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Hydrogel based porous matrices for immobilization of bioactive molecules

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Hydrogels are the specific group of hydrophilic porous materials, being composed of variety of natural, synthetic polymers or their combinations. Their characteristic feature is the possibility to swell in aqueous solutions. Moreover, the relatively high porosity and water content, softness, strength and the ability of various substances to diffuse through the pores of their cross-linked structure make the hydrogels valuable functional matrices for effective immobilization of different bioactive molecules, such as drugs, growth factors, cells and enzymes.

Presently, the main interest of industrial biotechnology is a production of valuable compounds with high efficiency, however at low cost and in a short processing time. Therefore, the practical use of immobilized enzymes finds profound economic justification. The most important advantages of such biocatalyst preparations is the increase in its stability, reusability and/or possibility to perform the process in a continuous system and significantly easier separation of the reaction products. Besides binding to insoluble carriers and crosslinking, the inclusion of enzymes (e.g. in hydrogel structures) is one of the basic types of immobilization. This method is relatively cheap, fast and enables to obtain active preparations with enhanced stability, without significant changes in the native structure of entrapped enzymes.

The parameters characterizing porous hydrogels as the effective enzyme carriers include: (i) type of used material (reversible or permanent gel), (ii) its molecular structure (linear polymer, blocks or grafted copolymer, poly-blend), (iii) origin (natural, synthetic or hybrid) and (iv) physicochemical properties (e.g. water absorption capacity, mechanical strength, resistance to increased temperatures and the quantity and quality of the reactive functional groups that could interact with molecules of caught biocatalyst). Among them, crosslinking degree, porosity and consequently the specific surface area potentially available for immobilized molecules seems to be a key factor.

The main aim of this research was to study the effect of preparation conditions on the porosity of obtained hydrogel matrices. For this purpose, different concentrations of applied polymers (gelatin, polyvinyl alcohol) and crosslinking agent (microbiological transglutaminase) were tested. The pore distribution in the studied hydrogel structures was examined using scanning electron microscopy (SEM). Subsequently, hydrogel matrices were tested for use as enzyme carriers. In this case, invertase from Saccharomyces cerevisiae was applied as the model biomolecule. Within this study, immobilization efficiency and the possibility of multiple use of such enzyme preparation were determined.

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References

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