Characteristics of bio-hybrid hydrogels modified with the thermosensitive nanocarrier - salicylic acid system

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INTRODUCTION

Hydrogels as a cross-linked polymer network can provide spatial and temporal control over the release of various therapeutic ingredients and consequently are utilized for drug delivery applications. Moreover, recently, due to the unique properties, **thermosensitive nanocarriers** have become greatly appreciated in the field of controlled drug delivery system. The combination of these components offers features for an ideal **wound dressing material**. Lately, both sodium alginate - an anionic polymer of natural origin, as well as a poly(vinyl alcohol), which is a synthetic polymer, are successfully used in medicine for wound dressing especially for difficult-healing wounds, including venous ulcers diabetic wounds and bedsores.

METHODOLOGY

In this work, the system of **thermosensitive nanocarrier** – salicylic acid was incorporated into **sodium alginate/poly(vinyl alcohol)** hydrogel with *Aloe vera* content to achieve a wound dressing material which might effectively accelerate the wound healing process.

Briefly, N-isopropylacrylamide based nanocarriers were prepared through a direct one-step emulsion polymerization technique. Then, the encapsulation of the salicylic acid as a model active substance in a prepared thermosensitive polymer nanocarrier was conducted. The efficiency of encapsulation and the average particle size of the carrier, were evaluated.

In order to prepare the hybrid system, pre-made drug-nanocarrier spheres were initially dispersed into the hydrogel precursor based on aquatic solution of sodium alginate, poly(vinyl alcohol) and *Aloe vera* extract.

CHARACTERIZATION OF BIO-HYBRID HYDROGELS

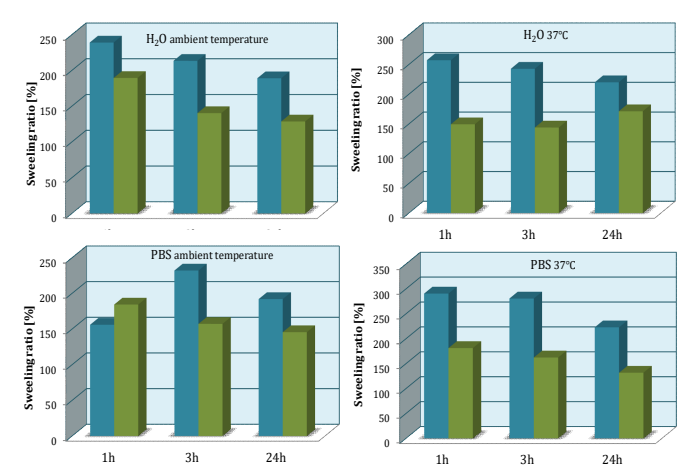

Fig.1. Sweeling ratio of bio-hybrid bydrogel modified with the thermosensitive nanocarrier - salicylic acid system (25 mg) compared to unmodified hydrogel (0 mg)

Gel fraction

Sample	Gel fraction [%]
0 mg	63
25 mg	66

CHARACTERIZATION OF NANOCARRIER-DRUG SYSTEM

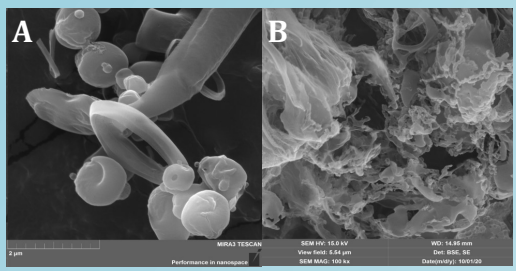

Fig.4. SEM analysis of A) nanocarrier, B) nanocarrier-drug system

Size distribution of nanocarrier-drug system

Sample	Average size distribution [nm]
Nanocarrier	118
Nanocarrier After dialysis	<100
Nanocarrier-drug system	364

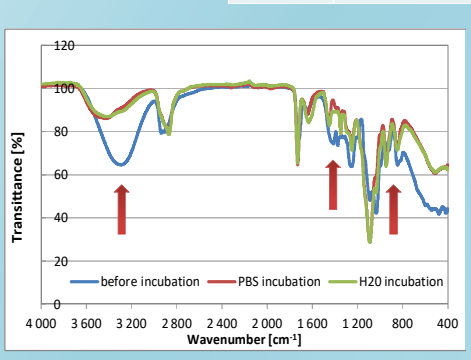

Fig.2. ATR-FTIR analysis of bio-hybrid hydrogel before and after incubation in distilled water and PBS

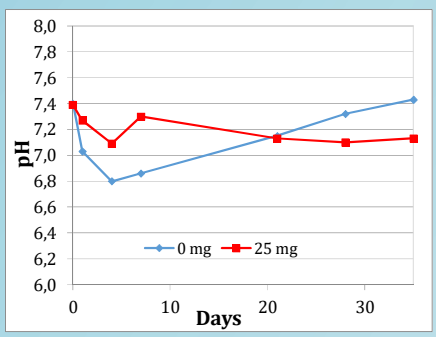

Fig.3. Changes of pH values after 35 days incubation in PBS 37°C

Encapsulation efficiency

- ✓ Samples preparation: lyophilization
- ✓ Redispersion in PBS (pH=7.4)
- ✓ Centrifugation, 13 000 rpm, 10 min
- ✓ UV-Vis analysis, λ_{max} = 295 nm

Sample	Drug amount [mg]	Encapsulation efficiency [%]
1	25	77.7

CONCLUSIONS

✓The proposed method used to obtain bio-hybrid hydrogel material allowed for the effective encapsulation of the active substance.
✓Bio-hybrid hydrogel modified with the thermosensitive nanocarrier - salicylic acid system is characterized by lower swelling values compared to unmodified hydrogel.

References:
[1] Li J., Mooney D.J., Designing hydrogels for controlled drug delivery, Nat Rev Mater. 2016, 1(12): 16071.
[2] Patra J.K., Das G., Fraceto L.F., Nano based drug delivery systems: recent developments and future prospects, J Nanobiotechnology. 2018,16: 71.

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