Investigation of the properties and microstructure of gelatin-alginate hydrogels for wound healing

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Introduction

Hydrogels based on natural polymers (gelatin, alginate) are a popular material in biomedical research and applications, as they have multipurpose properties [1]. The microstructure of such hydrogels, which includes porosity, pore size and distribution, fiber orientation, granulation, and morphology, has a significant impact on their physical, mechanical, and biological properties [2]. The aim of this study was to develop gelatin-alginate hydrogels with satisfactory mechanical properties, the ability to release painkillers and antiseptic drugs.

Materials and Methods

Gelatin (type A) isolated from pork skin, sodium alginate, poly(ethylene glycol) diglycidyl ether (PEGDE 500) with molar mass of 500 g/m, (purity 98.5 %) were purchased from Sigma-Aldrich were used without further purification. The structure and purity of the raw substances were confirmed by FTIR (Brucker FT-IR spectrometer Vertex 70V, measurements were performed in the range of wave numbers from 4000 cm^{-1} to 400 cm^{-1} in reflection mode (ATR), resolution 2 cm^{-1}, number of scans - 256) and NMR spectroscopy (Bruker Nuclear Magnetic Resonance Spectrometer, frequency 400 MHz in automatic scanning mode). Freeze-dried samples were covered with gold in a nitrogen atmosphere (Pump/Gold JEOL JFC-1300), photos of the microstructure were taken on a scanning microscope (JEOL, JSM 6510 LV).

