

Natural antimicrobial-based hydrogel for hands and food contact surfaces disinfection

samira.soltani.2@ulaval.ca



Samira Soltani ^{a, b}, Eric Biron ^{b, c}, Muriel Subirade ^{a, b}, Ismail Fliss ^{a, b}

^a Department of Food Science, Laval university, Quebec, Qc, Canada

^b Institute of nutrition and functional foods (INAF), Quebec, Qc, Canada

^c Faculty of Pharmacy, Laval University, Quebec, Qc, Canada



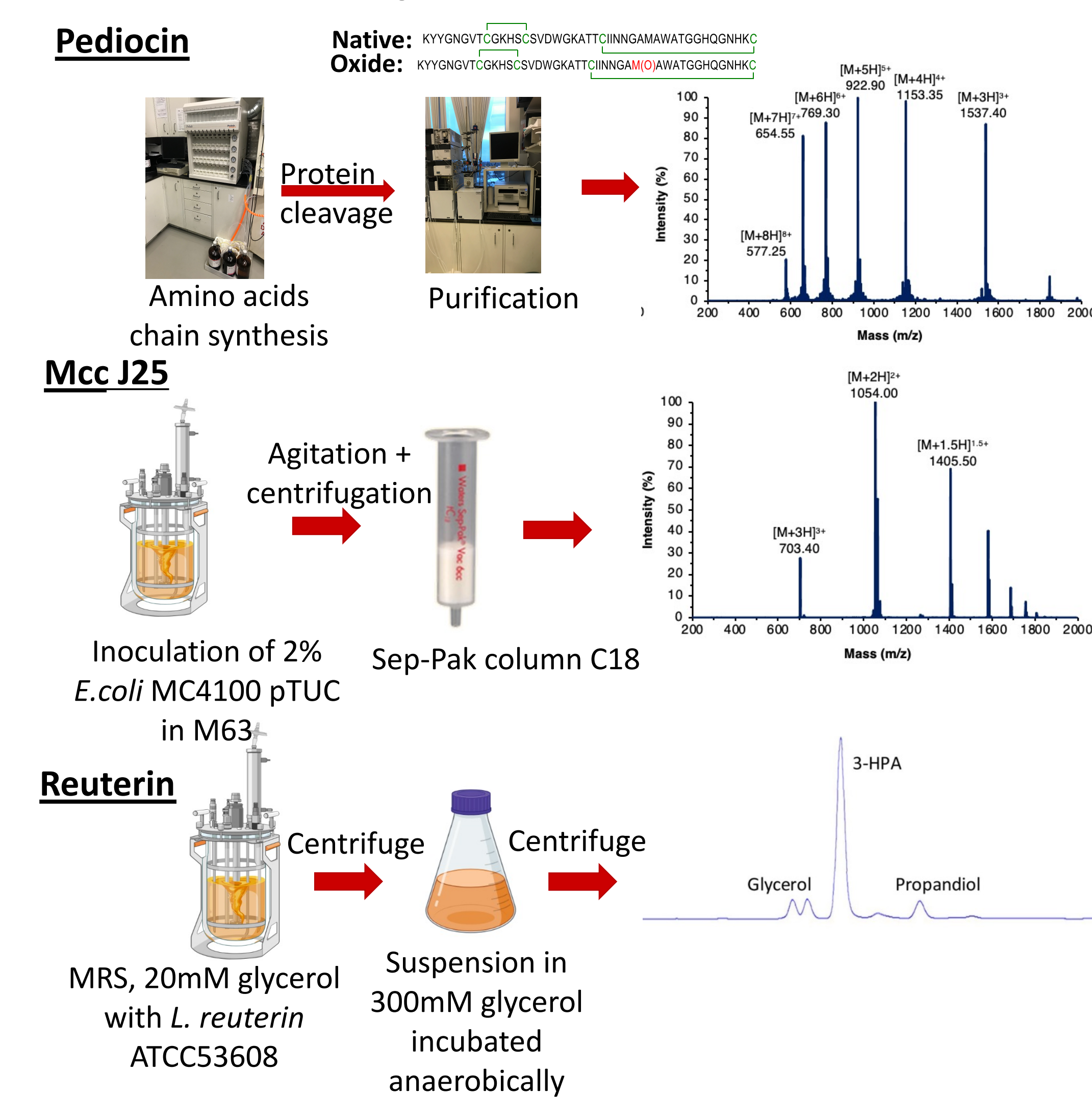
Introduction

Foodborne illness outbreaks are generally caused by contamination of food by handlers or contact with contaminated food surfaces. On the other hand, available disinfectant/sanitizers are mostly alcohol-based, which can cause adverse health