight increase in the Young´s moduli, indicating incorporation of the proteins into the matrices. Fibronectin co-localized with collagen fibres as revealed by fluorescence imaging. The values of Young´s moduli were slightly lower than those reported for tumour tissue stroma. All types of human collagen matrices revealed also strain stiffening under linear response conditions. Matrices prepared from human collagen showed mechanical properties similar to those found in natural tissues.

Conclusion

Described collagen matrices can be used for preparation of 3D cell cultures to better mimic pathophysiological conditions of tumour stromal tissues.

The research leading to the presented results has received funding from the Scientific Grant Agency of the Slovak Republic (Grant Vega No. 1/0119/19) and from Laserlab-Europe V (European Union's Horizon 2020 research and innovation program under grant agreement no 871124).

Literature

[1] Humphrey J.D., Dufresne E.R., Schwartz M.A.: Mechanotransduction and extracellular matrix homeostasis. Nat.Rev.Mol.Cell Biol. 15/2014, pp. 802-812.

[2] Paten J.A., Martin C.L., Wanis J.T., Siadat S.M., Figueroa-Navedo A.M., Ruberti J.W., Deravi L.F.: Molecular interactions between collagen and fibronectin: A reciprocal relationship that regulates de novo fibrillogenesis. Chem 5/2019, pp. 2126-2145.