UDC 54.057

Hyaluronic acid / Spider silk based antimicrobial hydrogels for biomedical applications

Withanage, S.R. (ITMO University), **Nikolaeva,V.O**. (ITMO University), **Kiseleva, A.P.** (ITMO University), **Dukhinova, M.S.** (ITMO University), **Krivoshapkin, P.V.** (ITMO University)

Scientific adviser – Dr Krivoshapkina, E.F. (ITMO University**)**

Abstract: Hyaluronic acid/ Spider silk-based hydrogels show excellent antimicrobial properties, optimum anti-inflammatory drug uptake and delivery leading to apply in vast range of biomedical applications such as wound dressings. The shear thinning viscosity of the hydrogels suggests promising capabilities to involve in 3D printing of antimicrobial surgical meshes.

Novel antimicrobial natural polymeric hybrid hydrogels based on hyaluronic acid and spider silk were prepared by 1-Ethyl-3-(3-dimethylaminopropyl) carbodiimide / N- hydroxy succinimide mediated chemical crosslinking method. The advanced physicochemical characterizations were performed using Scanning Electron Microscopic imaging, Fourier-transform infrared spectroscopy, and contact angle measurements. The overall characterizations confirm the success of the crosslinking procedure of spider silk with hyaluronic acid, exact composition of the hydrogels and the hydrophilic characteristics of the hyaluronic acid spider silk-based hydrogels.

Further characterizations of the hyaluronic acid spider silk-based hydrogels were performed by analysing the swelling degree, enzymatic degradability, viscosity, conductivity, and shrinking ability tests. There was no profound cytotoxicity of hyaluronic acid spider silk-based hydrogels over human postnatal fibroblasts which allows the applicability of the hydrogels as a skin contact material. Hydrogels show extraordinary antimicrobial ability on both gram-negative and gram-positive bacteria. Parallel analysis of the antimicrobial ability of the components was performed leading to identify which components are responsible for the antimicrobial ability of the hydrogels. The increased concentrations of hyaluronic acid show bacteriostatic inhibitory effects on both gram positive and gram-negative bacteria. Higher concentrations of spider silk demonstrate that spider silk proteins can inhibit the bacterial adhesion. The hydrogels can be an excellent alternative to overcome antimicrobial drug resistance, which is considered to be one of the major global problems in the biomedical industry.

Hyaluronic acid/ Spider silk-based hydrogels are promising material in collaborated antimicrobial and anti-inflammatory drug delivery systems for external use. The rheological properties of the hydrogels show shear-thinning properties, which suggest hydrogels to be applied in 3D printing applications such as 3D printing of antimicrobial surgical meshes.

Acknowledgement

This work is supported by the Ministry of Science and Higher Education of Russia Project No.075-15-2019-1896.