# Characterization and degradation of natural polysaccharide multilayer films

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## Introduction

**Polyelectrolite multilayer films (PEM-films) represent three dimensional multilayered composites, builded up in principle of interactions between oppositely charged polyions. These films are used for biofunctionalization of medical device surfaces, which find application in the biomedicine. In this study we constructed 5 and 10 bilayer films on the solid substrate using natural polysaccharides – pectin (PE) and chitosan (Chi), by means of layer-by-layer technique. Applying atomic force microscopy (AFM) and optical profilometry we established specific surface morphology and roughness (rms), depending on the number of the bilayers and in order to assay the potential of PEM-films to cover medical devices coming into contact with blood we tested human red blood cells adhesion on the Pe/Chi multilayer surfaces. We found that there is no adhesion on the coatings. This demonstrates their potential for biofunctionalization of medical materials, that directly contact with human blood.**

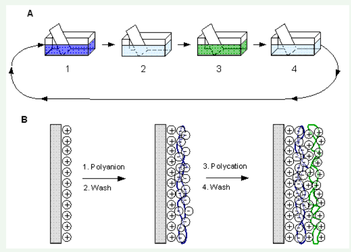
**The stability of the 5 and 10 bilayer films, in which the chitosan was replaced with fluorescence-labeled chitosan ($Chi^{FITC}$) was investigated, applying spectrophotometry. $Pe/Chi^{FITC}$ films were stored at different temperatures (4, 24, and 37 °C) and the kinetic of degradation was monitored. The appropriate storage temperature (at 4 °C) and degradation period of the coatings at room and physiological temperature were established. Based on the results of our research we can conclude that PE/Chi films have a potential to be used for covering medical devise surfaces.**

## Purpose

**The purpose of this study was to characterize the PEM films surface morphology and roughness, to examine RBCs adhesion on their surfaces, and to establish the period of degradation of these coatings at different storage temperatures.**

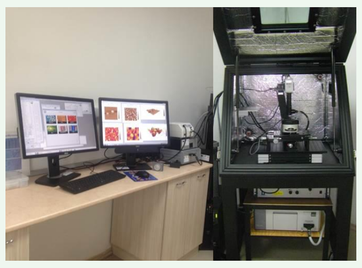
## Methods

### Layer-by-layer




### Optical profilometry

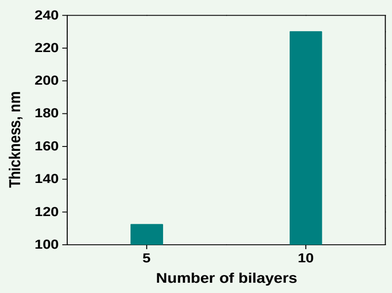
### Atomic force microscopy



## RESULTS

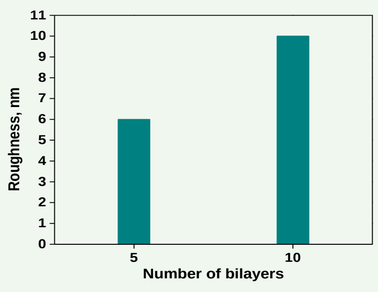
## Films characterization

### Thickness




Thickness of the 5 and 10 bilayer PE/Chi films, determined by atomic force microscopy

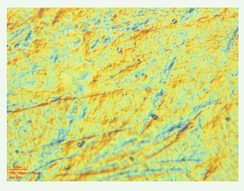
### Roughness



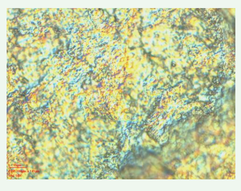

Roughness of the 5 and 10 bilayer PE/Chi films, determined by atomic force microscopy

### Surface morphology

5 bilayers



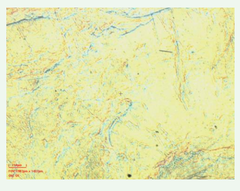
10 bilayers



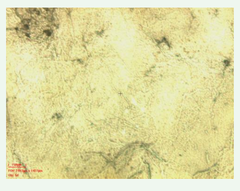
Optical profilometer images of 5 and 10 bilayer PE/Chi films, depicting the characteristic surface morphology of the films