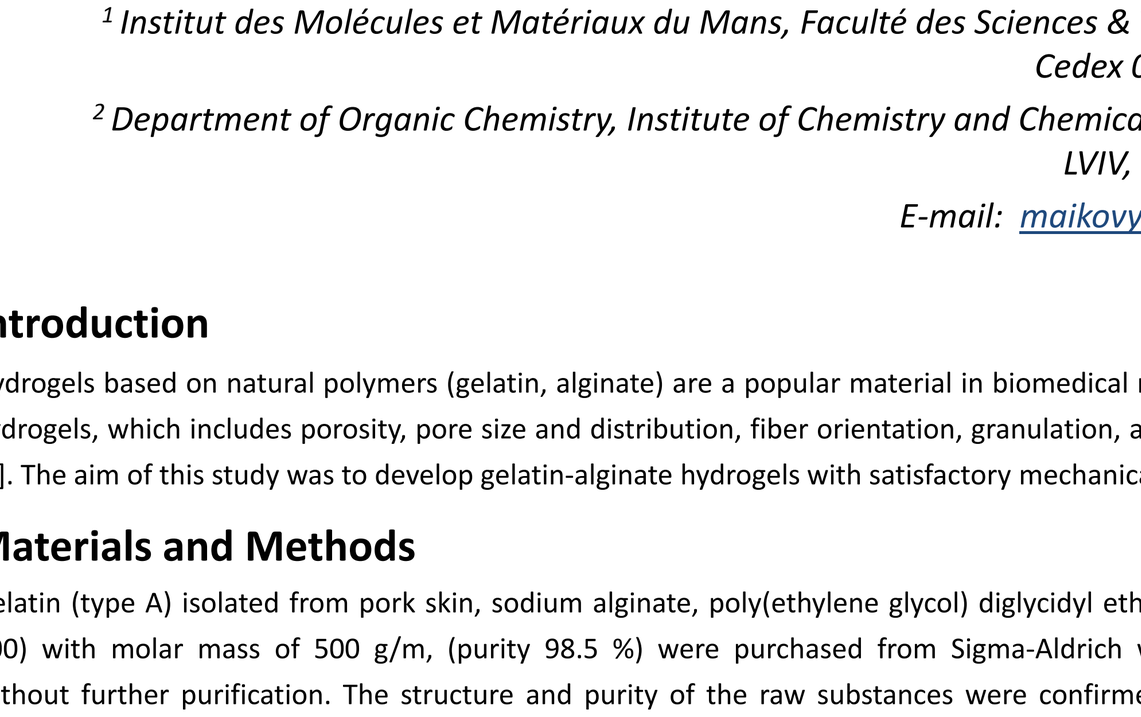

Figure 1. Synthesis scheme of combined gelatin-alginate hydrogel

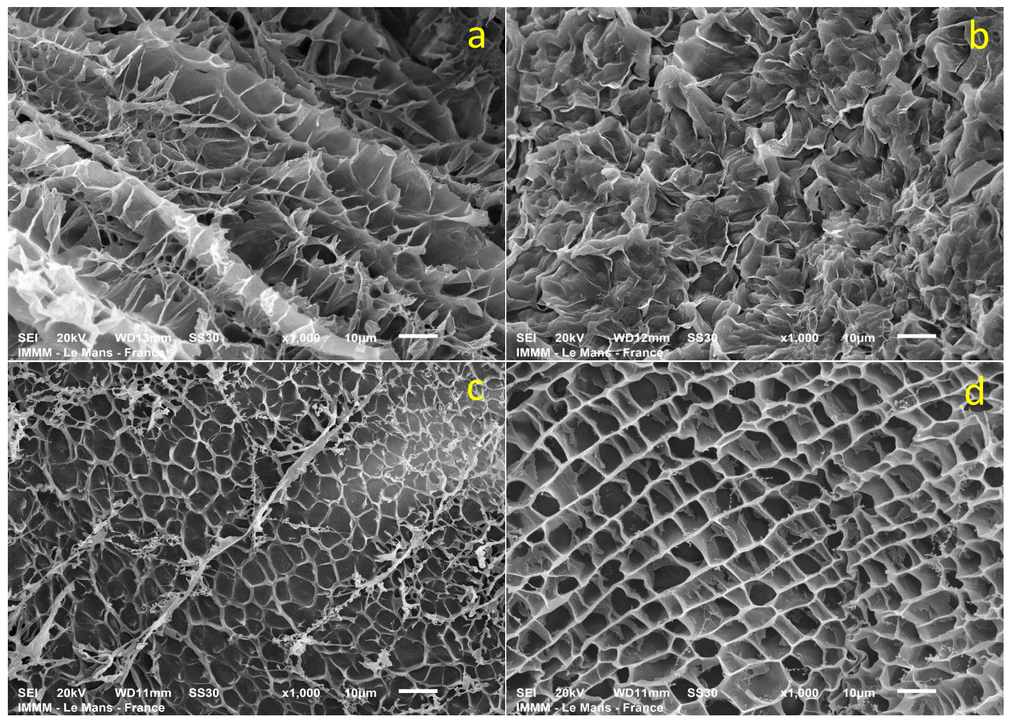

Figure 2. SEM image of the microstructure of gelatin-alginate hydrogels with different contents of the structuring agent (PEGDE 500): (a) – 6 %; (b) – 3 %; (c) – 2 %; (d) – 1%.

Result

Gelatin/alginate hydrogel materials structured by poly(ethylene glycol) diglycidyl ether were obtained (scheme fig.1). After fabrication, the hydrogels were characterized by IR-FTIR, SEM (fig. 2), DSC, swelling was also investigated, and then their stability was studied using degradation studies. To give the products a specialized medical purpose, they were filled with a number of painkillers and antiseptics. The drugs were introduced after studies of the compatibility between the active ingredients and their release were studied (fig. 3).

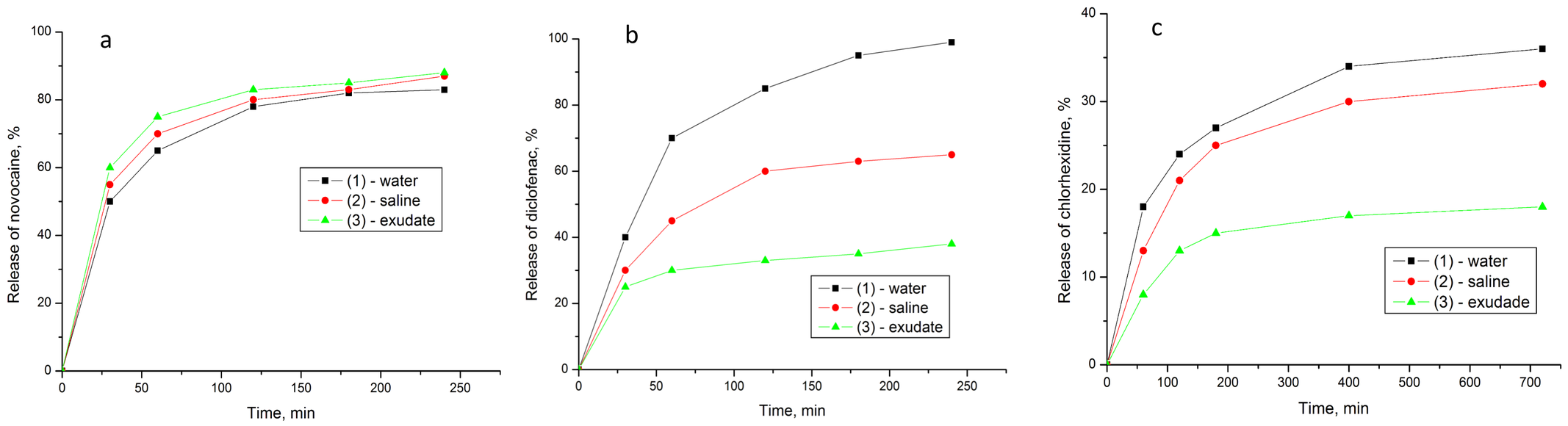

Figure 3. Kinetics of drug release: (a) - novocaine, (b) - diclofenac, (c) - chlorhexidine into different media.

Conclusion

Thus, drug release studies have demonstrated rapid release of analgesic drugs and sustained release of antiseptics, so such hydrogel materials may be useful for patients who require immediate anesthetic and long-lasting antiseptic effects during wound healing therapy.

References

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