HYDROGELS FOR BIOMEDICAL APPLICATIONS

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ABSTRACT:

The objective of the present work was to develop hydrogels for different biomedical applications. The major directions of the research were: (i) to obtain hydrogels that could induce the biomimetic mineralization, (ii) hydrogels with properties appropriate for soft tissue applications and (iii) polymers with multifunctional nanorough surfaces biofunctionalized for delivering different bioactive species.

In the **first part** of the work synthesis and characterization of hydrogels based on gelatin and sodium alginate ware described. The materials have been obtained through sequential crosslinking resulting interpenetrating polymer networks of crosslinked gelatin and calcium alginate. It is also described the correlation of the morphology of the scaffolds (in terms of porosity) with the intensity of the physical interactions expressed between the constitutive biopolymers. The hydrogels present potential for complex formulation to be used in biomedical applications.

In **the second part** of the work has been investigated the *in vitro* calcification potential of casein when the protein was physically immobilized in a synthetic hydrogel polymer matrix.

The third part of the original contributions describe the synthesis method and characterization of multicomponent interpenetrating polymer networks based on gelatin, calcium alginate and polyacrylamide. The morphology of the pores strongly depends on the composition and on the initial total solids content of the mixtures used to obtain the scaffolds. Increasing PAA and alginate allows reducing the degradation time while providing enzymatic more resistant materials.

The fourth part of the work was dedicated to the study of bicomponent polymer materials based on chemically combined methacrylamide modified gelatin and 2-hydroxyethyl methacrylate. Photoinitiation was used to simultaneously induce combined crosslinking and polymerization of the two starting components. The method developed allows the synthesis of materials with covalently coupled components and with the widest range of MAG/HEMA ratios. Nevertheless, this procedure generates bicomponent scaffolds with a homogeneous distribution of the constituents. *In vitro* cell adhesion and proliferation tests demonstrated that the novel MAG-PHEMA materials showed a promising cell activity. Therefore we consider that MAG-PHEMA scaffolds with various compositions may be generated as bulk or porous constructs with interesting properties useful when tissue engineering is aimed. The chemical method of combining gelatin and PHEMA presented in this study is a promising approach for the development of new bicomponent hydrogels.

The final part of the present work presents multifunctional amino-particles with nanorough surfaces were created through PAMAM immobilization on polymer beads. The bioconjugation efficiency and the high reactivity of the PAMAM-containing particles were successfully demonstrated. Further studies will be devoted to a deeper control of the coupling chemistry.

In conclusion, the hydrogels developed are promising classes of biomaterials, but further studies will continue based on the developed materials in more complex systems targeted for more specific applications.