DEVELOPMENT OF PHOTOCURABLE TERNARY HYDROGELS FOR TISSUE REGENERATION

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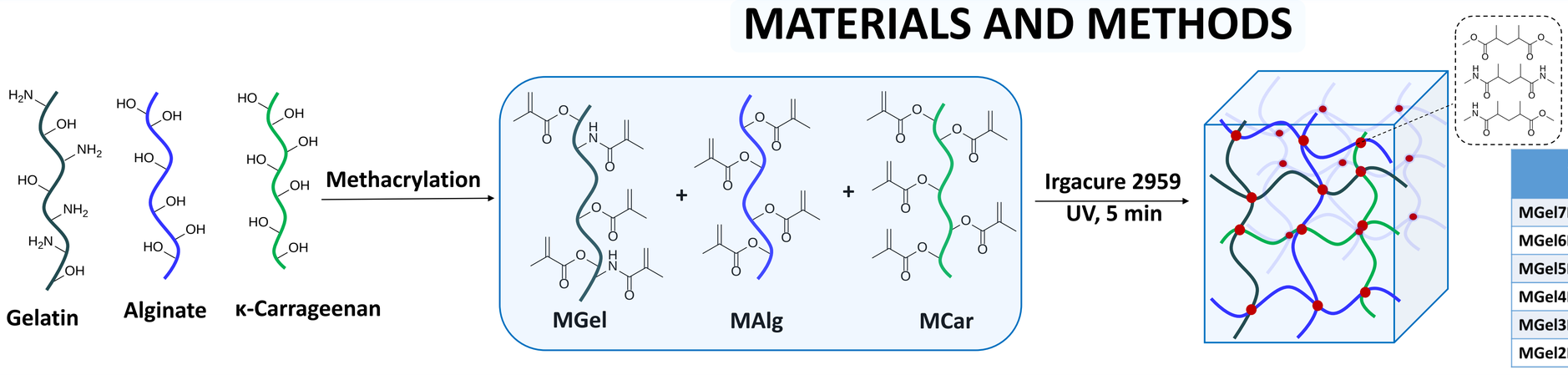
INTRODUCTION

Hydrogels are three-dimensional network structures with high-water content and they are capable of mimicking the highly hydrated porous and interconnected structure of the extracellular matrix.[1,2] Natural polymers are outstanding in terms of biocompatibility and biodegradability with specific cell-recognition sites but they have poorer mechanical properties which might be improved via crosslinking. Chemical crosslinking provides higher stability to the hydrogels. One easy and tunable method to fabricate crosslinked hydrogels is photoinitiated radical polymerization using polymers with photocurable functional groups such as methacrylated natural polymers.[3] In recent years, research has focused on the use of complex systems of multiple polymers rather than single polymeric network which enables higher mechanical properties and better integration with living tissues.[4,5] Various single components are crosslinked together chemically to improve the final characteristics of the composite construction.

In the present study, we designed a multi-component hydrogel structure using three different bio-based polymers, namely gelatin, alginate and κ-carrageenan. The biopolymers were modified through methacrylation reactions. Then, a series of multi-component biohydrogels with different ratios of methacrylated gelatin (MGel), methacrylated alginate (MAlg) and methacrylated κ-carrageenan (MCar) was produced via UV-curing in the presence of a photoinitiator. The fabricated hydrogels were characterized and the biocompatibility of the resulting biohydrogels has been investigated for tissue engineering applications.

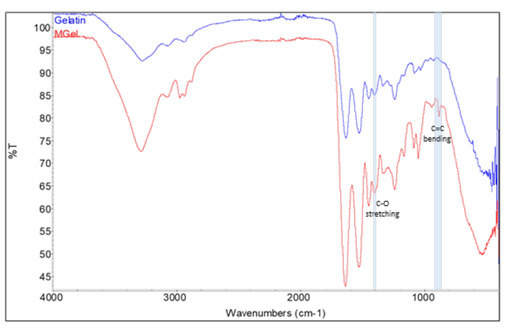
MATERIALS AND METHODS



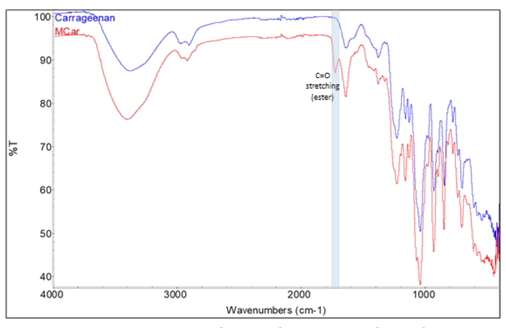
Sample	MGel (wt%)	MAlg (wt%)	MCar (wt%)	Gel content (%)
MGel7MAlg2MCar1	7	2	1	99.12
MGel6MAlg3MCar1	6	3	1	98.79
MGel5MAlg4MCar1	5	4	1	98.96
MGel4MAlg5MCar1	4	5	1	98.92
MGel3MAlg6MCar1	3	6	1	98.91
MGel2MAlg7MCar1	2	7	1	99.28

