Strontium ranelate loaded ε-poly-L-lysine/hyaluronic acid hydrogels

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INTRODUCTION

Nowadays, osteoporosis is becoming more common, affecting both young and old people. Various medications containing active substances increasing bone density, such as strontium ranelate (SrRan), can be used for the treatment. Hydrogels with anti-inflammatory and antibacterial properties have been a major research topic in the biomedical field for the past decades[1], thus combining antibacterial properties of ε-poly-L-lysine (ε-PL), bioactivity of hyaluronic acid (HA) and anti-osteoporotic properties of SrRan novel injectable polymer hydrogels providing controlled and prolonged drug release at the target site were prepared and analysed[2].

EXPERIMENTAL METHODS

Physically crosslinked HA/ε-PL/SrRan hydrogels (HA:ε-PL ratio of 80:20 wt%, 70:30 wt%, 60:40 wt% and 50:50 wt%) with and without addition of 5 wt% SrRan were prepared and characterized towards the swelling behavior, gel fraction, viscoelastic properties, and drug release kinetics. Viscoelastic properties were evaluated within oscillatory mode at a constant frequency of 1 Hz at 25 °C, with strain varied from 0.01% to 100% (Discovery HR 20, TA Instruments, USA). Swelling ratio was monitored in PBS for 7 days (37 °C and 100 rpm) to evaluate the degradation behavior of prepared hydrogels. To evaluate the hydrogel crosslinking degree, gel fraction was determined by placing the samples in 100 ml of PBS (37 °C and 100 rpm) for 24h. SrRan release rate was evaluated in PBS (37 °C and 100 rpm) and measured using Ultraviolet-visible light spectrophotometry (UV-VIS) at λ=318 nm.

RESULTS AND DISCUSSION

Physically crosslinked hydrogels were prepared combining such oppositely charged polyelectrolytes as HS and ε-PL by their complementary electrostatic attractions[1].

The hydrophilic functional groups in the structure of HA and ε-PL revealed an excellent ability to bind the water molecules. It was found that the hydrogel swelling degree increased with increasing HA content in samples and reached 547 ± 4% for HA/ε-PL 80:20 wt% and 466 ± 29% for HA/ε-PL/SrRan. Obtained results indicated that the maximum swelling degree was reached within the first 24 h and significant influence of SrRan addition on hydrogel swelling was not observed. Furthermore, all obtained hydrogels were characterized with gel fraction ~ 75% regardless of the hydrogel composition. It was found that the storage shear modulus (G') was higher than the loss modulus (G") for all prepared hydrogels, indicating that viscoelastic solid is formed and crosslinking reactions occurs just after the component mixing. All samples had a well-defined linear viscoelastic region up to ε ≈ 10%. The average crossover point of G' and G" was found at ε ≈ 50%, indicating the transition from gel to liquid state. Also, it was found that hydrogels with SrRan additive exhibited higher storage modulus values, than those without SrRan. Finally, obtained results indicated that initial SrRan burst release within first 24 h was ~ 30% and no significant differences in SrRan release kinetics were observed depending on the composition of the hydrogels.

CONCLUSION

Physically crosslinked hydrogels have many advantages, including ease of preparation, excellent biocompatibility, and biomedical safety. According to the results, all prepared HA/ε-PL/SrRan hydrogels are super-swelling materials since they can absorb a large amount of water (>100% of their weight) in a short amount of time[1]. During the research it was established that SrRan addition did not affect the hydrogel swelling behaviour or gel fraction but provided higher stiffness as indicated by the storage modulus.

In the future studies it has been planned to combine the obtained hydrogels with calcium phosphates to mimic the bone inorganic/organic phase composition and to promote the bone regeneration.

REFERENCES

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