effect. Hence, there has been a long-felt need for sanitizer hydrogel, which has a high degree of antimicrobial efficacy and could be safely ingestible by humans while posing no toxicity and environmental incompatibility.

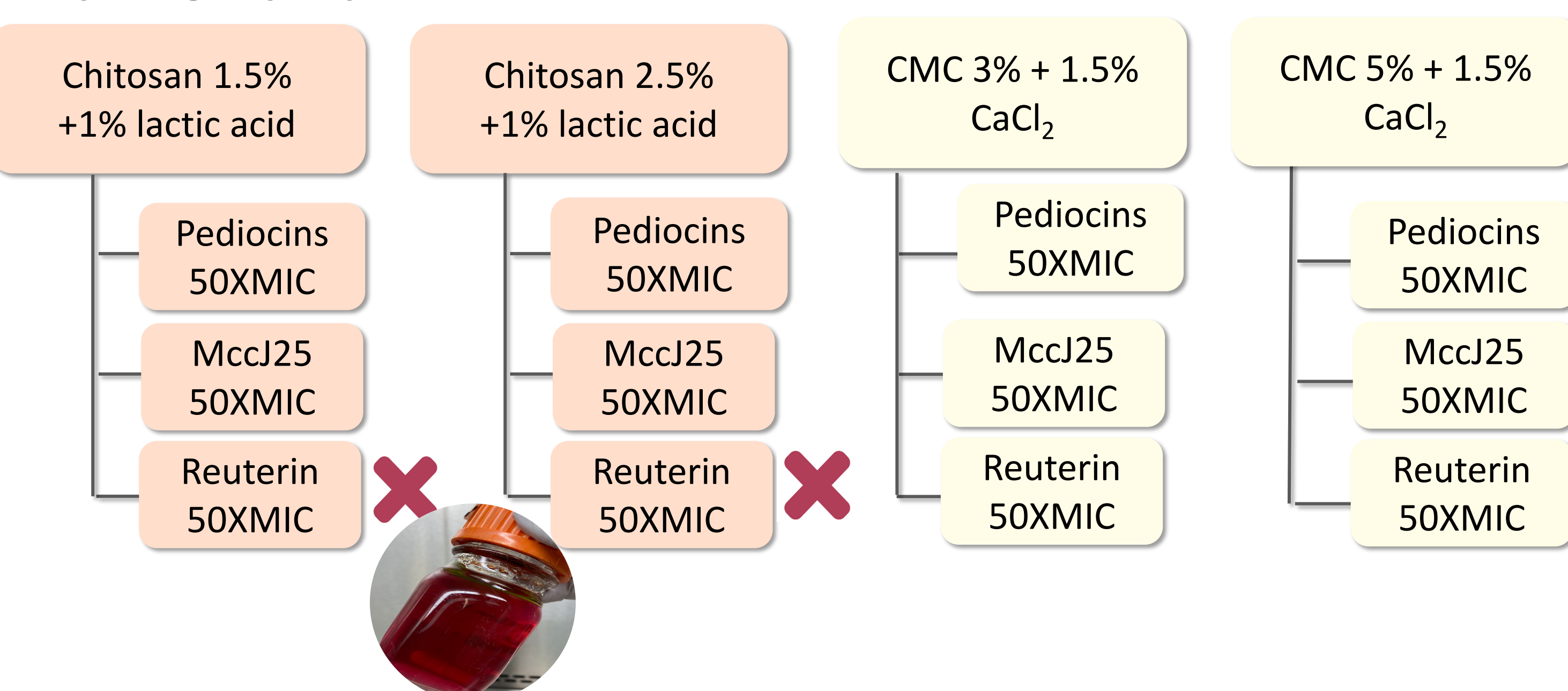
Therefore, This study aimed to develop and characterize hydrogels from biocompatible and biodegradable natural ingredients, with broad antimicrobial activity against pathogenic and spoilage organisms. Four natural antimicrobial agents were selected, including bacteriocins (pediocin, microcin J25), reuterin, and lactic acid. Hydrogel formulas containing one of the selected antimicrobial ingredients were developed from carbohydrate-based biopolymer chitosan and CMC.

