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# Development of Wound Dressing System Based on Hydrogel Matrix Incorporated with pH-Sensitive Nanocarrier-Drug Systems

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**Abstract :** The growing significance of transdermal systems, in which skin is a route for systemic drug delivery, has generated a considerable amount of data which has resulted in a deeper understanding of the mechanisms of transport across the skin in the context of the controlled and prolonged release of active substances. One of such solutions may be the use of carrier systems based on intelligent polymers with different physicochemical properties. In these systems, active substances, e.g. drugs, can be conjugated (attached), immobilized, or encapsulated in a polymer matrix that is sensitive to specific environmental conditions (e.g. pH or temperature changes). Intelligent polymers can be divided according to their sensitivity to specific environmental stimuli such as temperature, pH, light, electric, magnetic, sound, or electromagnetic fields. Materials & methods—The first stage of the presented research concerned the synthesis of pH-sensitive polymeric carriers by a radical polymerization reaction. Then, the selected active substance (hydrocortisone) was introduced into polymeric carriers. In a further stage, bio-hybrid sodium alginate/poly(vinyl alcohol) – SA/PVA-based hydrogel matrices modified with various carrier-drug systems were prepared with the chemical cross-linking method. The conducted research included the assessment of physicochemical properties of obtained materials i.e. degree of hydrogel swelling and degradation studies as a function of pH in distilled water and phosphate-buffered saline (PBS) at 37°C in time. The gel fraction represents the insoluble gel fraction as a result of inter-molecule cross-linking formation was also measured. Additionally, the chemical structure of obtained hydrogels was confirmed using FT-IR spectroscopic technique. The dynamic light scattering (DLS) technique was used for the analysis of the average particle size of polymer-carriers and carrier-drug systems. The nanocarriers morphology was observed using SEM microscopy. Results & Discussion—The analysis of the encapsulated polymeric carriers showed that it was possible to obtain the time-stable empty pH-sensitive carrier with an average size 479 nm and the encapsulated system containing hydrocortisone with an average 543 nm, which was introduced into hydrogel structure. Bio-hybrid hydrogel matrices are stable materials, and the presence of an additional component: pH-sensitive carrier – hydrocortisone system, does not reduce the degree of cross-linking of the matrix nor its swelling ability. Moreover, the results of swelling tests indicate that systems containing higher concentrations of the drug have a slightly higher sorption capacity in each of the media used. All analyzed materials show stable and statically changing swelling values in simulated body fluids - there is no sudden fluid uptake and no rapid release from the material. The analysis of FT-IR spectra confirms the chemical structure of the obtained bio-hybrid hydrogel matrices. In the case of modifications with a pH-sensitive carrier, a much more intense band can be observed in the 3200-3500 $cm^{-1}$ range, which most likely originates from the strong hydrogen interactions that occur between individual components.

**Keywords :** hydrogels, polymer nanocarriers, sodium alginate/poly(vinyl alcohol) matrices, wound dressings.
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