RESULTS AND DISCUSSIONS

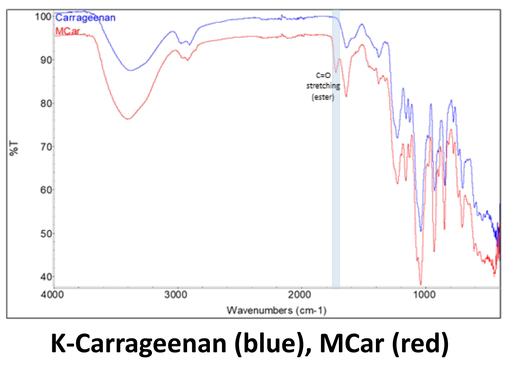
FTIR



Gelatin (blue), MGel (red)

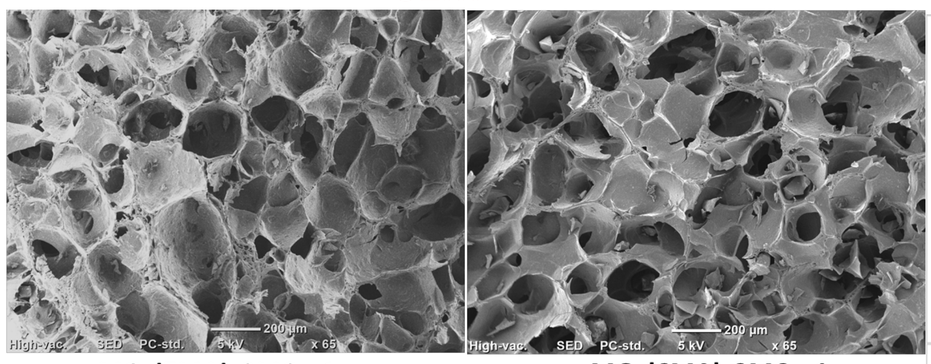


Alginate (blue), MAlg (red)

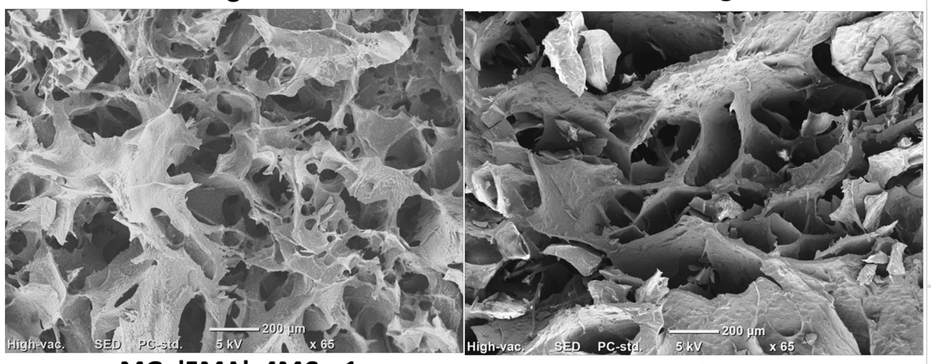


K-Carrageenan (blue), MCar (red)

