

New advances on fibroblast growth factor-based coatings for hip replacement implants

Ionela Cristina Nica^{1,*}, Miruna S. Stan^{1,2,3}, Anca Dinischiotu¹, Valentina Grumezescu⁴, Alexandra Elena Stoica², Alina Holban^{3,5}, Alexandru Mihai Grumezescu²

¹Department of Biochemistry and Molecular Biology, Faculty of Biology, University of Bucharest, 91-95 Splaiul Independentei, 050095 Bucharest, Romania

²Department of Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, University Politehnica of Bucharest, 1-7 Polizu Street, 011061 Bucharest, Romania

³Research Institute of the University of Bucharest –ICUB, 91-95 Splaiul Independentei, 050095 Bucharest, Romania

⁴National Institute for Lasers, Plasma and Radiation Physics, Măgurele 077125, Romania

⁵Microbiology Immunology Department, Faculty of Biology, University of Bucharest, 1-3 Portocalelor Lane, Sector 5, 77206 Bucharest, Romania

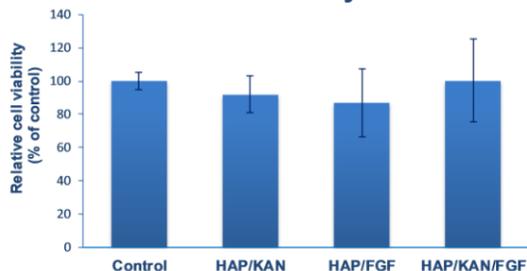
*cristina.nica@gmail.com

INTRODUCTION

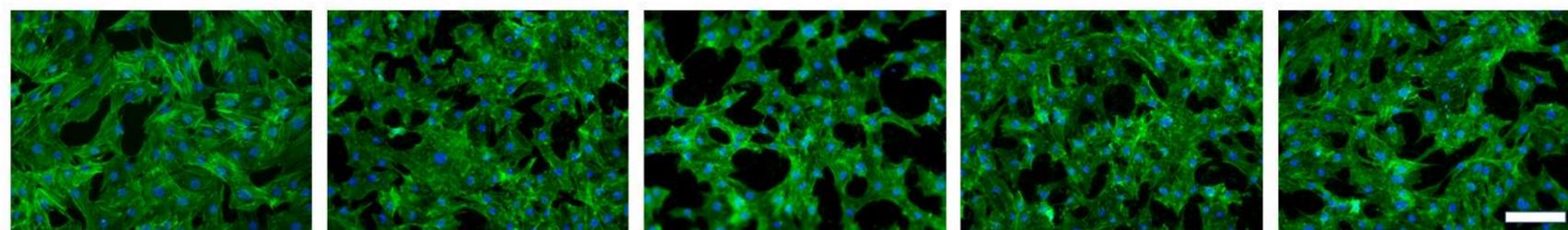
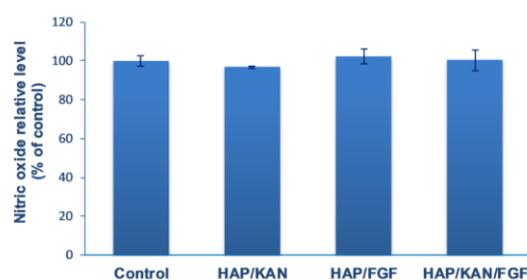
- It is already well known that the tissue-implant interface is one of the most critical factors for the success of the implant integration. The use of bioactive and biomimetic surfaces is of great interest in biomedical applications especially in tissue engineering.
- Therefore, in our study we aimed to obtain successful coatings based on hydroxyapatite, antibiotics and growth factors in order to increase the biocompatibility of commercial implant materials by promoting cell attachment and growth without toxic effects as well as inhibition of microbial biofilm formation.
- As shown by a series of recent studies, the fibroblast growth factor has the ability to enhance the osteoblasts' adhesion and their growth on this type of coatings. Therefore, we took into consideration this application of FGF for our target tissue - bone.
- On the other hand, kanamycin is particularly used to treat infections, such as osteomyelitis and septic arthritis, conditions that are related with the purpose of our research - new coatings for more efficient bone prosthesis.

➤ All coatings were able to impair the initial adherence of bacterial cells and to reduce the biofilm formation throughout the release of antibiotic with no harmful effects on human cells. The osteoblast number counted for HAP/KAN/FGF sample was equal to control. Also, our results showed that cell growth on these surfaces did not induce NO release, proving the biocompatibility of all tested samples.

Cell viability



Nitric oxide



Control

Uncoated alloy

HAP/KAN

HAP/FGF

HAP/KAN/FGF

➤ An excellent cell adherence and spreading on these coatings deposited on hip implants was evidenced by fluorescence microscopy (Scale bar = 100 μ m).

CONCLUSIONS

- ✓ HAP, KAN and FGF-based tested coatings successfully inhibited biofilm formation with no harmful effects on murine cells, supporting their usage as substrates in tissue engineering applications.

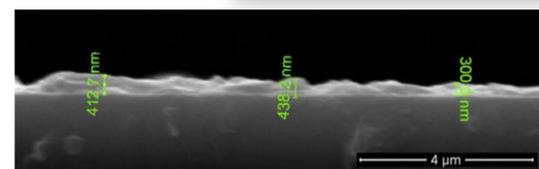
MATERIALS AND METHODS

Homogenous mixtures of hydroxyapatite, kanamycin and fibroblast growth factor (HAP/KAN, HAP/FGF and HAP/KAN/FGF) were coated on titanium-based metal plates for hip replacement implants. Thickness of each coating layer was about 383 ± 73 nm in order to offer the proper morphology and characteristics for cell adhesion.

The cytocompatibility of these samples was investigated on murine normal osteoblasts (MC3T3-E1 cell line) with fibroblast-like morphology after 24 h of exposure by evaluating their influence on cellular viability and potential to generate an inflammatory response.

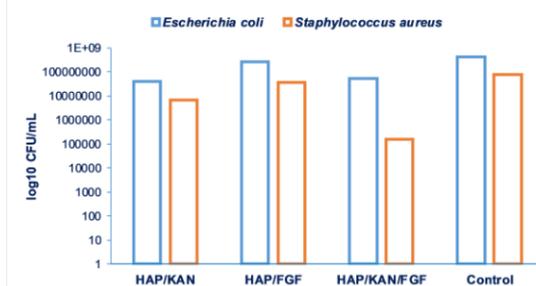
In addition, the adhesion and proliferation, as well as the actin cytoskeleton organization, were observed after 24 h of cell culture on these coatings.

RESULTS AND DISCUSSION



➤ Thickness of each coating layer was about 383 ± 73 nm in order to offer the proper morphology and characteristics for cell adhesion.

Biofilm formation



➤ Kanamycin exhibit a broad spectrum of activity, being efficient against most Gram-positive and Gram-negative microorganisms (Staphylococci, colon Bacillus, klebisella, Fridlender's Bacillus, Proteus, Shigella, Salmonella). After 24 h, our results showed a more pronounced effect on *S. aureus* which are Gram-positive.

▼ As a mechanism of action, kanamycin does not diffuse over long distances in the tissue, therefore it is beneficial to generate a concentration gradient in the immediate vicinity of the implant. This is why the coatings used in the present study were designed to assure a rapid release of antibiotic. It is already known that the release of kanamycin in organic media begins immediately after immersion and lasts at least 48 hours, due to its polarity.

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