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Injectable hydrogel based on carboxymethyl chitosan/oxidized agarose for potential application in local drug delivery

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INTRODUCTION

In recent years, there has been a growing interest in the study of injectable hydrogels due to their properties that facilitate their implementation in various biomedical applications. Some of these properties include their ability to adapt to irregular volumes, ease of implantation since they can be injected using a needle or catheter, and their potential to contribute to the development of bioinks for 3D bioprinting, as well as applications in tissue engineering and controlled drug delivery [1]. The aim of this study was to develop an injectable hydrogel from two modified polymers: carboxymethyl chitosan (CMCh) and oxidized agarose (OA), whose modifications favor crosslinking through Schiff base, avoiding the use of crosslinking agents.

METHODS

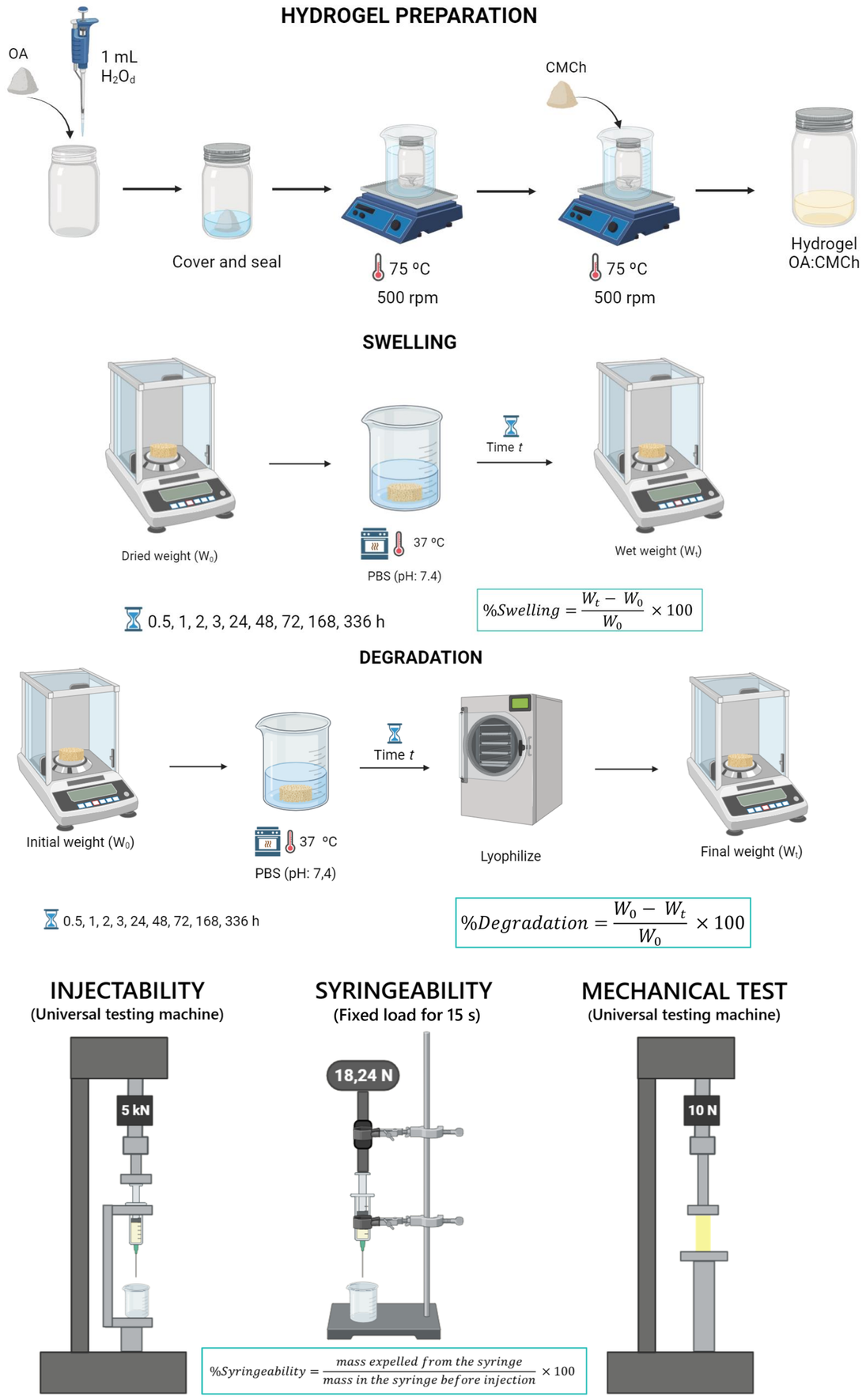

Fig. 1. Preparation and caracterization of the hydrogel OA:CMCh

RESULTS

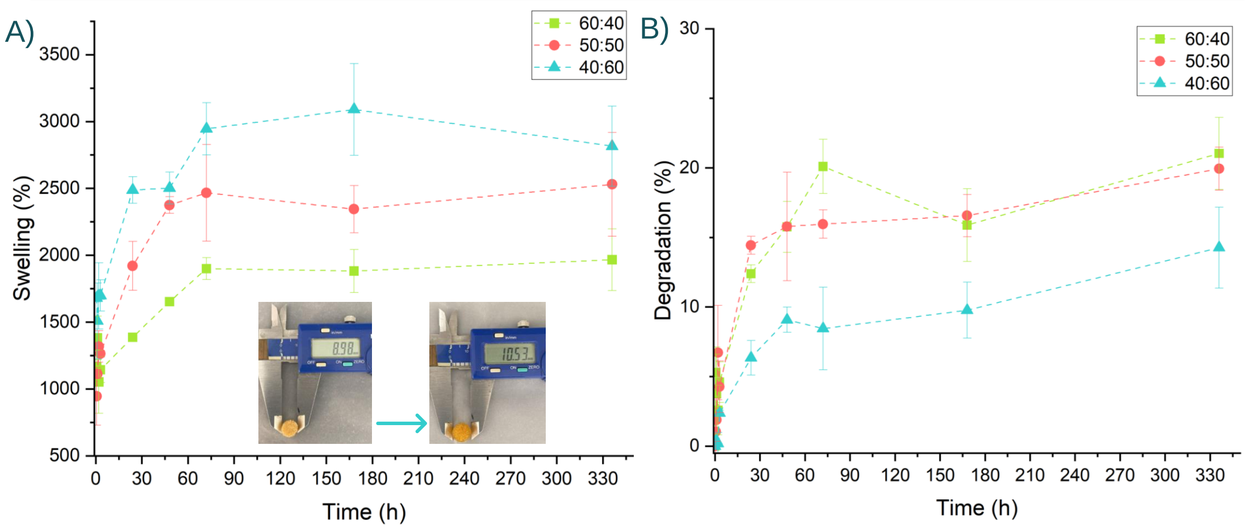

Fig. 2. Results of the evaluation of swelling capacity (A) and degradation (B) of the hydrogels in PBS (pH: 7,4) and 37 °C.