### Red blood cells adhesion

5 bilayers

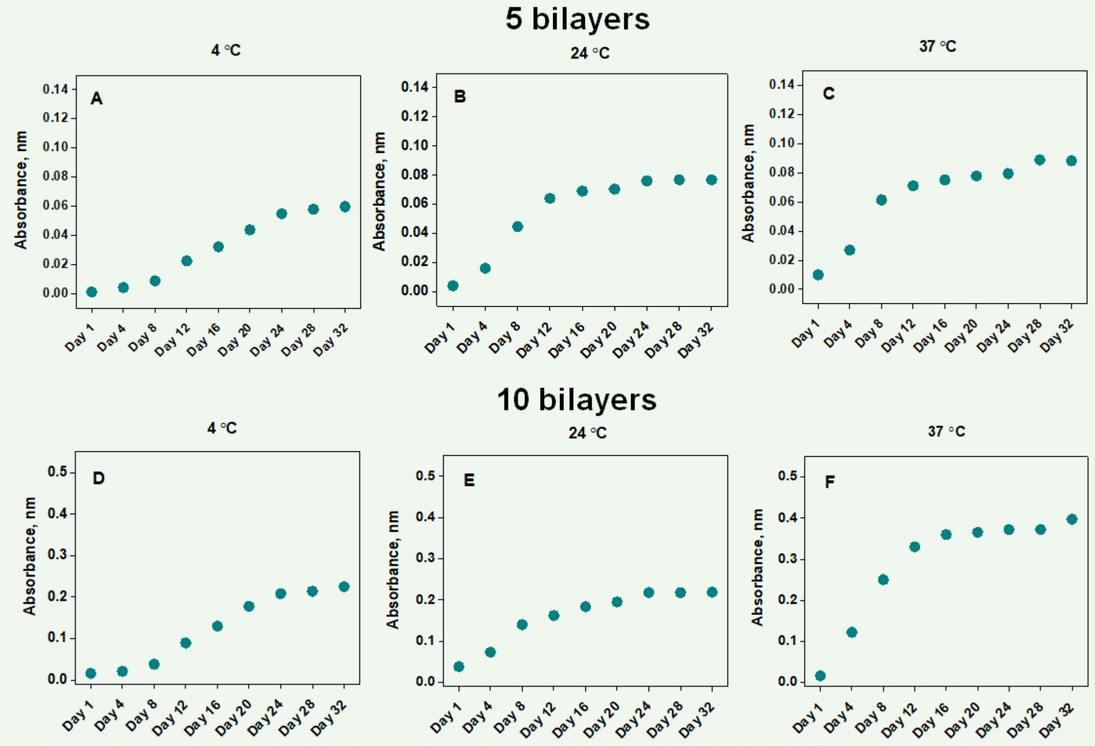


10 bilayers



Optical profilometer images of 5 and 10 bilayer PE/Chi films, depicting the lack or RBCs adhesion on their surface

## Films degradation




**Spectrophotometric analysis of the degradation behavior of 5 (A-C) and 10 (D-F) $Pe/Chi^{FITC}$ multilayer packaging films at different storage temperatures (4°C , 24 °C and 37 °C). The absorbance of the solution in which the films were incubated was measured at λ=492 nm every 4 days.**

## Conclusions

- **Specific surface morphology of Pe/Chi multilayer films and differences in thickness and roughness, depending on the number of the bilayers were found.**
- **The lack of RBCs adhesion on the Pe/Chi multilayer surfaces allows their use for biofunctionalization of medical materials, coming into contact with blood.**
- **The temperature at which the films remain intact for the longest time was found to be 4 °C and the rate of deconstruction was accelerated at the higher temperatures.**
- **Our data demonstrate a potential of Pe/Chi multilayers for biofunctionalization of medical device surfaces.**

## ACKNOWLEDGEMENT

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