MECHANICAL PROPERTIES OF POROUS COLLAGEN/ GELATIN/ HYDROXYETHYL CELLULOSE MATRICES CONTAINING MICROSPHERES BASED ON SODIUM ALGINATE

JUSTYNA KOZLOWSKA*, OLIWIA TYBINKOWSKA, ALINA SIONKOWSKA

DEPARTMENT OF CHEMISTRY OF BIOMATERIALS AND COSMETICS, FACULTY OF CHEMISTRY,
NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ, POLAND
*E-MAIL: JUSTYNAK@UMK.PL

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Introduction

Microencapsulation may be defined as a process to entrap one substance within another substance for the purpose of shielding the active ingredient from the surrounding environment. [1,2]. Therefore, this technique is mainly used in areas where particular attention is paid to the stability, efficiency and bioactivity of the obtained materials and it is used, among others things, in the pharmaceutical, medical, food and cosmetics industries [3].

The aim of this paper is to obtain and characterize the mechanical properties of composite materials for potential dermatological applications. The materials were prepared by incorporating polymer microparticles (containing pot marigold (*Calendula officinalis*) flower extract) in the three-dimensional polymer matrix with a porous structure.

The microspheres were produced from sodium alginate and sodium alginate with addition of starch through the emulsion and extrusion method. Alginates are salts of alginic acid and they're extracted from the cell walls of brown algae (*Phaeophyceae*). The natural origin of sodium alginate makes it a very attractive ingredient due to its characteristics, such as: non-toxicity and biodegradability [4]

The obtained microspheres were incorporated into a collagen/gelatin/hydroxyethyl cellulose matrix.

Materials and Methods

Sodium alginate-based microspheres were prepared by extrusion and water-in-oil emulsion described by Muthukumarasamy et al. with modifications [5]. Sodium alginate and starch were used as wall materials for microencapsulation of *Calendula officinalis* flower extract.

Extrusion was performed by expression of the wall material/*Calendula officinalis* flower extract mixture through a syringe needle (⌀=0.6mm) dropwise into 0.5 M $CaCl_2$. Microspheres were held at room temperature for 30 min to ensure complete solidification and then they were separated by filtration.

The emulsification (phase separation) method involved using paraffin oil containing tween 80. The mixture was stirred at 800 rpm for 5 min to form a uniform water-in-oil emulsion. Then 0.5 M $CaCl_2$ was added at the sides of the beaker until the emulsion was completely broken. The beads formed were collected by vacuum filtration.

Collagen (col) type I was obtained in our laboratory from fish scales of *Esox lucius* [6]. Gelatin (gel)/ hydroxyethyl cellulose (hec)/ col matrices were prepared as described in our earlier paper [7]. The weight ratio of collagen and gelatin to microspheres was 1:15.

The mechanical testing was carried out using a mechanical testing machine (Z.05, Zwick/Roell, Germany) at room temperature. The presented values are the average values calculated from five measurements for each type of matrix.

Results and Discussion

Porous collagen/ gelatin/ hydroxyethyl cellulose - based composites were fabricated by using freeze-drying method. The microspheres obtained by extrusion method were significantly larger than the microspheres obtained by emulsion method and the size of the incorporated particles affects the stiffness of the obtained materials (TABLE 1). In addition, the composition of the wall material plays an important role.

TABLE 1. Compressive modulus of col/gel/hec matrices with incorporated sodium alginate-based microspheres

The type of sample/microspheres	Ec [kPa]	
	extrusion method	emulsification method
CONTROL SAMPLE	6.10 ± 0.10	
SODIUM ALGINATE	5.95±0.25	7.62±0.38
SODIUM ALGINATE/STARCH	6.76±0.23	6.72±0.45

Conclusions

During the designing of polymeric materials containing incorporated microspheres, we can influence their mechanical parameters by adjusting the size of the used microparticles and their composition. We developed a novel delivery system for controlled released of a pot marigold flower extract that might be helpful in treating chronic skin wounds or in other dermatological and cosmetic applications. Further studies are required to evaluation of release profile of *Calendula officinalis* flower extract.

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