Methodology

Production and purification of antimicrobials



Hydrogel preparation



Stability: Antimicrobial efficacy

Antimicrobial activity by agar well diffusion assay and microtitration assay against *L. ivanovii* HPB28 and *S. newport* ATCC6962.

In vitro skin model (irritability)

Each antimicrobial formula were tested in triplicate (on three tissues), and the readout (MTT test).

Conclusion

- Different bacteriocins (pediocin, MccJ25) and reuterin have been produced and purified successfully.
- Hydrogel formulas based on Chitosan and CMC biopolymers and containing MccJ25, reuterin, pediocin have been developed and characterized.
- Hydrogels based on chitosan (1.5%, 2.5%) containing MccJ25 and pediocin and hydrogel based on CMC (3%, 5%) containing MccJ25 and reuterin remained active during 4 weeks of storage.
- Active ingredient did not cause skin irritability.

Results

Stability: Antimicrobial efficacy

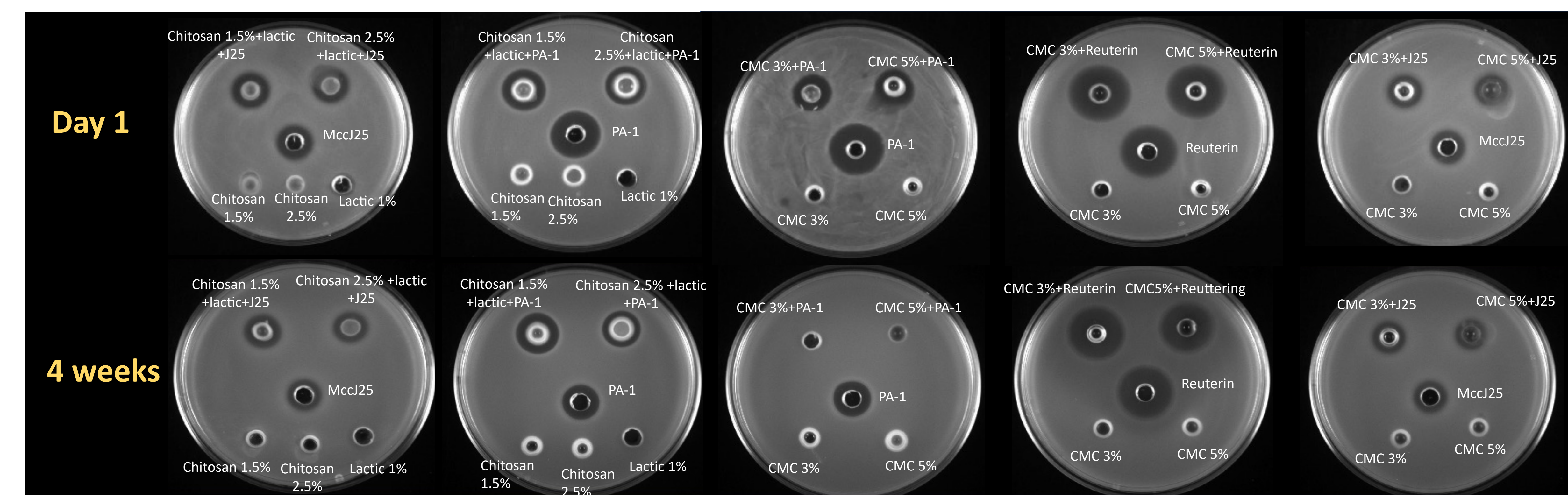


Figure 1. Agar well diffusion assay showing antimicrobial efficacy of developed hydrogel against *L. ivanovii* HPB28 and *S. newport* ATCC6962 during storage.

