THE CHARACTERIZATION OF SCAFFOLDS BASED ON DIALDEHYDE CHITOSAN/ HYALURONIC ACID

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[ENGINEERING OF BIOMATERIALS 163 (2021) 76]

Introduction

Hyaluronic acid (HA) is also known as hyaluronan, because in physiological conditions it exists in the form of a sodium salt, therefore negatively charged. Hyaluronic acid is a glycosaminoglycan copolymer of d-glucuronic acid and n-acetyl-d-glucosamine. HA has been shown to play an important role in lubrication, cell differentiation and cell growth. Its properties, both physical and biochemical, in solution or hydrogel form, are extremely attractive for various technologies concerned with body repair [1].

Periodate oxidation of chitosan has gained more attention in recent years. Periodate-oxidized chitosan has been described as a component for achieving biocompatible solid surfaces [2]. The process of periodate oxidation endows chitosan with multiple functional aldehyde groups. Hence, the aldehyde groups might react with the free amino groups within other substrates. The dialdehyde chitosan (DAC) is an effective cross-linking agent of collagen materials, cotton fabrics and chitosan/collagen/silk fibroin materials [2,3,4].

The aim of our study was to obtain scaffolds based on dialdehyde chitosan/hyaluronic acid mixture as a novel method of hyaluronic acid-based materials modification. Our study focuses on characterization of dialdehyde chitosan/hyaluronic acid scaffolds to be used in biomedical applications.

Materials and Methods

Reagents were purchased form Sigma-Aldrich (St. Louis, MO, USA). Dialdehyde chitosan was obtained by one step synthesis [2].

Dialdehyde chitosan and hyaluronic acid were dissolved separately in water at 1% concentration. Subsequently, substances were mixed in different ratios (w/w), and resultant solutions were homogenized on the magnetic stirrer for 1 h. Next, mixtures were poured into 24-well polystyrene culture plates, frozen, and lyophilized.

Obtained scaffolds were evaluated as described below.

Results and Discussion

Fourier transform infrared spectroscopy (FTIR) was used to observe chemical structure of scaffolds. Scanning Electron Microscopy (SEM) imaging was prepared to assessed microstructure of materials. 3D materials with highly porous structures are desired candidates for tissue regeneration where significant enhancement of the nutrient maintenance for targeted cutaneous cells is required. We also noticed that the resultant materials kept their shapes and homogeneity. The FTIR analysis allowed to observe the presence of functional groups in the DAC/HA scaffolds as well as shifts which may indicates the hydrogen interactions. Additionally human epidermal keratinocytes (NHEK) and dermal fibroblasts (NHDF) were used to evaluate of cell proliferation in presence of subjected scaffolds. It was found that scaffolds were characterized by porous structure with interconnected pores. There were no significant differences between cell proliferation in all scaffolds and this observation was visible in all subjected cell lines.

Conclusions

Scaffolds based on dialdehyde chitosan and hyaluronic acid were obtained. They had porous structure with interconnected pores. The material composition did not affect the cells viability. The porosity of material was around 90% what allow to classify it as highly porous and thereby suitable for the application in tissue engineering.

Acknowledgments

This research was funded by the Nicolaus Copernicus University in Torun, grant number: 282/2021 IDUB SD (B.K.S.) and to some part by the German Research Foundation (Deutsche Forschungsgemeinschaft [DFG]), grant number: KL2900/2-1 (K.K.) and by the National Science Centre, grant PRELUDIUM number 2018/31/N/ST8/01391 (S.G.Z).

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