Effect of genipin cross-linking on physico-chemical properties and cellularization process of PLL/HA multilayer polyelectrolyte films

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The integration of biomedical implants in human organism is dependent on the chemical composition and topography of the surface as well as the mechanical properties of an applied materials. While in the past most of the clinically used materials were developed only based on their acceptance by the body, today beneficial interactions of implants with cells and proteins gather more and more importance. Current development in cardiovascular devices is related to the biocompatibility improvement through manufacturing surfaces mimicking extracellular matrix components. This dynamic microenvironment facilitates covering an internal surface of implant by cell monolayer which mask the material from an inflammatory response and reduce risk of thrombosis. The aim of this study was to improve properties of blood contacting material such as polyurethane, by the "layer by layer" polyelectrolyte multilayer film formation on its surface in order to control implant endothelialisation. However, application of polyelectrolyte coatings as biomaterials for cell attachment has been limited due to their gel like characteristic. Herein, we attempt to improve the cellular adhesion properties of films through chemical cross-linking with a genipin. Hyaluronan (HA), poly-L-lysine (PLL) were used to assemble [PLL-HA]n films in two different thickness variants, 12 and 24 bi-layers respectively. The effects of genipin cross-linking on the internal composition, surface topography, nano-hardness of multilayers and as a consequence on cellular processes were investigated. Fourier Transform Infrared Spectroscopy (FTIR) measurements shown a slight changes in the internal structure of multilayers cross-linked with various genipin concentration. Atomic force microscopy (AFM) confirmed that cross-linking affected film topography and stiffness. Cellular adhesion, proliferation and functionality studies using endothelial cells, carried out on both variants of film thickness, demonstrated significant differences. The $[PLL–ALG]_{24}$ film was shown to better improve endothelialization, especially for higher concentrations of the cross-linker.