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Investigation of the antibacterial activity of gelatin-modified textile materials with incorporated metal nanoparticles

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Abstract

The properties of metal nanoparticles and metal oxides such as titanium dioxide (TiO_2), zinc oxide (ZnO), silver (Ag) and copper (Cu) are well known as effective antimicrobial agents. A comparative analysis of the antibacterial properties of cotton fabric modified with gelatin hydrogel cross-linked with glutaraldehyde and containing ZnO and TiO_2 nanoparticles, respectively, was made in this research. For the first time, titanium nanoparticles obtained by reduction of TiO_2 with oxalic acid were used to modify cotton fabrics. Three *in situ* synthesis methods of ZnO and TiO_2 were investigated by varying the components and processing conditions. The composite materials were examined by means of SEM, spectrophotometric, antibacterial activity analysis. Microscopic studies showed that TiO_2-NPs were impregnated into the hydrogel structure of the cotton fabric and were distributed into small film-forming structures. Spherical particles of ZnO nanoparticles changed into a flower-like shape with needle-like ends, indicating that the nucleation of ZnO crystal structures had started on the textile surface.The antimicrobial activity of the investigated cotton samples was tested against Gram-positive and Gram-negative used as model strains. The TiO_2-NPs modified samples showed better activity against the Gram-positive and Gram-negative bacteria used compared to the ZnO-NPs modified samples. Biocomposites cotton-gelatin-ZnO NPs or respectively with TiO_2 nanoparticles can be very effectively used in the form of wound dressings.

Keywords: cotton fabric, crosslinking, gelatin, medical, metal nanoparticles