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Cytocompatibility and immunomodulatory properties of nanocellulose for bone-tissue regeneration

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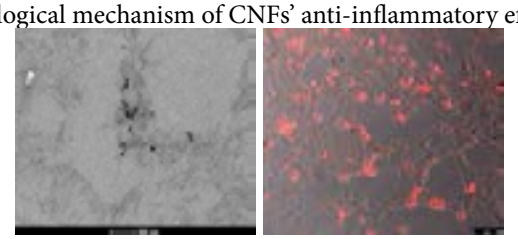
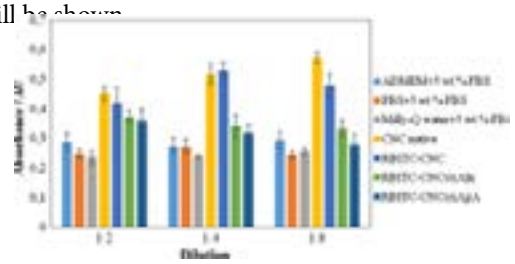
Nanocellulose (NC) has gained much attention recently for their use in pharmaceutical and biomedical applications (such as wound healing, tissue engineering, cell therapy, gene and drug delivery, and diagnostics) due to its large surface area, special mechanical characteristics, and generally-believed excellent biological properties. Out of the two main types of plant-based nanocellulose materials (cellulose nanocrystals (CNCs) and cellulose nanofibrills (CNFs), only CNFs possess a relatively low rigidity, thanks to the alternating crystalline (contributing to stiffness and elasticity) and amorphous cellulose structure (contributing to flexibility and plasticity), which significantly widens their biomedical applications. However, as the commercial applications of NC are approaching, the question about their safety and biocompatibility is also on rise. In contribution, the cytotoxicity as a key parameter of biocompatibility of CNF/CNCs will be presented and discussed depending on its structural properties (size, shape, assembling), surface chemistry, applied concentrations, study models, cell types and exposure time. The effect of NC labeling, being required to perform all the analysis, will be also taken into account. In addition, some studies on immunological mechanism of CNFs' anti-inflammatory effects will be shown.





TE and confocal microscopy images of RBITC-labelled native (1st line), and ApA modified (2nd line) CNCs after 1h of incubation with human osteoblasts.

MTT testing results (the absorbance intensity of formazan product measured at 570 nm) of osteoblasts incubated with differently diluted 0.5 wt% of CNCs.

Recent Publications

1. Gorgieva Selestina, Girandon Lenart and Kokol Vanja (2017) Mineralization potential of cellulose-nanofibrils reinforced gelatine scaffolds for promoted calcium deposition by mesenchymal stem cells. Mater Sci & Eng C, Materials for Biological Applications 73:478-489.
2. Gorgieva Selestina, Vivod Vera, Maver Uroš, Gradišnik Lidija and Dolenšek Jurij (2017) Internalization of (bis) phosphonate-modified cellulose nanocrystals by human osteoblast cells. Cellulose 24(10):4235-4252.
3. Tomić Sergej, Kokol Vanja, Mihajlović Dušan, Mirčić Aleksandar and Čolić Miodrag (2016) Native cellulose nanofibrills induce immune tolerance *in vitro* by acting on dendritic cells. Scientific Reports 6:1-14.
4. Gorgieva Selestina, Vogrinčič Robert and Kokol Vanja (2015) Polydispersity and assembling phenomena of native and reactive dye-labelled nanocellulose. Cellulose 22(6):3541-3558.
5. Čolić Miodrag, Mihajlović Dušan, Mathew Aji P, Naseri Narges and Kokol Vanja (2015) Cytocompatibility and immunomodulatory properties of wood based nanofibrillated cellulose. Cellulose 22(1):763-778.

Biography

Assoc. Prof. Vanja Kokol PhD got a PhD in area of Textile chemistry in 2001 at University of Maribor, Faculty of Mechanical Engineering (UM-FS). She have been employed at UM-FS from 1994, currently as a research counsellor with the habilitation of Assoc. Prof.. Her research work in the last decade is oriented in modification and functionalization of fibers and biopolymers, and their processing in highly-engineered materials for different applications (from technical to biomedical). Special attention is attributed to the development of biopolymeric 2D and 3D materials with targeted and biocompatible antimicrobial activity. She is author of more than 90 papers, 3 book chapters, 3 patents, was supervisor of several (seven) doctoral and post-doctoral (five) students, and have been active in research programme Textile chemistry (from 1999) and Center of Excelence (from 2010) for advanced materials and technologies, area of Soft biomaterials. She was involved (leading or collaborating) in many national (ARRS-L2-7576, ARRS-J2-7018), bilateral (SLo-CZ, Slo-IT, SLO-IND, SLO-DE), international (E!3100 CAWAB, E!3654 BIOPOLS, EraNet Manunet NANOWEL, EraNet Matera Plus ANTIMICROB PEPTIDES, E!4956 MAGNET, EraNet MNT TABANA, EraNet MNT n-POSSCOG) and EU (H2020-PILOTS-03-2017-760601-2-NanoTexSurf, FP7-NMP-2011-SMALL-5-280519-NANOSELECT, FP7-NMP-2011-LARGE-5-280759-NANOBARRIER, Erasmus-Mundus (EMA2)-2013–2540/001–EUPHRATES, Marie Curie ToK/DEV FP6-MTKD-CT-2005-029540-POLYSURF, FP6-2004-SME-COOP-032877-ENZUP) funded research projects.

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