(Dashed lines are for visual guidance only)

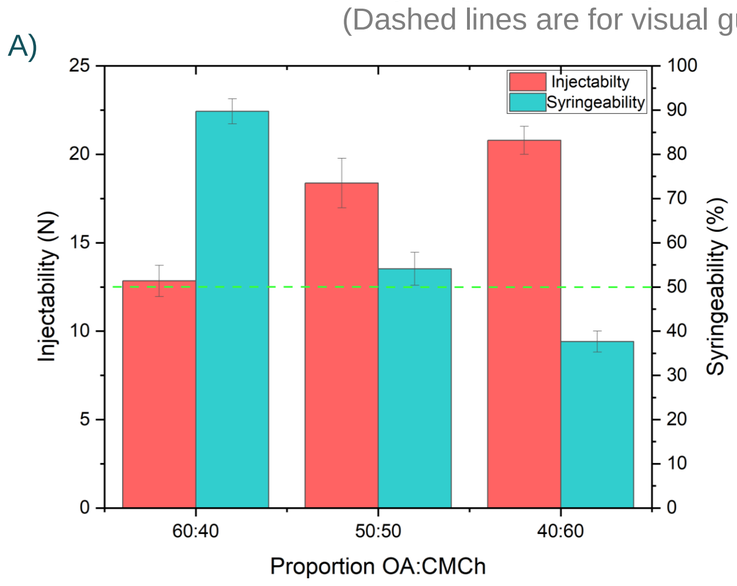

Fig. 3. (A) Results of the injectability and syringeability tests and (B) qualitative evaluation of injectability with a 1 mL syringe and 21 G x 1 ½” needle

Table 1. Results of the mechanical test of the hydrogels

OA:CMCh	Compressive strength (kPa)	Young’s Modulus (kPa)
60:40	26.92 ± 6.04	9.63 ± 1.39
50:50	46.28 ± 7.44	8.67 ± 0.73
40:60	46.36 ± 10.54	6.60 ± 1.12

CONCLUSION

Injectable hydrogels with different OA:CMCh ratios were obtained, where these highly hydrophilic polymers allowed swelling above 1900 %; moreover, Schiff base crosslinking ensured the hydrogels were stable over time. Additionally, the hydrogels formed gels at 37 °C and could still be injected with forces lower than 30 N (accepted limit) [2]. Regarding syringeability percentages, 60:40 and 50:50 ratios were superior to 50%. Finally, the mechanical properties indicate high compressive strength and low stiffness, which suggests that the OA:CMCh mixture forms hydrogels with potential for use in biomedical applications such as drug delivery.

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