Viscosity

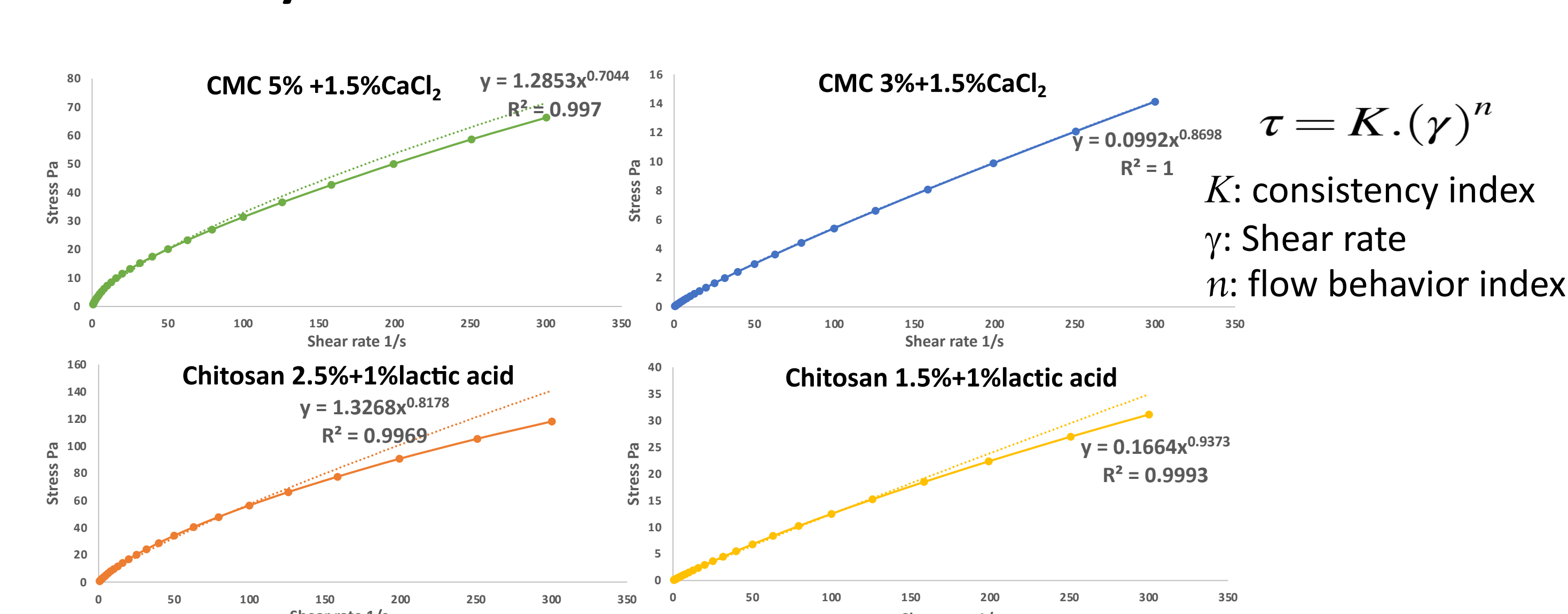


Figure 2. Flow behavior and rheological properties of hydrogels.

Table 1. Minimum inhibitory concentration of hydrogels and antimicrobial agents.

<i>S. newport</i> ATCC 6962		
	Day 1	Week 4
Chitosan 1.5% MccJ25	0.06 - 0.12 µg/mL	0.12 µg/mL
Chitosan 2.5% MccJ25	0.06 - 0.12 µg/mL	0.12 µg/mL
MccJ25	0.03 µg/mL	0.03 µg/mL
<i>L. ivanovii</i> HPB25		
	Day 1	Week 4
Chitosan 1.5% pediocin	1.4 µg/mL	1.4 µg/mL
Chitosan 2.5% pediocin	1.4 µg/mL	1.4 µg/mL
Pediocin	0.09 µg/mL	1.4 µg/mL

