Abstract

In many countries, awareness of the risk of hospital-acquired infections remains low. Hospitals are often perceived primarily as places of treatment rather than potential sources of infection. The global health crisis caused by the COVID-19 pandemic has significantly increased public awareness of pathogen transmission, whether through surfaces, air, or contact with other individuals.

In healthcare facilities, textiles such as medical staff clothing, bed linens, curtains, and other fabric-based items are significant contributors to the transmission of hospital-acquired infections. Despite growing awareness of this threat, the impact of microbial contamination of textiles on hospital infections remains insufficiently studied. Previous research has rarely focused on textiles as a key factor in pathogen transmission. Surface modification of textiles to reduce their susceptibility to microbial colonization and biofilm formation has become a critical area of research, particularly in the context of improving safety in healthcare facilities.

Another challenge associated with hospital textiles is their disposal, especially polypropylene-based materials, which make up a large proportion of hospital waste. Single-use masks, gowns, and covers generate thousands of tons of waste daily. Polypropylene, although cheap and durable, is not biodegradable – its natural decomposition takes hundreds of years, and its combustion requires appropriate conditions to prevent additional pollution. As a result, there is growing emphasis on the need to replace polypropylene with biodegradable materials, such as polylactic acid (PLA) or other biopolymers.

The challenges of modern textile engineering require innovative solutions that not only minimize the transmission of bacteria and viruses through textiles but also reduce the environmental impact of medical textiles.

This study focuses on functionalized nonwoven fabrics modified with complexes of poly (N,N-dimethylaminoethyl methacrylate) (PDMAEMA) and divalent metals. In the research, a bioactive PDMAEMA polymer containing tertiary nitrogen was synthesized and subsequently applied to selected nonwoven fabrics using a simple spray-coating method. Functionalization was carried out through an *in-situ* complexation process of PDMAEMA-modified nonwovens with selected divalent metal salts. Polylactic acid (PLA) nonwoven fabrics produced using the spunbond technology and polypropylene nonwoven fabric obtained by the needle-punching method were used as the primary materials for modification. The aim

of the study was to demonstrate that the proposed textiles can serve as biologically active materials effectively inhibiting the growth of harmful bacteria and viruses.

The modification process was designed to ensure that the amount of PDMAEMA was sufficient to cover the entire surface of the nonwoven fabric. The weight efficiency of the polymer application was approximately 1.4% and 2%. The presence of the polymer was confirmed through functional group analysis and electrokinetic property measurements.

In the subsequent stage, nonwoven fabrics with a PDMAEMA surface layer were cross-linked with solutions of divalent metal salts. The goal of this stage was to achieve a cross-linked, polymer structure, thereby converting the modifier into an insoluble form. The complexation process resulted in the formation of quaternary ammonium salts. Additionally, the bioactive properties of these quaternary ammonium salts were enhanced by complexing them with metals (Cu,Co,Zn,Fe).

Morphological changes in the functionalized nonwoven fabrics demonstrated the effect of the complexes on surface topography. X-ray microanalysis and atomic absorption spectroscopy confirmed the presence of metals on the functionalized nonwoven fabrics.

The modified PLA nonwoven fabrics exhibited antibacterial properties against *Escherichia coli*. They also showed antiviral activity against murine coronavirus MHV.

For all types of modified nonwovens, the effect of the modifiers on the thermal degradation process was observed. The introduction of complexes on PLA nonwovens was found to catalyzing thermal degradation, while the deposition of complexes on polypropylene delayed this process.

The results indicate that functionalized PLA nonwoven fabrics can act as biologically active materials, effectively limiting pathogen growth. At the same time, they represent a more environmentally friendly alternative to polypropylene nonwovens, making them a promising option for medical textiles.