Antibacterial superabsorbent hydrogels based on polysaccharides crosslinked with citric acid

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Introduction: Functional hydrogels are currently being actively studied. Due to their unique set of properties hydrogels are used in various fields. In particular, they are used for wound dressings, the global marker of which amounted to 476 million dollars in 2024. These materials effectively absorb exudate from the wound and keep it moist. The use of polysaccharides ensures the required level of biocompatibility, crosslinking improves mechanical characteristics, and various additives impact certain properties.

Methods: Hydrogels were made from carboxymethylcellulose (CMC, 1000 kDa) and hyaluronic acid (HA, 800 kDa) crosslinked by citric acid (CA). Polycaprolactone (PCL) nanomates obtained by electrospinning, CuO and ZnO nanoparticles, and Aloe vera (AV) were added to hydrogels. The samples were examined by FTIR, SEM and EDS analysis systems. Their appearance, swelling ratio, dissolution in tris-buffer and isotonic solution, pH, hydrophilic, adhesive, mechanical, and antibacterial properties were studied.

Results: The resulting transparent materials have high adhesive and hydrophilic properties. They have an interconnected system of pores with a size 5-100 microns. Based on the FTIR results, the crosslinking of -OH groups in polysaccharides using CA was confirmed by determination of C=O, C-O, O-C-O, and C-O-C ester vibrations. The relative elongation of materials is 170 %. The Young's modulus is 0.8 kPa. The highest swelling ratio was observed for samples with ZnO, CuO, and AV and measured as 919, 749 and 792 %, respectively. The hydrogels were stable for 7 days in model solutions. The highest rate of dissolution was observed in isotonic solution. The materials showed antibacterial properties against gram-positive and gram-negative bacteria.

Conclusions: The materials obtained showed antipathogenic, high mechanical, absorption, and stability properties. It makes them suitable for making wound dressings and effective wound regeneration.

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