Skin irritability

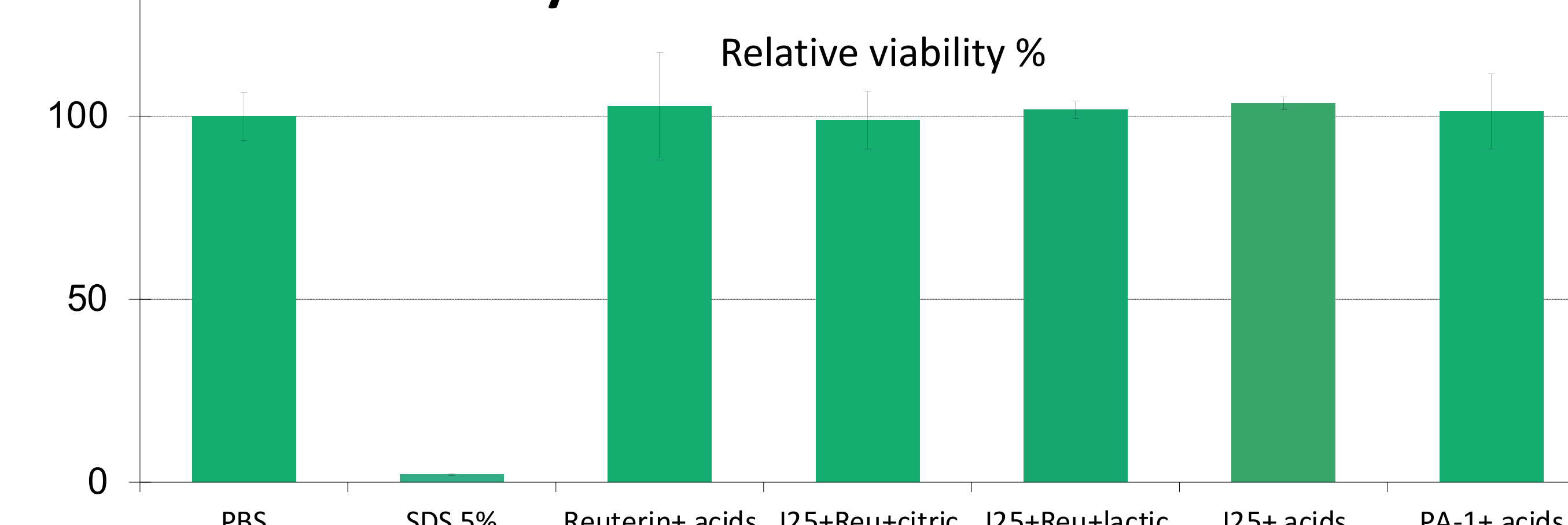


Figure 3. Skin irritability assay for antimicrobial combinations.

<i>S. newport</i> ATCC 6962			<i>L. ivanovii</i> HPB28		
	Day 1	Week 4	Day 1	Week 4	
CMC 3% MccJ25	0.03 µg/mL	0.12 µg/mL	CMC 3% pediocin	1.4 µg/mL	> 11.2 µg/mL
CMC 5% MccJ25	0.03 µg/mL	0.12 µg/mL	CMC 5% pediocin	1.4 µg/mL	> 11.2 µg/mL
MccJ25	0.03 µg/mL	0.03-0.12 µg/mL	Pediocin	0.09 µg/mL	11.2 µg/mL
CMC 3% reuterin	0.1 mg/mL	0.1 mg/mL	CMC 3% reuterin	0.2 mg/mL	0.2 mg/mL
CMC 5% reuterin	0.1 mg/mL	0.1 mg/mL	CMC 5% reuterin	0.2 mg/mL	0.2 mg/mL
Reuterin	0.1 mg/mL	0.1 mg/mL	Reuterin	0.2 mg/mL	0.2 mg/mL

References

1. Bedard F, Riadh H, Zirah S et al. Synthesis and antimicrobial activity of the bacteriocin pediocin PA-1 and analogs thereof *JOURNAL OF PEPTIDE SCIENCE* volume 24: WILEY 111 RIVER ST, HOBOKEN 07030-5774, NJ USA, 2018, S141-S2.
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Acknowledgment

