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Flexible, biodegradable LL37-anchored poly(vinyl alcohol)/cellulose acetate films for enhanced infection control

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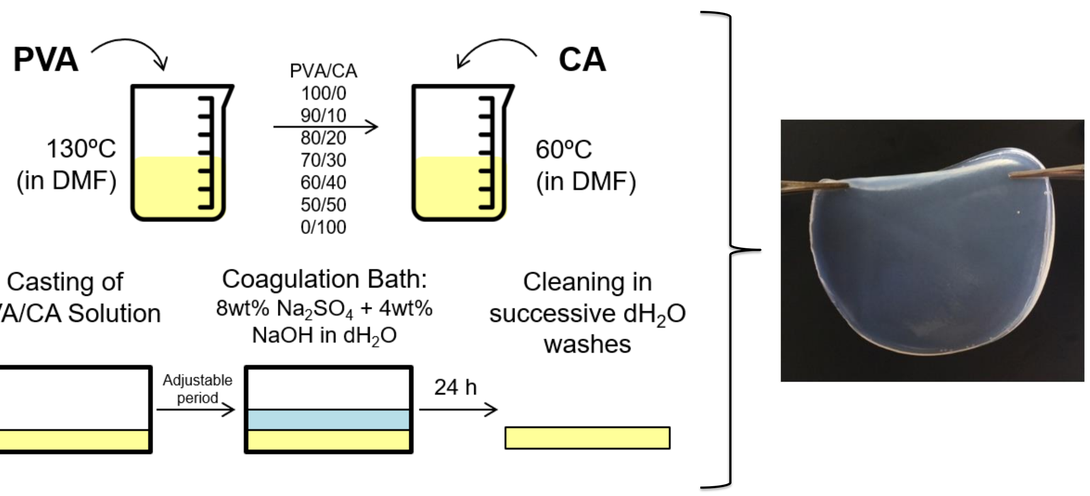
Introduction

Wound care is a growing industry that lately has been facing multiple challenges due to the increasing health care costs, aging of population, appearance of antibiotic-resistant pathogens, and rise in the incidence of chronic diseases. Unlike acute wounds which heal in a predictable amount of time following the stages of healing, chronic wounds (CW) often fail to progress past the inflammatory phase, increasing costs and healing time. Bioactive dressings that incorporate drugs/antibiotics or bioactive molecules in their formulation have been suggested as alternatives to the conventional gauzes and foams. Here, we propose the combination of poly(vinyl alcohol) (PVA) and cellulose acetate (CA), both biodegradable and biocompatible polymers, for the production of films processed via a new method that combines principles from solvent casting and phase inversion, and modified with the antimicrobial peptide (AMP) LL37, as a new active solution.

PVA/CA Film Production

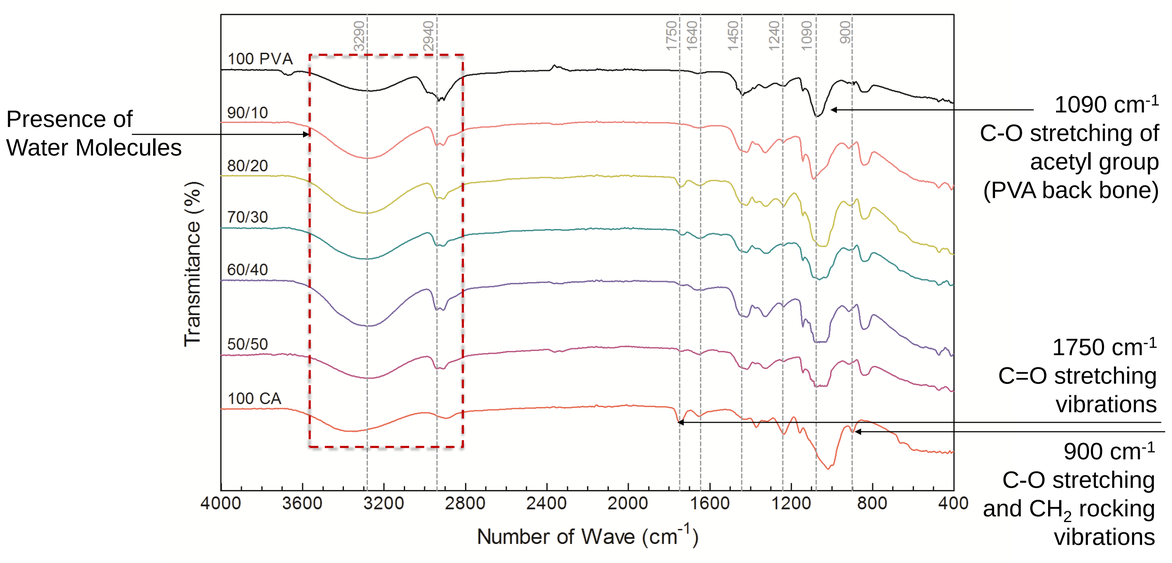
Materials: PVA, Mw 72,000 and 88% hydrolyzed, and Ca, Mn 30,000 and 39.8wt.% acetyl groups; dimethyl formamide (DMF) as solvent; coagulation bath of sodium sulfate (Na_2SO_4) and sodium hydroxide (NaOH)

