EFFECT OF POLYMER CONCENTRATION ON MORPHOLOGY AND FUNCTION OF CHITOSAN AS DRUG-RELEASING SCAFFOLDS

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Introduction

Controlled polymeric drug delivery system is a field that has recently gained popularity. Polymers incorporated with drugs prove to be bioactive to provide their own therapeutic benefit and improve release kinetics, making the system more effective [1,2]. A scaffold is one such system that finds immense application in drug delivery and tissue engineering. There is a need for polymeric scaffolds to be engineered to meet the requirements of its application.

This study aims to develop chitosan scaffolds and test if parameters such as cross-linking, polymer concentration and freezing temperature can be exploited to change its design and function.

Methodology

Chitosan hydrogel containing diclofenac sodium was prepared and lyophilized to obtain porous dry scaffolds. Various combinations were produced in this manner by varying parameters such as cross-linking, polymer concentration (1% and 2%) and freezing temperature (-20°C and -80°C). Natural cross-linker Genipin was used for cross-linking. The scaffolds were subjected to characterizations such as swelling behavior, porosity test, FTIR, SEM, drug release and kinetics to analyze their properties.

Results and Discussions

Chitosan scaffolds in the presence of cross-linking showed decreased swelling, reduction in porosity and pore size, lesser release rate of drug when compared to uncross-linked scaffolds.

Scaffolds produced with 2% polymer concentration exhibited lower swelling, reduction in pore size and porosity, and lower drug release rate than scaffold of 1% polymer concentration. Scaffolds produced using freezing temperature of -20°C showed increased swelling, higher pore size and porosity and faster release rate than scaffold produced at temperature of -80°C. Release of diclofenac sodium from all chitosan scaffolds (S1, S2, S3 and S4) found best fit in the Higuchi Model with Fickian Diffusion (for $n<0.5$) as the release mechanism.

The results showed that varying the parameters brought about some change in the design and function of the scaffold. Scaffolds S2 and S4 were able to regulate and sustain the release profile of diclofenac sodium drug from the scaffold making it an effective drug delivery device.

Scaffold	Scaffold specifications			CDR (%) ± SD
	Concentration	Temperature	Crosslinking	
S1	1%	-80°C	Uncross-linked	28.673 ± 2.40
S2	1%	-80°C	Cross-linked	26.377 ± 10.47
S3	1%	-20°C	Uncross-linked	30.575 ± 3.25
S4	2%	-80°C	Uncross-linked	18.410 ± 2.83

Table 1: Mean cumulative drug release (CDR) (%) ± standard deviation (SD) for 24 hours.

Scaffold	Pore size (µm) ± SD	Max pores in the range (µm)
S1	93.653 ± 24. 41	70-80 and 110-120
S2	55.935 ± 23.12	80-90
S3	107.71 ± 32.35	90-110 and 150-160
S4	88.726 ± 16.87	70-80

Table 2: SEM analysis indicating average pore size ± SD of chitosan scaffolds.

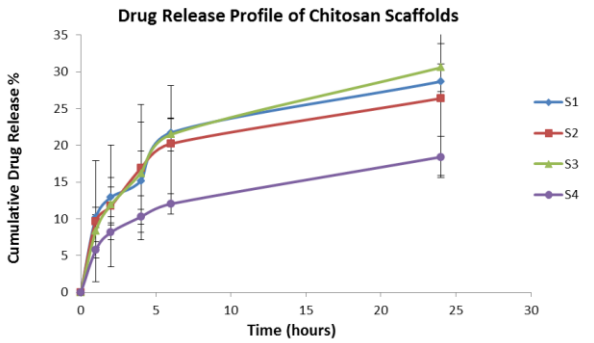

Figure 1: Mean cumulative drug release (%) ± SD of Diclofenac Sodium.

References

1. E.P.D. Azevedog, Int. J. Pharm. Pharm, 7:8-14, 2015.
2. H.P. James et al, Aceta Pharm. Sin. B, 4:153-170, 2014.

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