Cinnamon leaf oil release from chitosan microcapsules embedded within a sodium alginate-gelatin hydrogel-like film for the inhibition of multi-drug resistant bacteria

Catarina S. Miranda*, Joana C. Antunes, Natália C. Homem, Helena P. Felgueiras.

Centro de Ciência e Tecnologia Têxtil (2C2T), Universidade do Minho, Portugal
*catarina.miranda@2c2t.uminho.pt

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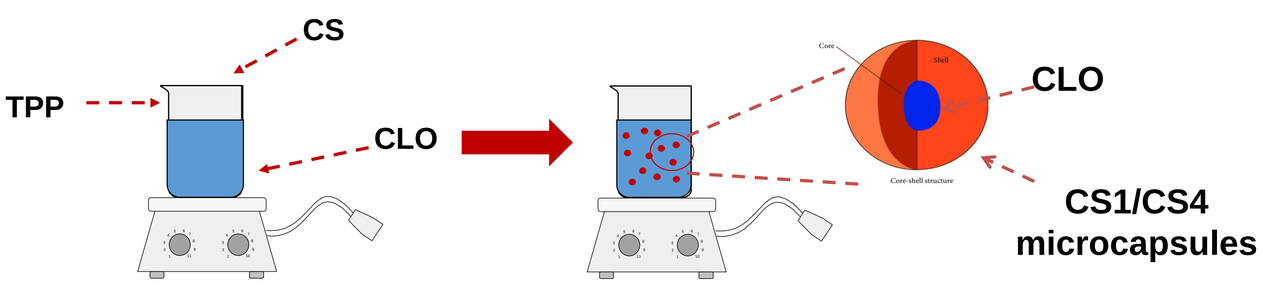
Introduction

Pseudomonas aeruginosa is considered a public threat, with a great number of antibiotic resistant microorganisms. Essential oils (EOs) have demonstrated significant effects against several pathogens, however, they present a volatile nature, therefore, biodegradable polymeric delivery platforms are being engineered. Here, hydrogel-like films were produced from a combination of sodium alginate (SA) and gelatin (GN) to serve as delivery platforms for the controlled release of cinnamon leaf oil (CLO) entrapped within chitosan (CS) microcapsules. CS microcapsules were prepared via ionotropic gelation with tripolyphosphate (TPP), with CLO at minimum inhibitory concentration (MIC) in the core. Microcapsules were then embedded within a biodegradable SA/GN polymeric matrix processed via a solvent casting/phase inversion methodology with SA/GN used at 70/30 polymer ratio and 2 wt% SA concentration in distilled water. The coagulation bath was composed of a 2 wt% calcium chloride ($CaCl_2$) aqueous solution. Qualitative and quantitative antimicrobial examinations validated the modified film potential to fight infections caused by *P. aeruginosa* bacteria.

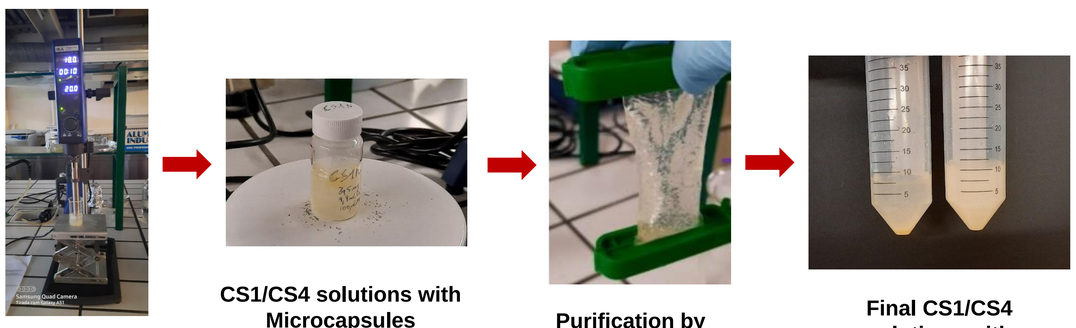
Goal

Engineer a hydrogel-like film delivery platform that guarantees the controlled release of cinnamon leaf oil for the eradication of *P. aeruginosa*-derived infections.

CLO Encapsulation: Chitosan microcapsules



Sample	CS (mg)	dH_2O (mL)	Acetic acid (µL)	CLO (µL)	TPP (mL)	pH adjust	NaOH (mL)
CS1	2.5	9.9	100	834	9	No	-
CS4	2.5	8.8	100	834	9	Yes	1.1



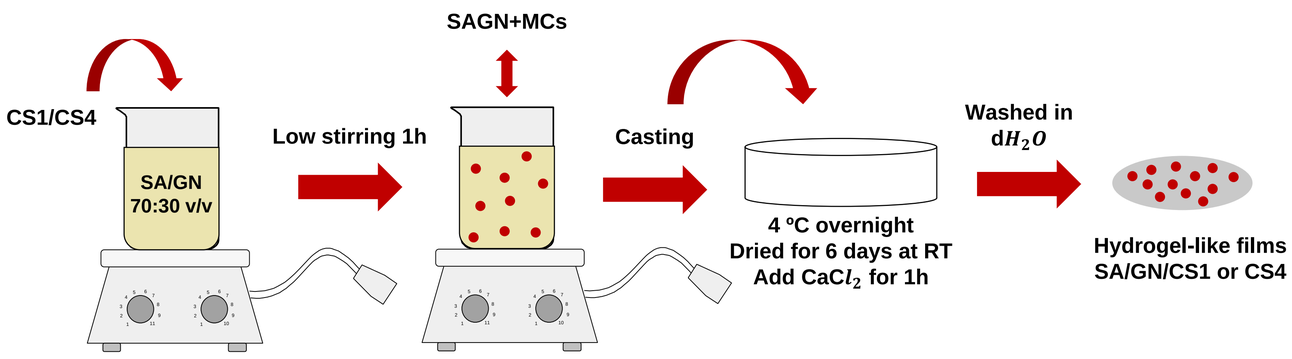
Ultraturrax (IKA T25) 10000 rpm, 10”, 5 x

