#00985

Antibacterial properties of cysteine-S-sulfonated wool keratin

N. Bio-based high-performance textile coatings

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Abstract

In the last decade, antibiotic resistance (AR) has dramatically increased and continues to spread. Since the availability of effective drugs is increasingly limited, AR represents a serious issue, with infections that are more difficult to treat and easier to spread, affecting morbidity and mortality rates. The result is an increase in the duration of hospitalization and related health care, with an economically significant impact. Multiple factors are involved in the onset and spread of AR, above all, the massive use and abuse of antimicrobial drugs, have permitted the selection of resistant bacterial strains that are able to bypass the effects of antibiotics through several different mechanisms. Bridging this gap requires the research and development of biocompatible and eco-friendly antimicrobial strategies. In this study, cysteine-S-sulfonated keratin (CSSK) was extracted from wool wastes by sulfitolysis and it was subjected to acidic pH modifications. The resulting biopolymer was characterized under the physicochemical and antibacterial profiles. The antibacterial activity of lyophilized CSSK at different concentrations was determined against a set of Gram-positive and Gram-negative microorganisms using the ASTM E2149-25 standard method, in dynamic contact conditions. The CSSK demonstrated excellent antibacterial properties. A correlation was observed between the decrease in pH values and the antimicrobial effect of the protein against test microorganisms, with bacterial reductions exceeding 80% and 90% for Gram-negative and Gram-positive bacteria, respectively. These promising results demonstrated the enormous potential of CSSK extracted from a textile by-product, and the importance of pH on the antibacterial activity of this sustainable biopolymer, representing an additional strategy to counteract some bacterial infections. Moreover, the biocompatibility and biodegradability of CSSK could make it suitable, in the future, as a matrix for biomaterials or scaffolds with antibacterial activity.