

Electrospinning of chloramphenicol-containing nanofibrous dressings for treatment of chronic wounds

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Background

An efficient treatment is crucial to overcome the delayed healing process and high infection rate in chronic wounds. Nanofibrous dressings, having a nano-sized fiber structure, can enhance cell ingrowth and support the healing process. In addition, nanofibers can deliver active ingredients e.g. antibiotics into the wound to treat wound infection. By incorporating broad-spectrum antibiotics like chloramphenicol into a nanofibrous dressing, wound infection can be treated whereas systemic side effects are avoided. Active nanofiber-forming polymers can be added to achieve more functionalities. Examples are the β -glucan- and chitosan polymers, with their immunostimulating and antimicrobial properties, respectively. Combining these polymers in one dressing might provide a multifunctional and more efficient wound dressing.

Goals

The goal of this project is to electrospin a multifunctional dressing comprising the active polymers β -glucan and chitosan. For this, we investigated the effect of the different active ingredients on nanofiber characteristics such as morphology, diameter, swelling index and cytotoxicity.

Methods

Nanofibers were spun from preformed polymer-solutions using the needle-free Nanospider™ technology. Nanofiber morphology and diameter were determined by SEM and the image-processing program ImageJ. The thickness was measured using a micrometer and swelling index was determined by submerging the nanofibers into artificial wound fluid. Cytotoxicity of the nanofibers was tested using the Cell Counting Kit-8 (Sigma-Aldrich).

Results and Conclusion

Nanofibers comprising 20% chitosan and 20% β G together with the copolymers polyethylene oxide and hydroxypropylmethylcellulose and 1% chloramphenicol were successfully fabricated. All fibers had a randomly distributed fiber structure with a diameter around 100 nm. Nanofibers containing chitosan had a reduced thickness with values from 0.03 mm to 0.05 mm, compared to fibers without chitosan that had a thickness from 0.06 mm to 0.08 mm, but an improved stability upon contact with water. In addition, chitosan-containing nanofibers showed a high swelling index, ranging from 700 to 1200 %. Fibers without chitosan disintegrated upon contact with water, the swelling index could therefore not be measured. All fibers showed no cytotoxicity compared to medium as control when tested on human keratinocytes. The incorporation of chloramphenicol neither influenced the fiber morphology nor the swelling index or cytotoxicity, proving that the design of nanofibers containing both active polymers together with chloramphenicol was successful.