CS1/CS4 solutions with Microcapsules

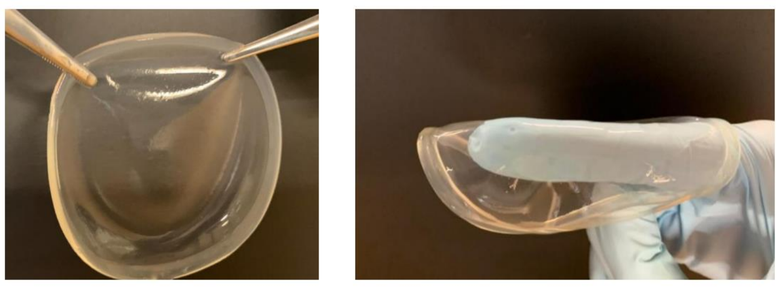
Purification by dialysis

Final CS1/CS4 solutions with Microcapsules

Films Production

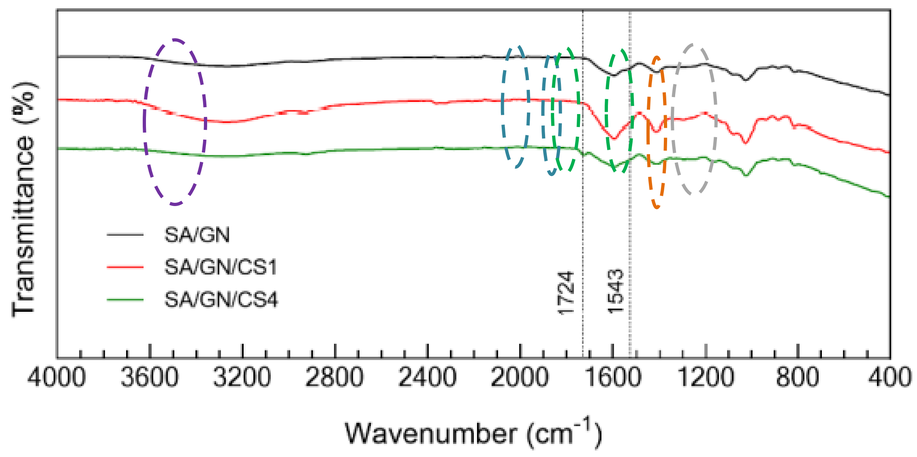


Films' morphology



Very hydrated films; Flexible; Homogeneous; Regular distribution of microcapsules

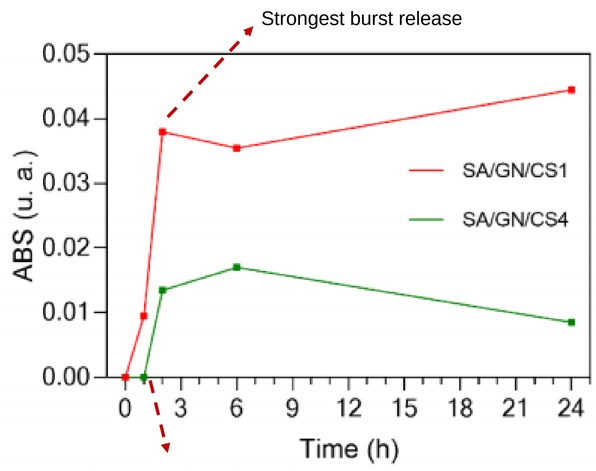
Chemical characterization - FTIR



CLO was more easily noticeable on the CS4-containing films

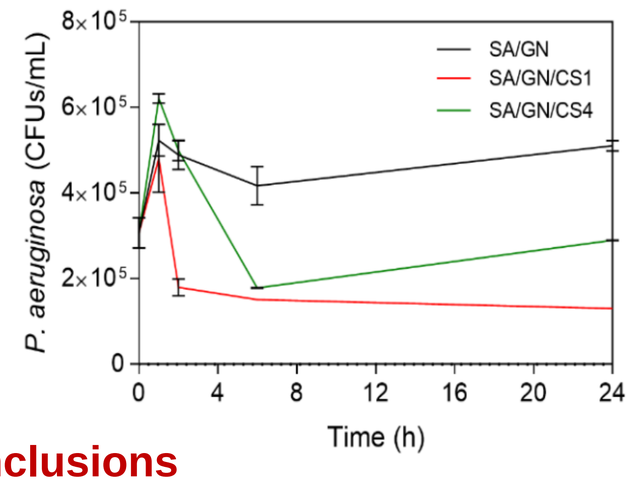
--- Characteristic band of hydroxil groups (OH)
--- CLO's characteristic peaks
--- SA/GN's characteristic peaks
--- CS's characteristic peaks
--- TPP´s characteristic peaks

CLO release profile



CLO release profile was inferior throughout the test on the CS4-loaded films

Antimicrobial action



Enhanced performance of the SA/GN/CS1 films in fighting bacteria

Conclusions

The incorporation of the CLO-containing CS microcapsules within the SA/GN fibers was confirmed

The continuous release of the entrapped oil over a period of 24h was attained, with a matched time kill kinetics against *P. aeruginosa*

CS1 loaded films were determined more effective than CS4 loaded films

Acknowledgments

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COMPETE

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