Doctoral Thesis Abstract

"STUDIES ON THE DEVELOPMENT OF FUNCTIONAL POLYMERIC BIOCOMPOSITES FOR THE TREATMENT OF WOUNDS"

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The increasing demand for wound dressing materials that will be providing protection and effective treatment for pressure ulcers in various stages has contributed to the study of functional biocomposites based on polymeric materials exhibiting adequate physicomechanical properties, sorption and stimulation of wound healing processes, and as a carrier for pharmacological substances with analgesic effect (lidocaine and lidocaine hydrochloride), antibacterial (sulfanilamide and chloramphenicol) and anti-inflammatory (zinc sulfate).

Poliaminosaccharides, in particular chitosan and its useful forms due to the specific biological properties such as the ability to accelerate the process of granulation and wound epitalization is an excellent material for the construction of this type of dressing intended for the treatment of pressure ulcers or other non-healing wounds. Worth mentioning is also alginate (sodium and soda-calcium), well known for its high swelling capacity, absorption of fluids, secretions and hemostatic properties, can be highly useful in the manufacturing of dressings used in the so-called "Moist wound therapy" as well as in the treatment of wounds in the first three phases of healing. The polymer used for the construction of dressing materials with an increased absorbency is sodium carboxymethyl cellulose.

The research has resulted in the development of a transdermal therapeutic system (TTS) - a dressing material which gives not only the possibility of supervised releasing of the medicine but as well the the administration of farmacological substances that are being decomposed in the digestive tract or metabolized in liver.

Biocomposite materials were evaluated for their physicomechanical, appropriable and biological properties. The amount of the active substance was determined based on the

dose recommended in the Polish Pharmacopoeia (FP VIII, 2008 and ed. XI, 2017) for preparations used for external use. Using the methods of thermal analysis (DSC), infrared spectrophotometric (FTIR), thermal analysis of dynamic mechanical properties (DMTA) and nuclear magnetic resonance (NMR), the effect of the variable share of chitosan, alginate, cellulose derivative (KMC) and addition of active substances examined the chemical structure and phase structure of two and three-component polymer biocomposites. NMR spectroscopic studies of biocomposites containing active pharmacological components indicated the complex nature of the interactions of lidocaine, sulfanilamide and zinc sulfate with a polymer blend. The FTIR spectroscopy results indicated a physical or chemical combination of a pharmacological substance with a biocomposite material, depending on the type of therapeutic substance introduced into the polymer blend. On the other hand, the conducted thermal analysis showed that the addition of biocomposite medicinal substances to the materials influences the lowering of the temperature melting point and lowering the melting enthalpy. The study showed that the quantitative composition of developed biocomposites significantly affect the release rate of the introduced pharmacological substance and their physical and mechanical properties, such as strength, elasticity, permanent deformation and transmission of moisture vapor.

As part of the research carried out, it was shown that the release of the drug substance from the examined biocomposite materials in the form of one, two and three-layer film is a complex process which follows the first order kinetics. The results of biological tests have shown that the addition of (sulfanilamide, zinc sulfate, and lidocaine) to the biocomposites developed in the form of film results in the improvement of their antibacterial activity against *Gram (-) Escherichia coli* and *Gram (+) Staphylococcus aureus* bacteria. The biocompatibility of two and ternary biocomposites containing a painkiller (lidocaine) or an antimicrobial agent (sulfanilamide) hasn't showed any cytotoxicity against the mouse fibroblasts NCTC clone 929; ATCC. It was proved that under the natural conditions these materials should not cause any inflammation due to the natural reaction of the environment during degradation, and enzymes released during enzymatic degradation can stimulate and accelerate the healing process of the wound.

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