Method: Solvent Casting followed by Phase-Inversion



PVA/CA Films Characterization

1) Fourier-Transformed Infrared Spectroscopy with Attenuated Total Reflectance (ATR-FTIR)



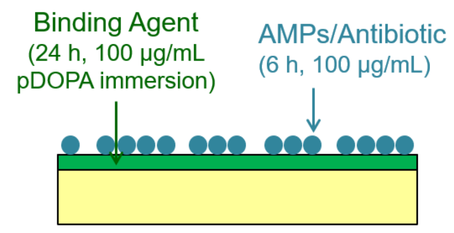
2) Tensile Strength, Elongation, Porosity and Swelling

Films	Breaking Strength (N ± SD)	Elongation at Break (% ± SD)	Porosity (% ± SD)	Degree of Swelling (% ± SD)
100 PVA	3.24 ± 0.03	253.53 ± 26.99	29.07 ± 5.12	89.87 ± 0.95
90/10	2.56 ± 0.14	247.00 ± 47.27	30.90 ± 2.43	89.26 ± 0.47
80/20	2.52 ± 0.25	244.47 ± 23.26	33.40 ± 3.79	88.35 ± 0.85
70/30	1.49 ± 0.18	244.20 ± 39.78	37.52 ± 6.81	88.12 ± 0.79
60/40	1.48 ± 0.15	222.13 ± 48.87	44.92 ± 2.15	89.01 ± 0.56
50/50	1.28 ± 0.20	201.87 ± 41.17	52.99 ± 4.95	89.21 ± 1.15
100 CA*	-	-	91.83 ± 14.62	89.62 ± 1.00

*Paper-like consistency, unable to explore mechanically.

LL37 Functionalization

"Graft to" methodology using poly(dopamine) (pDOPA) as binding agent. Vancomycin was used as control antibiotic.



AMP detected ≈ 56 ug/mL

21.6 ± 2.5 µg/cm²

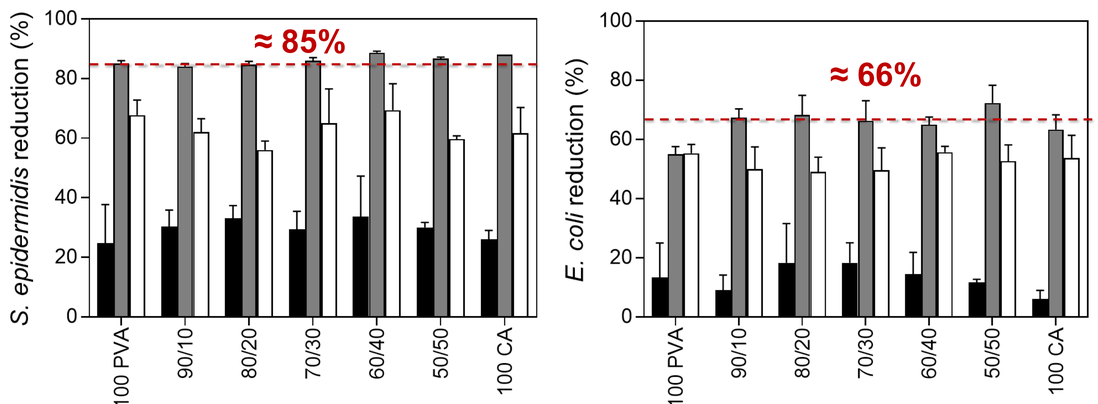
(detected by sulfo-SDTB)

- More than 50% of AMP immobilized and available for recognition
- Vancomycin detected: **32.8 ± 3.1 µg/cm²**

Antimicrobial Action

Shake Flask Method (ASTM-E2149-01)

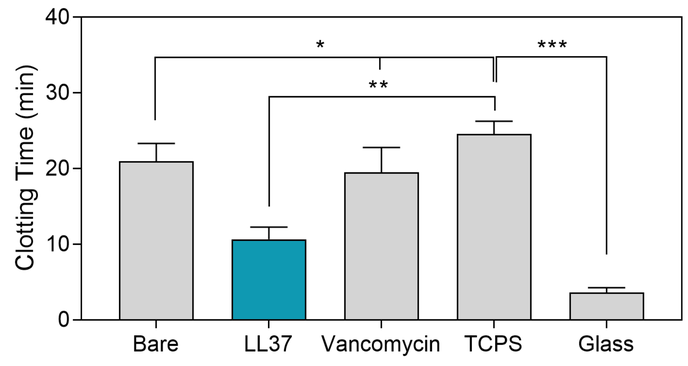
Initial Bacteria Concentration: 1x10⁷ CFUs/mL in PBS



Clotting Time

Lee-White Method

Re-calcified Human Plasma + 1M $CaCl_2$ at 20 mM (37ºC)



Conclusions: The potential of LL37 functionalized PVA/CA films for prospective wound-healing applications was demonstrated.
For more details please refer to **DOI: 10.1002/app.48626**

Acknowledgments

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COMPETE

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