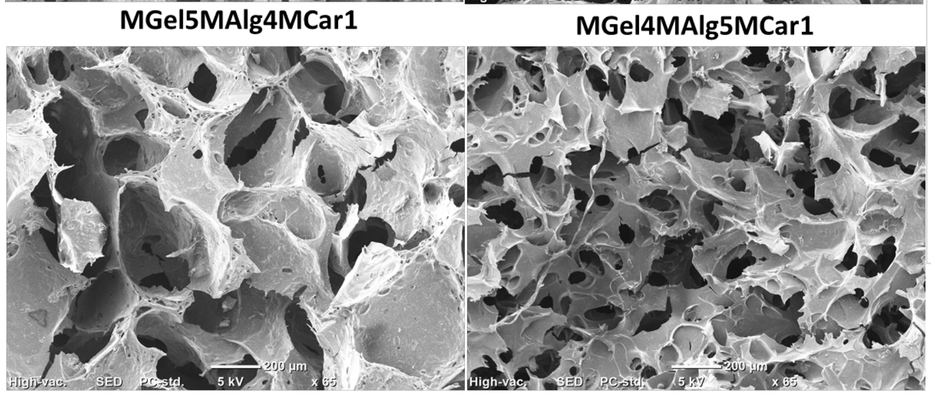
SEM



MGel7MAlg2MCar1 | MGel6MAlg3MCar1

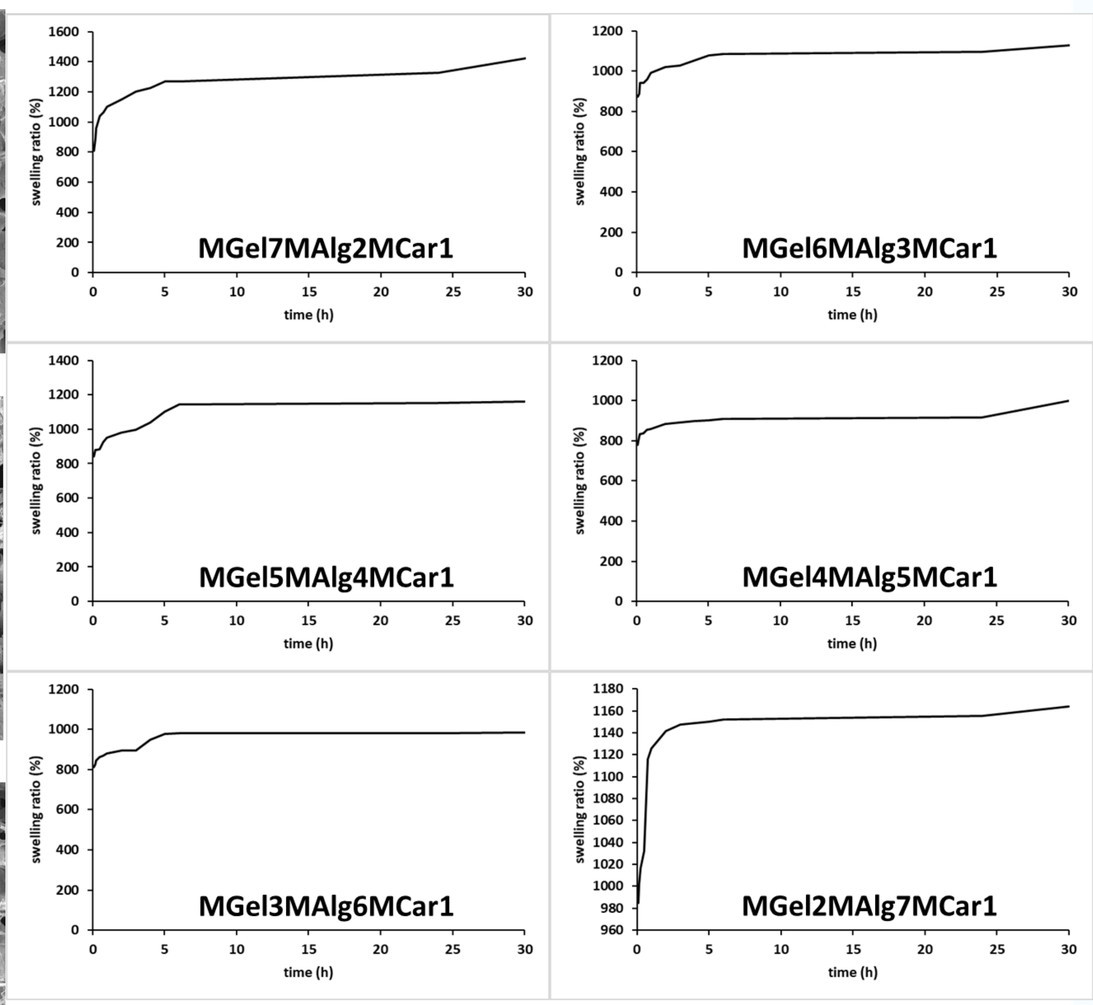


MGel5MAlg4MCar1 | MGel4MAlg5MCar1

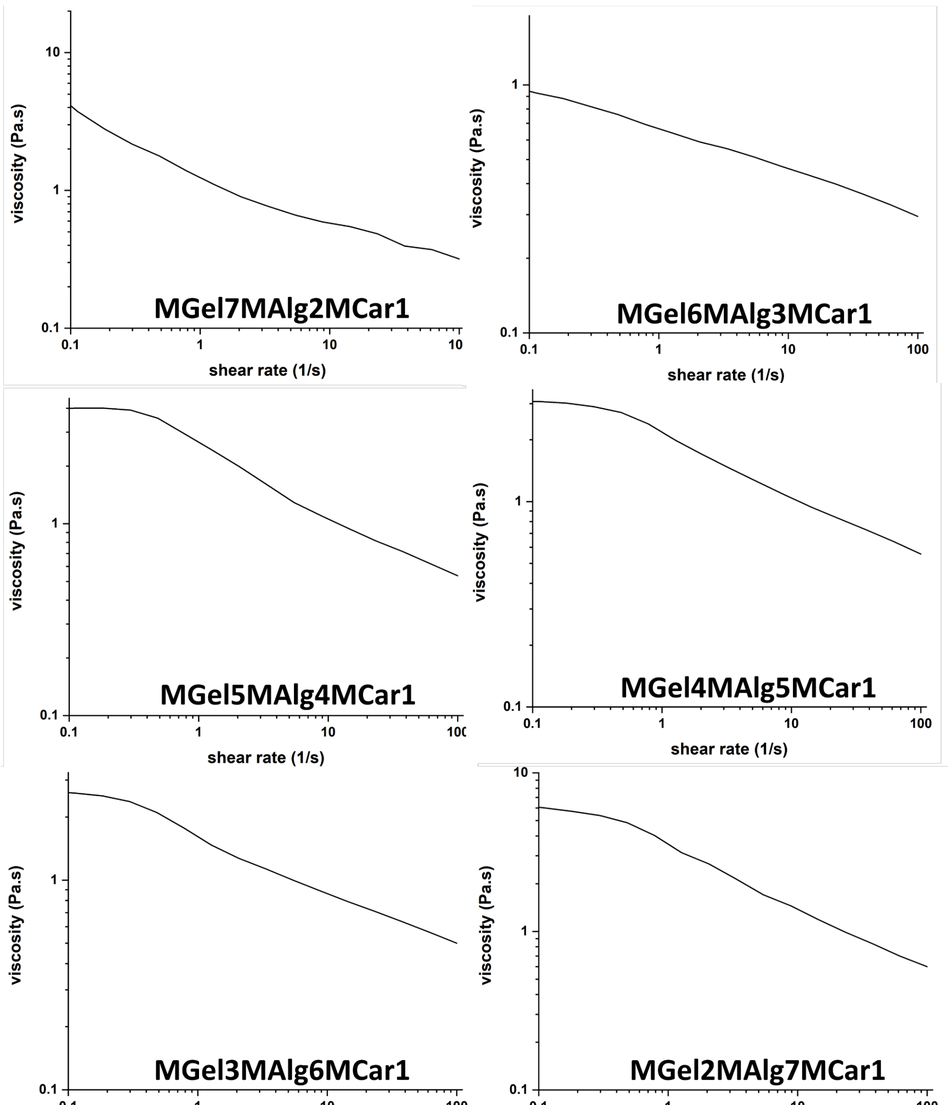


MGel3MAlg6MCar1 | MGel2MAlg7MCar1

WATER UPTAKE



VISCOSITY



YOUNG'S MODULUS

Sample	Young's Modulus (kPa)
MGel7MAlg2MCar1	72.96 ± 20.95
MGel6MAlg3MCar1	95.35 ± 20.94
MGel5MAlg4MCar1	101.02 ± 33.98
MGel4MAlg5MCar1	101.34 ± 31.62
MGel3MAlg6MCar1	74.49 ± 15.99
MGel2MAlg7MCar1	106.48 ± 36.04

Compression test

CELL VIABILITY

Sample	Cell viability (%)
MGel7MAlg2MCar1	88.59 ± 1.91
MGel6MAlg3MCar1	94.52 ± 1.35
MGel5MAlg4MCar1	97.83 ± 3.41
MGel4MAlg5MCar1	98.80 ± 1.92
MGel3MAlg6MCar1	96.03 ± 2.08
MGel2MAlg7MCar1	95.29 ± 1.43

Human foreskin fibroblasts

BIODEGRADATION

Sample	Weight loss (%)			
	DAY 1	DAY 3	DAY 7	DAY 14
MGel7MAlg2MCar1	9.94 ± 1.32	14.90 ± 2.75	19.84 ± 3.83	33.34 ± 6.37
MGel6MAlg3MCar1	5.20 ± 2.89	10.74 ± 1.52	15.07 ± 3.14	33.76 ± 5.39
MGel5MAlg4MCar1	7.80 ± 0.89	9.54 ± 2.42	14.98 ± 1.00	30.72 ± 6.75
MGel4MAlg5MCar1	5.06 ± 2.38	12.84 ± 2.20	14.10 ± 1.37	22.77 ± 3.60
MGel3MAlg6MCar1	5.30 ± 1.38	7.11 ± 0.96	9.58 ± 2.75	14.71 ± 1.24
MGel2MAlg7MCar1	5.34 ± 1.05	11.49 ± 0.90	13.40 ± 2.32	16.15 ± 0.75

PBS, 37°C

FUTURE STEPS

- Cell culture studies will be performed.

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Acknowledgements
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