THE INFLUENCE OF THE STERILIZATION PROCESS ON THE MICROSCOPIC STRUCTURE OF HYALURONIC ACID-BASED NANOFIBROUS SCAFFOLDS

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Introduction

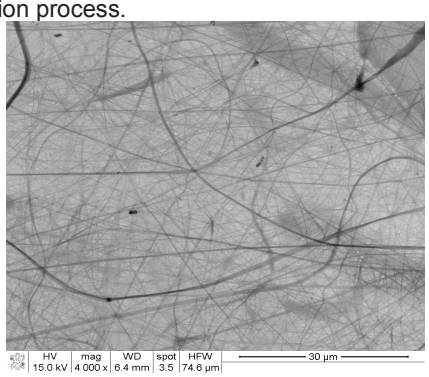
Regenerative medicine is one of the fastest growing areas of contemporary medicine. Constant search for newer and newer biomaterials creates the possibility of taking up the close cooperation between scientists from many areas of science, including biology, material science, chemistry and medicine. Currently, one of the groups of polymers that are widely used in biomedical engineering are various types of polysaccharides, such as alginates, chitin and its derivatives and hyaluronic acid. Alginates have been used in regenerative medicine in various types of materials for the regeneration of muscle tissue, scaffolds for recovering the bone and cartilage tissues, as well as dressing materials adapted to various stages of wound healing [1-4]. Materials based on chitin derivatives can be found in many applications in the field of regeneration of skin tissue in the case of difficult-to-treat wounds of different aetiologies. Recently, such polymers have also found applications in bone tissue engineering. In contrast, materials based on hyaluronic acid are used mainly in aesthetic medicine as well as regeneration of skin tissues. The new application of a hyaluronic acid comprising very high biocompatibility can be the use thereof in the preparation of hybrid materials for both - the treatment of tissue defects of skin and bones. Due to its high hydrophilic properties it can be used as a reservoir for biologically active compounds such as medicines, nano- and microadditives, cell growth factors, as well as others.
The paper presents the behaviour of materials based on hyaluronic acid under the influence of the sterilization process. The essence of the problem was based on the observation of microscopic structure of the substrate of hyaluronic acid treated with various types of radiation.

Materials and Methods

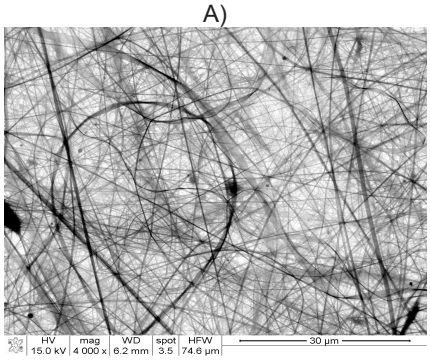
For production of nanofibers, the hyaluronic acid sodium salt was used (Contipro Biotech, Czech Republic) with a molecular weight of M=100-150 kDa. The low molecular weight of hyaluronic acid provided the ability to use higher concentrations of the spinning solutions. The analysis of the microscopic structure of the nanofibers was performed based on the scanning electron images obtained by FEI NOVA Nanos 230 equipped with an electron gun with a field emission (FEG).
The samples were irradiated with a dose of 25 kGy in air by means of accelerated electrons from the accelerator ELU-6 (Eksma) having a horizontal beam. Electron energy was 6 MeV, applied pulse duration 4 μs, frequency 20 Hz, dosing rate 6 kGy/min and a gamma radiation dosing rate of 3,4 kGy/h.

Results and Discussion

The obtained nanofibrous scaffolds based on hyaluronic acid that were obtained by electrospinning process with the selected process conditions, were subjected to microscopic structure analysis. The behaviour of the porous structure (the spaces between the fibres) provides access for physiological fluids and suitable cells to active substances. Despite the rapid dissolution process of the substrates in the body, it creates the possibility of proper distribution of the bioactive substance in the vicinity of diseased tissue or cavities. FIG. 1 presents sample images of hyaluronic acid substrates before and after the sterilization process.



A)



B)

FIG. 1. SEM images of hyaluronic acid-based scaffolds: A) before the sterilization process; B) after the sterilization process.

Conclusions

The research revealed that under the influence of the radiation dose of 25 kGy used during the sterilization process, no changes in the structure of microscopic substrates were observed. However, further studies to determine changes in the chemical structure of compounds used in necessary.

Acknowledgments

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