SUSTAINABLE RELEASE PROPERTIES OF INJECTABLE ANTIBACTERIAL GEL BASED ON CHITOSAN /MODIFIED CARBOXYMETHYLCELLULOSE

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Introduction

Endodontic treatment can be vastly affected by bacterial infections in the oral and root canal system. In this study, the injectable antibacterial gel based on chitosan /modified Carboxymethylcellulose(M-CMC) with sustainable release properties was developed and characterized.

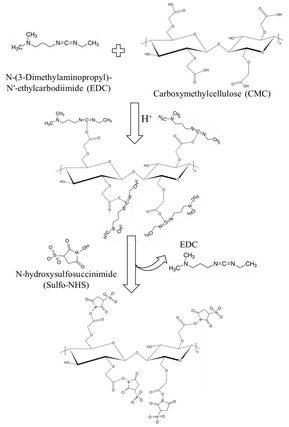

Fig. 1. Synthesis of modified Carboxymethylcellulose(M-CMC).

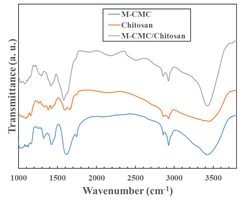

Fig. 2. ATR-FTIR spectra of M-CMC , Chitosan , and M-CMC/Chitosan .

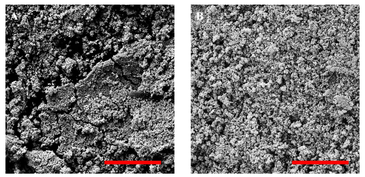

Fig. 3. SEM images of (A) CMC/Chitosan and(B) M-CMC/Chitosan

Experimental methods

Initially, a Carboxymethylcellulose (CMC) was chemically modified by N-hydroxysuccinimide (NHS) residue. Briefly, 0.03g of 1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC) and 0.05g of NHS was added to 5 mL of CMC solution (2 wt %). After 10 min the resulting solution was washed and sedimented 5 times with -70 ℃ ultrapure ethanol. The gel was fabricated by mixing 1 ml of 2 wt % of chitosan solution with 1 ml of 2 wt % of M-CMC solution. Then the different concentration of amoxicillin (100, 200, and 500 mg) was added to the solution and agitated gently. Gelation behavior of gel during gelation was also carried out by the rheometry test. The drug released amount at certain set times was determined by UV/Vis spectroscopy at 229 nm.

Results

FTIR analysis shows that CMC was successfully modified by NHS. The rheometry test shows that the gel was formed in 30 s after mixing. The results show that in comparison to the untreated CMC gel, the mechanical properties of the M-CMC/chitosan gel were significantly improved. Also, about 38% of the M-CMC/chitosan gel and 86% of the CMC/chitosan gel was degraded after one week in PBS at the physiological condition. 97% of amoxicillin was continuously released in 14 days, and a dose of the released antibiotic drug was below 100 mg/g of gel.

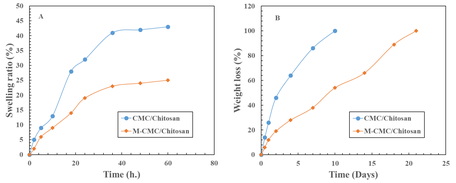

Fig. 4. (A) The swelling ratio curves of hydrogels measured in PBS buffer. (B) The weight loss curves of hydrogels measured in PBS buffer at 37˚C.

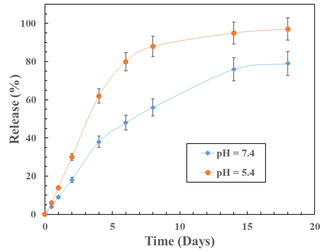

Fig. 5. Release profiles of amoxicillin from M-CMC/Chitosan in PBS.

Conclusion

The M-CMC/chitosan gel with sustained-release capabilities of antibiotic drug developed in this study has the potential to be used in the dental application due to its stability and sustainable release profile.

References

Chai Q, Jiao Y, Yu X. Gels. 2017;3(1):6

Kerstin M. Galler, Jeffrey D. Hartgerink, Adriana C. Cavender, Gottfried Schmalz, and Rena N. D'Souza.J Biomed Mater Res A. 2009 Jun 15;89(4):1063-71.