CHEMICAL MODIFICATION AND BIOLOGICAL ACTIVITY OF ALGINATE-BASED HYDROGELS

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In recent years, the problem of wound infection has risen dramatically. Infectious complications of surgical wounds have increased significantly, often leading to severe sepsis. Gram-negative bacteria and microorganisms, which are immune to virtually all currently available antimicrobials, are the main culprits. In this regard, the development and implementation of innovative drugs and wound dressings, purulent and chronic wound treatment methods is an urgent problem of many domestic and foreign researchers.

Brown algae are extracted using an alkaline solution to produce the ionic polysaccharide sodium alginate. It still holds one of the top positions among water-soluble polymers of natural origin as a result of various highly useful practical characteristics. Based on alginate hydrogels, it is possible to create new materials for biotechnological, pharmaceutical and medical purposes, as they have high moisture retention capacity, non-toxicity and self-decomposing ability.

After reviewing the literature, we concluded that cefepime is a new antibiotic researched for wound dressing using IV generation cephalosporins as an antibacterial agent. It is highly resistant to hydrolysis by most beta-lactamases and quickly penetrates the cells of gram-negative bacteria. Inside the bacterial cell, it targets penicillin-binding proteins. To obtain new derivatives of sodium alginate with special properties, a chemical method, in particular, thiolene reactions, was used. It should be noted that click chemistry refers to a set of chemical reactions for the rapid and reliable synthesis of compounds by the uniform addition of individual components. Thiolene reactions offer significant advantages, includingversatile reaction conditions (including radical reactions and catalytic processes) and the ability to use a wide range of substrates with different unsaturated bonds such as acrylates, methacrylates and ethers.

To monitor the rate and efficiency of UV activation, we used a sol-gel assay technique that allowed us to quantify insoluble (spatially cross-linked) and soluble polymers. After UV activation, samples with different ratios of thiol derivative (S-H bond) showed low viscosity, indicating the predominant degradation of polymer molecules in these systems. Since alginate-polymer derivatives primarily exhibit deconstructive behavior, the dominant process in alginate molecules is the breaking of bonds rather than their formation. The size of the gel fraction reflects the efficiency of polymer cross-linking, which in turn affects the efficiency of immobilization of the drug in the hydrogel matrix and its release rate.

This study presents an experimental characterization of photocrosslinked hydrogels aimed at evaluating and elucidating the physicochemical and biological properties of the antibiotic cefepime in an alginate polymer. The obtained kinetic parameters of the swelling-dissolving process show that the synthesized alginate hydrogel is capable of providing a diffused and prolonged release of drugs. In addition, the synthesized hydrogel effectively delivers cefepime to the tested bacterial strains, showing high antibacterial activity without toxicity. However, further in vivo studies are needed to evaluate the fate and toxicity of the alginate-based hydrogel before definitive conclusions can be drawn regarding the usefulness of the synthesized drugs. These preliminary results can be the basis for the development of medical products.