MODIFIED CHITOSAN NANOFIBERS FOR EFFICIENT CAPTURE OF MYCOBACTERIA

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ABSTRACT

Tuberculosis (TB) is a major cause of morbidity and mortality across the world, affecting adults as well as children.[1] It is therefore important to diagnose TB timeously and accurately in order to provide effective treatment against the disease.[2] Most of the laboratory techniques used for the diagnosis of TB is dependent on the detection of *Mycobacterium tuberculosis* (*Mtb*), the pathogen that causes TB.[3] It is therefore vital that good quality specimens are obtained with the highest possible concentration of mycobacteria to enable the accurate diagnosis of this disease.[4] A previous study has indicated that *Mtb* can be successfully captured using modified poly(styrene-*co*-maleic anhydride) (SMA) nanofibers, and can thus be used as a specimen collection platform for *Mtb*. The modification agent used to modify the polymer facilitated interaction with the mycobacterial cell wall and the nanofibers provided a high specific surface area for increased mycobacterial capture effectivity. It was also revealed that the nanofibrous-capturing polymer should not be too hydrophobic in character as this causes poor wetting of the modified nanofibers, thus preventing close contact with the mycobacteria and a reduction in the capture effectivity of the polymer nanofibers.[5]

In this study we aimed to test the hypothesis that a modified polymer that is hydrophilic in character would be able to increase the capture effectivity of the modified polymer nanofibers. Chitosan (CS) was chosen as the polymer to be modified due to its hydrophilic character and ease with which it can be modified. It is a non-toxic, biocompatible and biodegradable polysaccharide, known for its inherent antibacterial activity.[6] CS is composed of glucosamine and N-acetyl glucosamine units and is thus characterized by primary amine moieties of the D-glucosamine residues and two hydroxyl functionalities. Amino functionality provides the potential for chemical reactions such as acetylation, alkylation, quaternization, grafting and metal chelation, making it an ideal platform for modification.[8]

In this study, CS was bulk-modified with the same affinity ligand used previously to facilitate interaction with *Mtb* and electrospun into nanofibers. Poly(vinyl alcohol) (PVA) was included as a non-ionogenic polymer during electrospinning of the modified CS. PVA has a plasticizing effect, thereby easing uniformization and increasing chain entanglements to enable the formation of smooth, bead-free nanofibers. Gluteraldehyde was used as crosslinking agent to render the nanofibers water-insoluble for further use in an aqueous environment. *Mycobacterium bovis* bacillus Calmette-Guérin (BCG) was used as test mycobacterium as BCG is non-pathogenic yet genetically closely related to *Mtb*.[9] Results of the affinity studies indicated that the modified CS nanofibers captured BCG more effectively than the original modified SMA nanofibers. The hydrophilic/hydrophobic character of the polymer therefore seems to play a vital role.

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References

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